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Honorable Jessica A. Palmer-Denig
Administrative Law Judge
Office of Administrative Hearings
600 North Robert Street
P.O. Box 64620
Saint Paul, MN 55164-0620

Re: Proposed Rules Governing Groundwater Protection, *Minnesota Rules*, 153
Revisor's ID Number RD4337
OAH Docket No. 71-9024-35205

Dear Judge Palmer-Denig:

The Minnesota Corn Growers Association submits the following written comments with respect to Proposed Rules Governing Groundwater Protection that were published by the Minnesota Department of Agriculture. The Minnesota Corn Growers Association is a grassroots organization with more than 6,500 members that works in conjunction with the Minnesota Corn Research & Promotion Council to conduct and fund research and provide educational programs on behalf of Minnesota's 24,000 corn farmers.

At the outset of these written comments, the Minnesota Corn Growers Association reaffirms its commitment to the basic goal of the Groundwater Protection Act to maintain groundwater "in its natural condition, free from any degradation caused by human activities," to the extent practicable. *See* Minn. Stat. § 103H.001 (2017). The vast majority of Minnesota farm families rely on groundwater as a source of drinking water. Protecting groundwater against degradation to ensure that it is—and remains—safe to drink is important to ensuring the health and well-being of all Minnesotans, including farm families.

The Minnesota Corn Growers Association also acknowledges there are elevated levels of nitrates in certain areas of the state and Minnesota corn farmers want to be a part of the solution in addressing local areas of concern. Over time, our knowledge has improved and farming practices have evolved based on new information. Best management practices and other effective nitrogen management tools have been disseminated to farmers and adopted. As practices continue to evolve and continuously improve, Minnesota corn farmers will adapt accordingly to effectively manage nitrogen fertilizer applications. For example, the Minnesota Corn Growers Association has invested nearly $6 million dollars since 2012 to fund research and educate farmers on ways to improve the efficient use of fertilizer in their farming operations. A more thorough description of these investments and efforts is attached to these comments.

During the public hearings on the proposed Groundwater Protection Rule, and in written comments that have been submitted since the hearings, you have heard from numerous Minnesota farmers regarding changes that they have voluntarily made to their farming operations based on new information and technologies that have become available in recent years. For example, as the Minnesota Department of Agriculture itself acknowledges, most Minnesota farmers have implemented the voluntary best management practices (which are discussed more thoroughly below) regarding the timing and amount of nitrogen fertilizer applications. And many farmers have gone even farther and are now using grid soil testing, advanced GPS technology, and variable-rate application equipment to precisely target the amount of fertilizer applied across fields to maximize the efficient use of nitrogen to improve crop production and minimize the nutrients that are lost through leaching, runoff, or volitization. These improvements provide economic benefits to farmers (who are often able to reduce input costs while maintaining good crop yields) and health and environmental benefits for all Minnesotans.

In summary, the Minnesota Corn Growers Association does not question the stated goal of the Minnesota Department of Agriculture to protect Minnesota groundwater. But as the Department expressly acknowledged during the public hearing in Park Rapids on July 26, 2018, the proposed rule targets the "sins of the 1970s" (i.e., the excessive use of nitrogen fertilizer when commercial fertilizer first become widely available) and does not properly consider the extensive efforts that Minnesota corn farmers voluntarily implemented over the last few years and the effect of which have not yet been measured or considered. In other words, the Department has not established that the voluntary best management practices for nitrogen fertilizer have been ineffective or that the proposed rule is needed at this time. And even if such requirements were satisfied, the Minnesota Corn Growers Association disputes the reasonableness of several specific provisions of the proposed rule. Accordingly, for the reasons set forth more fully

herein, the Minnesota Corn Growers Association respectfully requests that you find that the Minnesota Department of Agriculture has not established the need for, reasonableness of, or statutory prerequisites for the proposed Groundwater Protection Rule.

I. Because the Voluntary Best Management Practices for Nitrogen Fertilizer Have Not Been Proven to Be Ineffective, the Minnesota Department of Agriculture Does Not Have Statutory Authority to Adopt the Proposed Groundwater Protection Rule.

The Minnesota Department of Agriculture proposes to adopt the Groundwater Protection Rule as a "water resource protection requirement" pursuant to its authority under the Groundwater Protection Act, as codified at Minnesota Statutes § 103H.275 (2017). (Admin. R. ex. C (SONAR), at pp. 8-9, 49, 60-61.) Under the Groundwater Protection Act, the Department is required to "develop best management practices for agricultural chemicals and practices" and to "promote [such] best management practices and provide education about how the use of best management practices will prevent, minimize, reduce, and eliminate the source of groundwater degradation," Minn. Stat. § 103H.151, subds. 2-3 (2017), particularly in areas where groundwater pollution is detected and was caused (or potentially caused) by agricultural chemicals or practices, *see* Minn. Stat. § 103H.275, subd. 1(a). The Department "may adopt water protection requirements . . . that are consistent with the goal of [the Groundwater Protection Act] and are commensurate with the groundwater pollution if the implementation of best management practices has proven to be ineffective." Minn. Stat. § 103H.275, subd. 1(b) (emphasis added). In other words, the Groundwater Protection Act specifically emphasizes voluntary efforts to prevent, minimize, reduce, and eliminate sources of groundwater pollution and expressly restricts the Department's authority to impose mandatory governmental regulations to situations were such voluntary efforts have been demonstrated to be ineffective.[1]

Consistent with its obligations under the Groundwater Protection Act, the Minnesota Department of Agriculture adopted best management for nitrogen fertilizer in 1991—and updated these best management practices in 2008—based on research conducted and recommendations developed by the University of Minnesota Extension

[1] Similarly, the Minnesota Administrative Procedures Act requires that as part of the rulemaking process, the Department must "make an affirmative presentation of facts establishing the need for and reasonableness of the proposed rule." Minn. Stat. § 14.14, subd. 2 (2017); *see also* Minn. Stat. § 14.15, subd. 4 (2017). Because the requirement to show the "need" for proposed Groundwater Protection Rule is substantially related to whether the Department has established that the voluntary implementation of best management practices has been ineffective, the Minnesota Corn Growers Association will combine its analysis of these requirements in these written comments.

Service. Specifically, the Department adopted separate best management practices for use in four different regions of the state and on coarse-textured soils.[2] But all of the best management practices "are built on a four-part foundation that takes into account the nitrogen rate, application timing, source, and placement of the application, known as the '4Rs.' " More specifically, "[t]he cornerstone of the nitrogen fertilizer BMPs is identifying the optimum rate and then a series of other related practices (timing, split applications, inhibitors, etc.) to ensure that the nitrogen will be there when the crop needs it." As a whole, the best management practices "represent a combination of practices that will reduce risk of excessive nitrogen loss in a normal year" based on the unique geology and climate covered by the practices. (Admin. R. ex. C (SONAR), at pp. 30-35.)

A. The Minnesota Department of Agriculture Improperly Focuses on Total Use of Nitrogen Fertilizer and Arbitrarily and Capriciously Ignores Data Showing Increased Efficiency of Nitrogen Fertilizer Use.

In attempting to establish that voluntary efforts to reduce potential groundwater pollution from nitrogen fertilizer have been ineffective, the Minnesota Department of Agriculture focuses on data showing that the total amount of nitrogen fertilizer sold in Minnesota has increased since the 1960s and that the total number of acres planted with nitrogen demanding crops (such as corn) have increased over the last 90 years. (Admin R. ex. C (SONAR), at pp. 16-19.) But by focusing on the total amount of nitrogen fertilizer that is applied to crop land, the Department ignores the fundamental fact that as the yield from growing corn plants increases (at least up to an maximum potential yield that can be achieved in a particular environment), the plants use more of the available nitrogen in the soil to produce the crop and thus leave less nitrogen in the soil that may leach into groundwater. (*See* Minn. Dep't of Agric., *Minnesota Nitrogen Fertilizer Management Plan*, at p. 38 (Mar. 2015).[3]) This data—which is described by the Department in the *Minnesota Nitrogen Fertilizer Management Plan*, but which the Department completely ignores in the SONAR—shows that the bushels of corn produced per pound of nitrogen fertilizer used by Minnesota corn farmers has "steadily increased from 0.8 to 1.3 over the past twenty years." (*Id.*, at p. 39.) In other words, the data in the administrative record demonstrates that farmers have substantially increased the efficiency of their nitrogen fertilizer use in

[2] A copy of the most recent best management practices that were adopted by the Minnesota Department of Agriculture is included in the Appendix to the SONAR (which is part of the administrative record in this rulemaking proceeding) as items 2 through 8.

[3] A copy of the *Minnesota Nitrogen Fertilizer Management Plan* that was published by the Minnesota Department of Agriculture in March 2015 is included in the Appendix to the SONAR (which is part of the administrative record in this rulemaking proceeding) as item 9. For ease of reference, these comments cite directly to the *Minnesota Nitrogen Fertilizer Management Plan* rather than to the Appendix to the SONAR.

recent years. The Department also admits in the *Minnesota Nitrogen Fertilizer Management Plan* that this trend of increased efficiency is positive for the environment. (*Id.*)

Thus, the nitrogen fertilizer sales data on which the Minnesota Department of Agriculture relies is incomplete and does not answer the fundamental question of whether the current nitrogen fertilizer practices used by Minnesota farmers pose a threat to Minnesota's groundwater that necessitates governmental regulation as provided in the proposed Groundwater Protection Rule. Instead, the available data in the administrative record demonstrates that production changes that Minnesota farmers have been voluntarily implemented have increased the efficiency of nitrogen fertilizer use and thereby reduced the threat that nitrogen fertilizer poses to Minnesota groundwater in the future. In other words, this data confirms the Department's admission that the proposed rule is actually based on historical practices rather than current practices and that the adoption and implementation of voluntary best management practices has been effective in Minnesota. In short, this data undercuts the Department's argument that the proposed rule is needed at this time.

B. The Minnesota Department of Agriculture Admits that the Nitrogen Fertilizer Best Management Practices Have Been Generally Adopted by Minnesota Farmers.

The evidence in the administrative record demonstrates that the best management practices for nitrogen fertilizer have been generally adopted by the vast majority of Minnesota farmers. In the *Minnesota Nitrogen Fertilizer Management Plan* published by the Minnesota Department of Agriculture in March 2015, the Department cites the "[g]eneral adoption of the '4R' concept (right rate, right source, right timing and right placement)" as one reason for the improved efficiency in nitrogen fertilizer use in the last 20 years. (*See* Minn. Dep't of Agric., *Minnesota Nitrogen Fertilizer Management Plan*, at p. 39 (Mar. 2015).) As noted above, the "4Rs" represent the foundation on which the nitrogen fertilizer best management practices are built. Thus, by stating that the " '4R' concept" has been generally adopted by Minnesota farmers, the Department implicitly acknowledged that the best management practices for nitrogen fertilizer have been generally adopted.

The Minnesota Department of Agriculture partially reaffirms this conclusion in the SONAR. Specifically, in concluding that "there should be very little or no increased costs" from Part 1 of the proposed Groundwater Protection Rule—which restricts the fall application of nitrogen fertilizer—the Department admits that "a large majority of farmers in southeast and central Minnesota, where most vulnerable groundwater areas occur, do not currently fall apply nitrogen fertilizer." (Admin R. ex. C (SONAR), at pp. 62, 67, 71.) As the "right timing" of nitrogen fertilizer represents one of the "4Rs" on

which the best management practices are based, the SONAR reaffirms that at least one portion of the best management practices has been generally adopted by Minnesota farmers.

C. The Minnesota Department of Agriculture's Reliance on Flawed Surveys Is Arbitrary and Capricious.

Although the Minnesota Department of Agriculture admits (as set forth more fully above) that Minnesota farmers have generally adopted the best management practices for nitrogen fertilizer, the Department nonetheless claims that the implementation of the best management practices has been ineffective because "excessive rates are used in some locations" and "credit for existing nitrogen is not always taken." (Admin R. ex. C (SONAR), at p. 49.) The Department bases its conclusions on these issues in the SONAR entirely on results from two sets of surveys: FANMAP surveys and NASS surveys.[4] (*Id.* at pp. 49-59.)

But the surveys on which the Minnesota Department of Agriculture relies include farms that represent only a small percentage of the total corn acres in Minnesota. With respect to the NASS surveys, the acres represented in the survey reports referenced in the SONAR were only fifteen percent (15%) for the 2010 crop year, five percent (5%) for the 2012 crop year, and seven percent (7%) for the 2014 crop year. And because the FANMAP survey results include a limited percentage of the total crop land located in Drinking Water Supply Management Areas—which itself represents less than one-half of one percent (< 0.5%) of the total crop land in Minnesota—the FANMAP survey results are even more limited in scope. (*See* Admin R. ex. C (SONAR), at p. 50.) Finally, none of the survey results or reports (or any other information in the administrative record) provide any margin of error for the survey results or provide any analysis to confirm that the results are statistically significant under generally accepted statistical practices. Accordingly, the Department has failed to establish the basic accuracy or reliability of the survey results on which it relies in the SONAR.

Moreover, the Minnesota Department of Agriculture supports its conclusions by cherry-picking isolated data from different surveys (when it references specific data at all) rather than providing a comprehensive presentation of the survey results showing historical trends over time. (*See* Admin R. ex. C (SONAR), at pp. 51-59.) As a result, the Department has failed to show whether or not the historical rates of compliance with the nitrogen fertilizer best management practices are improving—which would suggest that

[4] The results of the NASS surveys, which are cited in the SONAR, are available to the public on the Minnesota Department of Agriculture's website at http://www.mda.state.mn.us/protecting/cleanwaterfund/gwdwprotection/nutrientmgmtsurvey.aspx.

the promotion and education activities and voluntary adoption of the best management practices are effective—or remaining static or decreasing.

Finally, all of the survey data on which the Minnesota Department of Agriculture relies is outdated. With respect to the FANMAP survey results, the report and data that the Department cites in the SONAR is from 2001—more than 15 years ago. (*See* Admin R. ex. C (SONAR), at pp. 56-59.) And while the NASS survey data is from 2010 through 2014 and is thus more recent (*see id.* at p. 50), all of this data preceded the adoption by the Minnesota Legislature of the "Buffer Law" in 2015, *see* Minn. Stat. § 103F.48 (2017). The Department acknowledges that riparian buffers are the second most effective practice for reducing nitrogen loading in watersheds. (*Id.* at p. 26.) Nonetheless, the Department has completely failed to consider the impact of the buffer law in determining whether the voluntary implementation of best management practices is effective.

Based on the foregoing issues, the Minnesota Department of Agriculture's reliance on the FANMAP and NASS survey results to support its conclusions is arbitrary and capricious, and the Department therefore cannot legitimately establish that the voluntary implementation of best management practices is ineffective.

D. The Perham Case Study Confirms that Voluntary Education and Implementation of Best Management Practices Is Effective.

The Minnesota Department of Agriculture relies on a case study of drinking water in Perham, Minnesota, to establish a link between nitrogen fertilizer use on agricultural land and nitrate levels in groundwater. (Admin R. ex. C (SONAR), at pp. 26-27.) During the 1990s, Perham experienced increasing nitrate concentrations in its drinking water. (*Id.* at p. 26.) As a result, beginning in the late-1990s, Perham worked with the Department and the agricultural community to sponsor "[e]ducational events, on-farm nitrogen trials, crop variety trials, fertilizer management changes, the use of new fertilizer technology, and perennial crops in select fields" to promote <u>voluntary</u> efforts to increase nitrogen use efficiency in the area. (*Id.* at pp. 26-27.) And as the Department recognizes, these <u>voluntary</u> efforts were successful: "[t]hrough combined efforts of the city and the agricultural community over 20 years, average annual nitrate-nitrogen concentrations in community wells have declined." (*Id.*)

Although the results of the Perham case study provide some support for the Minnesota Department of Agriculture's conclusion that nitrate concentrations in groundwater are correlated with nitrogen fertilizer practices, the Department ignores the broader lessen that the case study teaches—<u>education and promotional activities to promote voluntary adoption improved nitrogen fertilizer management practices are successful</u>. Thus, the Perham drinking water case study demonstrates that education,

promotion, and voluntary adoption of best management practices are effective and that the proposed Groundwater Protection Rule is not needed at this time.

E. Conclusion.

In conclusion, the administrative record is rife with testimony and evidence about the voluntary efforts that Minnesota farmers have undertaken to adopt the best management practices for nitrogen fertilizer (or even better practices) to improve the efficiency of their nitrogen fertilizer use and reduce the risk of nitrate leaching into groundwater. But rather than waiting to measure the impact of these recent changes and determine whether the voluntary implementation of the best management practices has been effective, the Minnesota Department of Agriculture seeks to charge ahead and adopt the proposed Groundwater Protection Rule. This proposed action is inconsistent with the basic structure of the Groundwater Protection Act—which places a strong emphasis on voluntary actions and restricts the Department's authority to circumstances where voluntary actions have been shown to be ineffective. Because the Department has thus failed to satisfy its statutory burdens to show that voluntary implementation of best management practices is ineffective and that the propose rule is needed, the Minnesota Corn Growers Association respectfully requests that you reject the Department's attempt to adopt the proposed rule at this time.

II. <u>If the Minnesota Department of Agriculture Proceeds with Adoption of the Proposed Groundwater Protection Rule, Some Specific Provisions of the Proposed Rule Are Unreasonable and Should Be Modified.</u>

If the Minnesota Department of Agriculture elects to move forward with the proposed Groundwater Protection Rule, despite the issues raised above, the Minnesota Corn Growers Association has identified several specific provisions that are unreasonable and should be modified. These provisions will be addressed separately below.

A. Local Advisory Teams.

The proposed Groundwater Protection Rule defines a "local advisory team" as "a team of individuals approved by the commissioner who advise the commissioner regarding appropriate response activities for a specific local area." (Prop. Minn. R. 1573.0010, subp. 14.) The SONAR explains that the goal of the local advisory teams "is to involve the agricultural community in problem solving at the local level" and states that "[t]he majority of the members will be local farmers and their crop advisors/consultants." (Admin R. ex. C (SONAR), at p. 83.) But the proposed rule itself does not impose these (or any other) specific conditions or criteria for the composition of

a local advisory team. The proposed rule is therefore inherently ambiguous and unreasonable.

To address this issue, the Minnesota Corn Growers Association respectfully requests that you require the Minnesota Department of Agriculture to correct this defect before adopting the proposed rule. Specifically, the Minnesota Corn Growers Association suggests the following modifications to the proposed rule (additions shown in underline format):

> Subp. 14. **Local advisory team.** "Local advisory team" means a team of individuals approved by the commissioner who advise the commissioner regarding appropriate response activities for a specific local area. Each local advisory team shall be comprised only of persons who own real property in the drinking water supply management area for which the team is appointed, and a majority of the members of each local advisory team shall be comprised of farmers and professional crop advisors or consultants.

B. Vulnerable Groundwater Areas.

The proposed Groundwater Protection Rule defines a "vulnerable groundwater area" by specifically referencing and incorporating designations in the United States Department of Agriculture, Natural Resources Conservation Service, Web Soil Survey, for determining "coarse textured soils" or "soils that are shallow to bedrock." (Prop. Minn. R. 1573.0010, subps. 3, 23.) But the designation of specific areas as having coarse textured soils or soils that are shallow to bedrock depends on the actual conditions in a specific field, and thus requires inherently local knowledge, if such designation is to bear any relationship to reality. And the evidence in the administrative record indicates that the designations of soil types in referenced source—which is a national survey—does not always reflect the actual vulnerable area.

To address this issue, the Minnesota Corn Growers Association respectfully requests that you require the Minnesota Department of Agriculture to correct this defect before adopting the proposed rule. Specifically, the Minnesota Corn Growers Association suggests the following modifications to the proposed rule (additions shown in ~~strikethrough~~ and underline format):

> Subp. 3. **Coarse textured soils.** "Coarse textured soils" means soils that are sand, loamy sand, fine sand, coarse sand, loamy coarse sand, very fine sand, loamy very fine sand, single grained, or any of these textures with the following textual modifiers: gravelly, cobbly, channery, and flaggy~~,~~

~~based on the United States Department of Agriculture, Natural Resources Conservation Service, Web Soil Survey~~.

* * * *

Subp. 23. **Vulnerable groundwater area.** "Vulnerable groundwater area" means land with:

A. coarse textured soils;

B. soils that are shallow to bedrock~~ as identified in the United States Department of Agriculture, Natural Resources Conservation Service, Web Soil Survey~~; or

C. karst, as identified in the Department of Natural Resources Pollution Sensitivity of Near-Surface Materials Report.

Vulnerable groundwater area does not include areas identified as ultra-low sensitivity in the Department of Natural Resources Pollution Sensitivity of Near-Surface Materials Report.

<u>The designations of soil in the United States Department of Agriculture, Natural Resources Conservation Service, Web Soil Survey, shall create a rebuttable presumption as to whether specific soils are "coarse textured soils" or "soils that are shallow to bedrock."</u>

Additionally, the designation of vulnerable groundwater area based on a 50 percent of a quarter section is 80 acres and is a relatively large area from a management standpoint, thus the threshold is still too coarse. By incorporating a procedure for a farmer to petition the commissioner on the designation will enable the responsible party to submit soil maps or other local data to document applications in vulnerable areas.

The proposed Groundwater Protection Rule should be modified to provide specific review procedures—consistent with farmers' due process rights—that allow farmers to challenge the designation of specific land as a "vulnerable groundwater area" based on the actual conditions of the land. This proposed modification is addressed more fully below.

C. Protection of Procedural Due Process.

The proposed Groundwater Protection Rule imposes significant restrictions based on the designation of land as a "vulnerable groundwater area" or the designation of a specific mitigation level for a drinking water supply management area. But while the

proposed rule provides for a contested case hearing and judicial review of a water resource protection requirements order, the proposed rule does not similar protect the procedural due process rights of farmers with respect to designations that may lead to the imposition of regulatory requirements or the issuance of such orders. This omission is thereby unreasonable and violates farmers' constitutional rights to due process of law.

To address this issue, the Minnesota Corn Growers Association respectfully requests that you require the Minnesota Department of Agriculture to correct this defect before adopting the proposed rule. Specifically, the Minnesota Corn Growers Association suggests the following modifications to Proposed Minnesota Rule 1573.0030, subpart 1 (additions shown in underline format):

1573.0030 STATEWIDE WATER RESOURCE PROTECTION REQUIREMENTS.

Subpart 1. **Prohibitions.**

* * * *

D. Any responsible person in charge of cropland in an area that has been designated as a vulnerable groundwater area as depicted on the commissioner's vulnerable groundwater area map may petition the commissioner for a contested case hearing to challenge such designation. A petition for a hearing must contain a statement of the issue or issues proposed to be addressed at the hearing and the specific relief or resolution requested. Upon receipt of a petition for a hearing, the commissioner shall order a hearing to be conducted in accordance with the procedures in the Administrative Procedure Act, Minnesota Statutes §§ 14.57 through 14.62.

E. Any responsible person in charge of cropland in an area that has been designated as a vulnerable groundwater area as depicted on the commissioner's vulnerable groundwater area map who has petitioned the commissioner for a contested case hearing and is aggrieved by a final decision in the contested case may seek judicial review of such final decision pursuant to the Administrative Procedure Act, Minnesota Statutes §§ 14.63 through 14.69.

The Minnesota Corn Growers Association also suggests the following modifications to Proposed Minnesota Rule 1573.0040 (additions shown in underline format):

1573.0040 DRINKING WATER SUPPLY MANAGEMENT AREA; MITIGATION LEVEL DESIGNATION.

* * * *

Subpart 11. **Contested Case Hearing.** Any responsible party who owns cropland in a drinking water supply management area may petition the commissioner for a contested case hearing to challenge a mitigation level designation for such drinking water supply management area. A petition for a hearing must contain a statement of the issue or issues proposed to be addressed at the hearing and the specific relief or resolution requested. Upon receipt of a petition for a hearing, the commissioner shall order a hearing to be conducted in accordance with the procedures in the Administrative Procedure Act, Minnesota Statutes §§ 14.57 through 14.62.

Subpart 12. **Judicial Review.** Any responsible party who owns cropland in a drinking water supply management area and who has petitioned the commissioner for a contested case hearing regarding a mitigation level designation for such drinking water supply management area and is aggrieved by a final decision in the contested case may seek judicial review of such final decision pursuant to the Administrative Procedure Act, Minnesota Statutes §§ 14.63 through 14.69.

D. Definitions (Part 1573.0010.)

There are a few of the proposed definitions that lack clarity and need additional specificity (additions show in underline format). The additional specificity needed for Subp. 14. Local advisory team is covered in a previous section.

Subp.5. Cropland. "Cropland" means land used primarily for the production or harvest of annual perennial field, forage, food, fiber, or energy crops. Cropland includes pasture but does not include forestland or turfgrass.

Subp. 17. Nitrogen fertilizer definition needs further clarification as to what constitutes "manipulated" and if nitrogen stabilizing products are included in this definition. Although this proposed definition appears to exempt animal manure from the definition of "nitrogen fertilizer," this exemption is limited to manure "that [is] not manipulated." And the proposed rule does not define the term "manipulated." This omission creates substantial ambiguity and confusion as to the circumstances under which animal manure may be deemed by the Department to be "nitrogen fertilizer" under the proposed rule.

In order to address this ambiguity, the Minnesota Corn Growers Association respectfully requests that the Department modify Proposed Minnesota Rule 1573.0010 to insert a new subpart to define the term "manipulated" as follows:

> **Manipulated.** "Manipulated" means animal or vegetable manures that have been changed from their initial physical state by manipulations such as mechanical drying, cooking, chopping, grinding, shredding, ashing, or pelleting.

This suggested definition is based on an existing definition of "physical manipulation" that has already been adopted by the Minnesota Department of Agriculture in Minnesota Rule 1510.0411, subpart 8, and would expressly codify in the proposed rule the Department's stated intent regarding the scope of the proposed rule.

> Subp. 20 Responsible party definition lacks clarity as to who is ultimately responsible for complying with the proposed rule. The Department should consider if language should be added that the party conducting nitrogen applications is ultimately responsible for complying with the rule. This change would be consistent with how the Department designates a "responsible party" under Minnesota Statutes § 18B Pesticide Control.

E. Criteria for Initial Level Designation.

The proposed Groundwater Protection Rule states that "the nitrate-nitrogen concentration of the public well is 8.0 mg/L or greater at any point in the previous ten years" for one of the mitigation level 2 drinking water supply management criteria (Prop. Minn. R. 1573.0040, subp. 3). However, one of the criteria for a level 4 drinking water supply management area designation is if the nitrate-nitrogen concentration of the public well "is 9.0 mg/L or higher for any three samples in the previous ten years" (Prop. Minn. R. 1573.0040, subp. 8). The SONAR explains that "the concentration of nitrate in groundwater can vary significantly in a well based on a number of factors." (Admin R. ex. C (SONAR), at p. 115) Therefore it is reasonable to use multiple samples above a numeric threshold to determine if the source water is at risk.

The Minnesota Corn Growers Association respectfully requests that you require the Minnesota Department of Agriculture to correct this defect before adopting the proposed rule. Specifically, the Minnesota Corn Growers Association suggests the following modifications to the proposed rule (additions shown in underline format):

Subp. 3,A,2(b) the nitrate-nitrogen concentration of the public well is 8.0 mg/L or higher for any three samples in the previous ten years.

F. **Monitoring.**

The proposed Groundwater Protection Rule states that the commissioner may establish a groundwater monitoring network or conduct residual soil nitrate tests. (Prop. Minn. R. 1573.0040, subp. 5); however, no criteria are offered in the proposed rule as to when these monitoring approaches will be used nor the protocols associated with these monitoring methods. The Minnesota Corn Growers Association respectfully requests that you require the Minnesota Department of Agriculture to specify when these monitoring tools will be employed.

The SONAR explains that "a variety of statistical analyses that can be used to evaluate changes in concentration over time. These methods will be evaluated to determine which would be the most appropriate for the data being assessed." (Admin R. ex. C (SONAR), at pp. 120-121). Given the importance of these statistical analysis in determining drinking water supply management area mitigation level designation, the Minnesota Corn Growers Association respectfully requests that you require the Minnesota Department of Agriculture to specify which statistical methods will be used for each monitoring method described in the proposed Groundwater Protection Rule. (Prop. Minn. R. 1573.0040, subp. 5)

G. Mitigation Designation Review.

The proposed Groundwater Protection Rule states that "the nitrate-nitrogen concentration of the public well within the drinking water supply management area is 8.0 mg/L or more at any point in the previous ten years" as part of the criteria for designating a mitigation level 2 drinking water supply management area as a mitigation level 3 drinking water supply management area (Prop. Minn. R. 1573.0040, subp. 7). For the same reasons cited above regarding the criteria used for the initial designation of a level 2 drinking water supply management area, the Minnesota Corn Growers Association respectfully requests that you require the Minnesota Department of Agriculture to correct this defect before adopting the proposed rule. Specifically, the Minnesota Corn Growers Association suggests the following modifications to the proposed rule (additions shown in underline format):

Subp. 7,C,2 the nitrate-nitrogen concentration of the public well within the drinking water supply management area is 8.0 mg/L or higher for any three samples in the previous ten years.

CONCLUSION

The Minnesota Corn Growers Association appreciates the opportunity to submit these written comments regarding the proposed Groundwater Protection Rule and appreciates the time and effort that you have invested in conducting the public hearings and reviewing the written comments and exhibits. And while the Minnesota Corn Growers Association also appreciates the efforts that the Minnesota Department of Agriculture has made to solicit public comment regarding this proposed rule, a review of the administrative record and applicable law demonstrates that the voluntary efforts that have already been undertaken by Minnesota farmers should be given the opportunity to produce results and that the proposed rule is premature. In short, the Department has failed to satisfy its statutory burdens to show that the voluntary implementation of the best management practices has been ineffective or that the proposed rule is needed and reasonable

Thank you for your attention concerning this matter.

Sincerely,

Kirby Hettver
President
Minnesota Corn Growers Association
khettver@hotmail.com

Minnesota Corn Growers Association – Exhibit 1 – Summary of nitrogen related research and education efforts

The Minnesota Corn Growers Association submits this as an exhibit to our comments on Proposed Rules Governing Groundwater Protection, Minnesota Rules, 153. Revisor's ID Number RD 4337. OAH Docket No. 71-9024-35205

This exhibit summarizes funded research and grower education initiatives by the Minnesota Corn Research and Promotion Council in conjunction with the Minnesota Corn Growers Association. This research involved with understanding Nitrogen fertilizer management toward increased Nitrogen Use Efficiency NUE), reduced loss potential while maintaining crop performance. Much of this work contributed to the base of information upon which the BMPs are founded.

All of the information contained in this exhibit is publically available on our website, www.mncorn.org, but specific initiatives relating to nitrogen management research and education has been pulled from longer research summaries and included here.

Carbon, Nitrogen, Phosphorus, and Sulfur Interactions Effects on Soil Biochemical Processes and Corn Grain Yield (2012) $428,419

Paulo Pagliari and Jeff Strock: University of Minnesota

This research was designed to investigate how the addition of nutrients at different levels interacted with residue management and their impact on the parameters controlling corn grain yield. Our primary interest was to understand how different levels of

N, P, and S affected nutrient availability during the growing season in addition to how those levels affected microbial activity.

Furthermore, we were also interested in investigating if residue management would interfere with nutrient availability and microbial activity. The study was set up in small plots located in a farmer's field that had initial test levels for P and K that were considered low. The area of the study was just over 13 acres, which should provide enough data to answer our research questions. The study was carried out from 2012, the initial year when a detail characterization of the site was done, until the end of the 2015 growing season. The cropping systems used was a continuous corn rotation. The results of the study showed that corn grain was significantly affected in some level by all parameters being studied. The most dramatic effect, however, was residue management. It was determined that residue incorporation, in general, provided the best conditions for corn grain yield to be maximized when higher levels of P, N and S were applied. It was observed that plots were the residue was incorporated kept microbial activity higher than in the plots were the residue was removed, which in combination with higher moisture levels, led to a higher nutrient availability to the growing crop. Although, the in-season measurements seem to indicate that nutrient uptake and biomass yield would be greater in plots where residue was removed, final grain yield and nutrient uptake showed a contradictory result. It was observed that a change in fertilizer and residue management will likely be need to maintain or improve corn grain yield in continuous corn cropping system in soils that are similar in properties to those used in this study.

Paying Attention to the Details: Corn Nitrogen Recommendations in Uncertain Times (2013) $129,818

Jeff Coulter, Michael Russelle, Deborah Samac and Gary Feyereisen: University of Minnesota

Drought-tolerant hybrids have not been evaluated under controlled drought stress in Minnesota, leading to variable results influenced by location- specific weather conditions. In addition, nitrogen (N) response in first-year corn after alfalfa has been variable on fine-textured soils.

This project was conducted to help growers improve their decisions about hybrid selection and N fertilizer rate in years when water stress is anticipated, and have increased predictability of N response in

First year corn after alfalfa on fine-textured soils. Experiments were conducted in 3 fields on a coarse textured soil at Becker, MN in 2013 to compare standard and drought-tolerant hybrids under 3 controlled drought stress treatments with multiple N fertilizer rates.

Grain yield did not differ between drought-tolerant and standard hybrids in the absence of drought stress or when sustained drought stress occurred from the R2 to R6 corn stages, but was 11% greater with the drought-tolerant hybrid when sustained drought stress occurred from the V14 to R6 corn stages. Response to N fertilizer did not differ between hybrids. Another set of trials evaluated N fertilizer rates applied near planting or as a sidedress in first- year corn after alfalfa on 14 farms with fine-textured soils in 2014.

On the 7 of 14 farms where grain yield was increased with N fertilizer, the range in the EONR for net return within $1.00/acre of maximum net return for N applied near planting ranged from 59–91 lb N/acre on 4 farms, was 90–111 lb N/acre on 1 farm, was 105–141 lb N/acre on 1 farm, and was 179 lb N/acre or more on 1 farm.

On the 7 of 14 farms where grain yield was increased with N fertilizer, the average EONR was 9–26 lb N/ acre higher on 3 farms, 58–67 lb N/acre higher on

2 farms, and 6–29 lb N/acre lower on 2 farms for N that was applied near planting compared to as a sidedress. Results from these trials will help growers improve economic returns and environmental stewardship.

Effects of Time of N Application and Instinct® on Corn Production and Nitrate Losses from Tile Drainage Water (2013) $38,000

Jeffrey Vetsch and John Lamb: University of Minnesota

Fall is a desirable time to apply nitrogen (N) fertilizer for corn in south-central Minnesota; however, the potential for N loss is greater with fall application. A research study was conducted to determine if adding a nitrification inhibitor to fall and spring-applied

N fertilizers could increase corn grain yield and/or reduce N loss to tile drainage.

The objective of this study was to measure the agronomic and environmental effects of adding the nitrification inhibitor Nitrapyrin (Instinct®, Dow AgroSciences) to spring and fall-applied urea and sidedress-applied UAN. Spring-applied urea or split- applied UAN had 22 bu/ac greater grain yields than fall-applied urea in 2 of 4 years in this study. Fall- applied urea had slightly greater grain yields than spring urea in 1 of 4 years. The addition of Instinct® to fall-applied urea increased grain yield and reduced NO3 concentration and loss in tile drainage water in 1 of 4 years. Fall-applied urea resulted in 38% greater NO3 loads to tile drainage water than did spring urea. These data do not support the application of fall-applied urea with or without Instinct® in south- central Minnesota.

Farmable Vegetative Buffers (2018) $166,000 to date

John Baker: USDA-ARS

The overall objective is to develop and test management practices that will establish perennial vegetative buffers that can sustain row crop production within them. Specific objectives include development of data-driven guidelines for nitrogen (N) management in corn/kura clover living mulch systems; compare the performance of kura clover and Kentucky Bluegrass as perennial living mulches for corn production; develop and test methods to promote faster establishment of kura

clover; and field demonstrate living mulch systems as vegetative buffers.

Phosphorus (P), potassium (K), sulfur (S), and micronutrients will be applied to the entire area if needed, based on soil test recommendations. Plots will be zone tilled prior to planting and urea and ammonium nitrate fertilizer (UAN) will be applied at 5 rates: 25, 50, 100, 150 kg ha^{-1} and a control (no N). Plots will be inspected weekly for weeds and pests. As was done in previous work, soil inorganic nitrogen will be measured throughout the growing season to a depth of 15 cm to monitor nitrogen additions from the living mulch during spring management. The Soil Plant Analysis Development (SPAD) chlorophyll meter will be used as an in-season plant nitrogen monitoring tool that strongly relates leaf chlorophyll content to plant nitrogen content and end of season yield. Sampling at the physiological maturity stage of kura clover, stover, cobs, and grain as well as subsamples of each will be conducted in each plot and will be analyzed for total nitrogen on combustion. Residual soil nitrate to a depth of 60cm will be quantified to determine its relationship with fertilizer additions. An economic analysis of corn production profitability within the living mulch system will also be compared to conventional corn systems. In addition, methods for establishing kura clover living mulch will be evaluated, with a specific goal of determining the benefit, if any, of N fertilizer in kura clover establishment.

Soil Health Partnership Farm Network $120,000

Nick Goeser: Soil Health Partnership/National Corn Growers Association

This project is to fund four additional sites across Minnesota as part of the Soil Health Partnership (SHP) network. The vision of SHP is to demonstrate the research-supported value of soil health to agricultural productivity, profitability, and environmental sustainability, through a continual awareness of and investment in soil health by farmers, consumers, policy makers, the private sector and non-profit organizations.

SHP is a farmer-led initiative fostering transformation in agriculture through improved soil health, benefiting both farmer profitability and the environment. Established in 2014 by the National Corn Growers Association (NCGA), a network of working farms has been built where advanced farm management practices that will enhance sustainability and farm economics for future

generations are tested, measured and the results then shared with farmers and the non-farming pubic. Long-term data on working farms is collected in real growing conditions, and use that data to mentor farmers. Our primary objectives are: build a robust Farm Network of over 100 farms across 12 states, including the Greater Mississippi River Basin, the Great Lakes Basin and the Chesapeake Bay Watershed; generate data, using scientific protocols for standardized research methodology, commissioned by a Scientific Advisory Council; employ sustainability metrics, outcome tracking, and generate updated, science-based Best Management Practices (BMP's) recommendations and peer-reviewed publications; and leverage state and national outreach, and drive increased awareness among thought leaders on the impact of improving soil health to agriculture and the environment.

Evaluation of the New Nitrogen Fertilizer Guidelines for Corn Grown on Coarse Textured Soils (2008) $44,425

Carl Rosen, John Lamb and Rodney Venterea: University of Minnesota and USDA-ARS

Even though water was applied to the 2008 water stressed plots in time to prevent total loss of the crop, yields were adversely affected by the severely dry conditions. This was potentially due to pollination occurring before the water was applied.

These results clearly indicate the current **N** guidelines for irrigated corn on sandy soils are too low. It is also interesting to note that the EONR under water stressed conditions when lack of pollination did not affect yield (i.e. in 2009 and 2010), the EONR was also higher than the current **N** guide lines. This research has been continued on a wide range of irrigated sandy soils in Minnesota to refine the N guidelines. These new guidelines are expected to be available in 2015.

At equivalent N rates, yields with split applied urea were higher than yields with ESN and Super U applied pre-plant. Of interest in 2009 and 2010 at equivalent N rates (160 lb. N/A) and with irrigation, yields with pre-plant ESN and Super U were higher than those with pre-plant urea. These results indicate that the products are working, but they are not as efficient as split urea applications.

In contrast under water stressed conditions, the coated and stabilized products at equivalent rates and timing had no effects on yield. These results indicate that conditions for N loss and higher yield potential are needed for these products to work properly. Basal stalk nitrate increased with increasing N rate and with water stress. However, these results clearly suggest that if the crop is water stressed, the interpretation of the stalk nitrate test could be compromised.

Tillage, Residue, and Nitrogen Management in High-Yield Continuous Corn for Grain, Ethanol, and Soil Carbon (2010) $198,770

Jeff Coulter, John Lamb and Jeffrey Vetsch: University of Minnesota

Corn emergence was 92% or greater within all combinations of residue management and tillage except with no-till and residue retained. Residue removal increased corn grain yield by 4 to 12% among tillage systems. However, there were limited differences in grain yield among tillage systems within a given residue management strategy. Lower yields when residue was retained were associated with lower early-season soil temperatures and reduced early-season corn growth. The response of corn grain yield to N fertilization was not affected by residue management, but was greater than anticipated.

Maximizing On-Farm Nitrogen and Carbon Credits from Alfalfa to Corn (2008) and Predicting On-Farm Nitrogen Credits from Alfalfa to Second-Year Corn (2011) $208,843

Jeff Coulter, Matt Yost and Michael Russelle: University of Minnesota and USDA-ARS

In the trials of first-year corn following alfalfa, the presence of fall alfalfa regrowth did not affect first year corn grain yield or its response to N fertilizer applied near planting, even though this alfalfa regrowth ranged from 4 to 18 inches among the six farms. Similarly, there was no effect of tillage timing on first year corn grain yield.

These results indicate that growers should harvest alfalfa regrowth in the last year on medium - to fine textured soils with good alfalfa stands, and that growers have some flexibility in tillage timing when terminating alfalfa.

In this study, first year corn grain yield responded to N fertilize rate only one of six farms, even with average yields of 180 to 231 bu/acre. On the one responsive farm where 70 to 81 lb. N/acre was needed to economically optimize grain yield, there was fine-textured soil, abundant early-season rainfall, and inadequate drainage, which likely slowed N mineralization due to low oxygen levels in the soil.

When the results of these six on-farm trials were combined with the results of 25 other trials that were conducted in Minnesota and western Wisconsin from 2009 through 2011, grain yield of first year corn following alfalfa was not increased with N fertilizer in 28 of the 31 trials.

In the trials of second year corn following alfalfa, there was a response of corn grain yield to N fertilizer in all three on-farm trials in 2011, and the economically optimum N fertilizer rate ranged from 40 to 60 lb. N/acre when applied near planting. In 2012, five of the eight on-farm trials had a grain yield response to N fertilizer. The optimum N fertilizer rate in these five trials ranged from 72 to 175 lb. N/acre when applied near planting, and N use efficiency was slightly greater in some trials when N fertilizer was applied as a side dress rather than near planting.

When the results of these 11 on-farm trials were combined with the results of 56 other trials that had previously been conducted in the U.S., there was no response of grain yield to N fertilizer in 45% of the 67 trials. In the responsive trials, the optimum N fertilizer rate ranged from 35 to 180 lb. N/acre.

In conclusion, the results from these on-farm trials of first and second-year corn following alfalfa indicate a great potential to reduce N fertilizer application without reducing corn yield if non-responsive fields can be identified prior to the time of N application, and if more site-specific N rate guidelines can be developed for responsive fields.

Balancing Production Gains against Environmental Impacts of Nitrogen Fertilizer Management Practices (2012) $90,000

Rodney Venterea and Jeff Coulter: USDA-ARS and University of Minnesota

Split application did not affect grain yield and did not reduce N_2O or soil nitrate-N intensity. Across N rates and rotations, N_2O was 55% greater with split compared with single application in 2012. Increased N_2O with split application in 2012 likely resulted from a prolonged dry period prior to the second split application followed by large rainfall events following the third split application.

Across years and rotations, split application also increased N_2O by 57% compared with single application when the maximum N rate was applied. Exponential relationships between N_2O and fertilizer N rate explained 62 to 74% of the variance in area-based N_2O and 54% of the variance in yield based N_2O. Applying urea to coincide with periods of high crop N demand does not necessarily reduce and may increase N_2O emissions. Combining split applications with stabilized N sources and/or chemical inhibitors that resist leaching and microbial transformation might be effective in reducing N losses, but more studies examining such combined approaches are needed to identify effective strategies for reducing N_2O emissions and other N losses while maintaining or enhancing crop production.

Determining Optimum N Ratesfor Corn after Soybeans in On-Farm Trials in Southern Minnesota (2008)

Gyles Randall and Jeffrey Vetsch: University of Minnesota

Economic optimum N rates (EONR) for corn after soybeans were 109 , 114, and 115 lb. N/acre with accompanying yields of 184, 237, and 181 bu/ acre at the three sites.

When corn followed corn, an EONR of 152 lb. N/ acre was obtained with an accompanying yield of 232 bu/acre. At all four sites, the EONR was within the present optimum N rate guideline range recommended by UMN. Soil N provided

68% of the optimum grain yield when the previous crop was soybean and 38% when corn was the previous crop. For each lb. of fertilizer N applied at the EONR, the grain yield response over the zero-N control treatment yield was 0.82 bu for corn after corn and 0.36 bu following soybeans. The poorer efficiency for corn after soybeans was primarily due to soil N providing a greater portion of the yield. Apparent recovery of fertilizer N in the grain was 59% and 51 % when following corn and soy bean, respectively. Split-applying (pre-plant + V6 side dress) fertilizer N at the two Olmsted County sites did not increase grain yield above pre-plant applied N.

Achieving Maximum Profit and Minimal Nitrate Loss in Drainage by Optimizing Nitrogen Rate for a High-Yield Corn-Corn-Soybean Rotation (2008)

Gyles Randall and Jeffrey Vetsch: University of Minnesota

The amount and distribution of rainfall had a marked influence on the grain yield and nitrate loss results. Although spring rainfall was slightly above normal through mid-July, only four inches was received between July 18 and the end of September. As a result, yields were slightly less than anticipated in early August. Split application (60 lb. N/acre pre-plant and the remainder at V3) did not increase yields above the single pre-plant treatment.

The apparent 5 to 8 bu/acre advantage for pre-plant application was consistent for both first and second year corn but was not statistically significant at the P=0.10 level. Economic return to fertilizer N was $26 and $14/acre greater for a single pre-plant application for first year and second year corn, respectively, compared with split application, when using a 0.10 ratio ($0.35/lb. N and $ 3.50/bushel corn). NUE in terms of bu of corn produced per lb. of fertilizer N was greater for split application. This was expected since the N application rate was 20 lb./acre less when split applied. Nitrate-N concentrations in the drainage were influenced by the fact that 90% of the sparse 3.3" of drainage occurred in April-June.

Thus, the higher but rather uniform concentrations for first year corn reflected nitrate being lost from the previous soybean crop rather than the N applied on May 10. Similarly, nitrate-N losses in second year corn and in soybeans reflected the first year corn and second year corn treatments in 2007. Nitrate-N concentrations did not exceed 12.3 mg/L and a consistent advantage was not shown for split application.

Other Funded Projects:

Nitrogen Management for Success in the Strip-Till System $90,687

John Lamb, Liz Stahl and Jodi DeJong-Hughes: University of Minnesota

Efficient Use of Nutrients Applied as Starter Fertilizer $133,000

Dan Kaiser: University of Minnesota

Evaluation of the New Nitrogen Fertilizer Guidelines for Corn Grown on Coarse Textured Soils

Carl Rosen: University of Minnesota

Evaluation of the Slow Release Nitrogen Fertilizer for Irrigated Corn Grown on Coarse Textured Soils $40,000

John Moncrieff; University of Minnesota

Testing the Origin of Agricultural N Sources $316,162

Ki-In Kim: University of Minnesota

Evaluation of New Management Practices for Increasing Corn Production and Reducing Environmental Risks Following Fall Anhydrous Ammonia Application $111,000

Rodney Venterea: USDA-ARS

Optimizing Nitrogen Use Efficiency and Minimizing Nitrification-Induced N Leaching and Gaseous Losses with Post-Plant Fertilizer Applications: Field and Lab Studies $75,177

Rodney Venterea: USDA-ARS

Nitrogen fertilizer management for rain-fed corn in MN if spring application is the only option $74,315

Fabian Fernandez: University of Minnesota

Mineralization Potential of Agricultural Soil and Canopy Sensing Technologies to Predict Corn Nitrogen Needs after Fertilization in Minnesota $515,278

Fabian Fernandez: University of Minnesota

Education:

Nutrient Management Specialist for Agronomic Cropping Systems (2012) $1,000,966 to date

Carl Rosen: University of Minnesota

Minnesota Corn Growers partnered with University of Minnesota to hire at nutrient management specialist to provide leadership for programs dealing with environmental issues related to nutrient management of corn cropping systems. Research and education activities for this position continue to emphasize the linkages between nitrogen management, water quality and economic impacts. This is a greatly needed position that will help provide continuity and support for nutrient management programs.

Nitrogen Smart (2018) $94,018 to date

Brad Carlson: University of Minnesota

The Nitrogen Smart program was conceived by leadership at the Minnesota Corn Research and Promotion Council (MCR&PC) and the Minnesota Agricultural Water Resources Center (MAWRC) and developed into a program by University of Minnesota Extension. The program has been a three way partnership, with the MCR&PC providing financial and promotional support, MAWRC providing administrative assistance with registration and tracking attendance, and University of Minnesota Extension providing content, teaching, and evaluation.

The program consists of a three hour training on how nitrogen behaves in the environment and how this affects nitrogen fertilizer management, as well as environmental concerns. There have been 25 meetings held the past two years with an attendance of approximately 600. While having no official status, attendees receive "Nitrogen Smart" designation for having attended. Evaluation data from this past year indicates 86% of attendees would recommend attendance to another, and 86% intend to maintain their "Nitrogen Smart" status.

This program is currently engaged in the third year of the Nitrogen Smart program. The program is well established with 553 receiving "certification" over the past two years. A second component of this project is to complete the on-line curriculum development component and is expected to be available in 2018.

4140-18SP Soil Fertility

Advanced Nitrogen Smart (2018) $17,089 to date

Brad Carlson: University of Minnesota

The Nitrogen Smart program has been a success with documented outcomes showing reductions in unnecessary nitrogen (N) fertilizer applications and increased profits due to changes in application practices. The program offers "certification," although it has no legal status. This certification is good for three years. The program is now poised to enter its third year in 2018, meaning that 2019 will see the first group of attendees needing to recertify. Written evaluations of the program show that approximately 89% of attendees state they will maintain their certification status when it expires.

Conversation over the past few years with partners (Minnesota Corn Research and Promotion Council [MCR&PC], MAWRC), participants, and others poised to give input has examined how recertification will be handled. There are multiple options for this, but one option receiving support is to offer "Advanced Nitrogen Smart." Evaluation data shows that approximately 73% of previous attendees say they would be interested in attending an advanced course.

A model that has been successful for Extension in recent years is to offer focused training around a single topic. We believe this is the preferred way to approach Advanced Nitrogen Smart, and propose to develop a number of these trainings over time. After consulting with the group that collaborated on the original version of Nitrogen Smart, the consensus is to develop a session focusing on manure applications first.

Evaluation data shows that approximately 50% of attendees are using manure as a fertilizer source on at least some of their land. Manure has been challenging to manage in the context of Nitrogen Best Management Practices due to the complexity of managing livestock production facilities, balancing time management, and the variability of manure itself.

This project will develop Advanced Nitrogen Smart – Manure Management. This will be the first of what is envisioned as several Advanced Nitrogen Smart presentations, and represents the expansion and evolution of this highly successful program. The program will be delivered during the 2019 winter meeting season and on into the future.

University of Minnesota Extension Water Quality, Nutrient Management, and Agricultural Drainage Education (2018) $260780 to date

Michael Schmitt: University of Minnesota

Issues related to water quality are at the forefront for Minnesota Agriculture in the past several years and appears that the issues will continue for some time. The future of agriculture is tied to our ability to manage water and nutrients in ways that both insures a strong agricultural economy and maintains Minnesota's environmental integrity. Sound research-based education delivered to producers, natural resources professionals and citizens is a key. This project is a continuation of an existing collaboration between University of Minnesota Extension and the Minnesota Corn Growers, to bring in-depth education/outreach expertise to research-based issues pertaining to water quality/water management especially as it relates to plant and soil nutrient management. The project centers on a dedicated position that will bring together existing information, the greater resources of the University of Minnesota and other institutions to provide unbiased, research-based education around nutrient management, water quality and drainage issues with the end goal of a sustained agricultural economy.

Vegetative Cover Crops as a Nitrate Reduction Strategy for Tile Drainage $85,700 to date

Jeff Vetsch: University of Minnesota

Nitrogen (N) is an essential input for profitable corn production. Previous research (Randall and Mulla, 2001, Dinnes et al., 2002) has shown subsurface tile drainage systems deliver nitrate-N to surface waters and thereby degrade water quality. Row crop agriculture in the Midwest is under scrutiny to reduce nitrate (NO_3) concentrations and loads in tile drainage. The use of cover crops and applying appropriate rates of N for corn are potential management strategies to reduce NO_3 losses in tile drainage water (Dinnes et al., 2002). The species of cover crop, establishment date and termination date could greatly affect their potential to sequester N. Cereal rye is effective at scavenging N when it's established early and not terminated until spring. Generally, Minnesota farmers who use cover crops either use cereal rye in a no-till system or seed a blend of annuals like oat, annual rye, clover and radish. These annuals are terminated by cold temperatures and/or tillage. The potential of fall/winter terminated covers to scavenge N in a corn - soybean rotation in Minnesota is not well known. The goal of this study is to quantify the effects and interactions of cover crop management and N rate on tile water flow, NO_3 - N concentration and loss in tile drainage water, corn and soybean production, N uptake and nitrogen use efficiency (NUE).

Impact of Cover Crop Strategies on Productivity of Corn (2018) $417,593 to date

Axel Garcia Y Garcia: University of Minnesota

The dominant crops in Minnesota are corn and soybean; together they are responsible for more than 80% of the $9.25 billion value of the state's field and miscellaneous crops in 2014 (USDA-NASS, 2015). As part of the Midwest, the state is within one of the most intense agricultural areas in the world. Corn and soybeans, the main crops, are typically grown in rotation using conventional cropping practices, including high external inputs. The practice is under scrutiny due to issues with soil erosion and nutrient losses, such as nitrogen in the form of nitrate (NO_3) lost to ground or surface water. Cover crops integrated into current cropping practices have been promoted as an affordable and environmentally friendly option for crop production. Intuitively, cover crops will use water and nutrients and may negatively influence weed, insect and pathogen populations but the strategy is expected to result in a more efficient use of resources while maintaining or improving productivity and enhancing the quality of the environment.

The goal of this proposal is to assess the impact of cover crop strategies on the productivity of corn grown under different environments and production practices.

<u>Other Education Programs</u>:

Discovery Farms $506,592 to date

Warren Formo

Production Stewardship – Innovation Grants $218,887 to date. 33 Unique projects over 3 years

2018 Innovation Grant Projects

Some of the greatest challenges currently facing Minnesota corn farmers may have solutions that they have already thought of or have had the insight to try. Innovations like these often can be furthered through seed money to test the idea on a limited scale for workability and potential to help other farmers address the same challenge in their operation.

To foster farmer lead innovative solutions, the Minnesota Corn Research & Promotion Council (MCR&PC) and the Minnesota Corn Growers Association (MCGA) allocated funding to aid farmers with an innovative practice to solve a specific challenge that they wanted to test or prove on their farm. With an anticipated focus by citizens and legislators on nitrate loss and soil conservation efforts in Minnesota agriculture, MCR&PC and MCGA released a request for proposals (RFP) to Minnesota corn farmers. The RFP requested proposals from farmers with interest in testing their ideas related to improved nitrogen management and/or conservation practice through an on-farm project in corn production or more sophisticated replicated trials.

Integrating Swine Manure Application and Strip Tillage into a Single Pass System.

Lee Thompson

Manure application is a challenge for many farmers due to time constraints and adopting new application practices. The goal of this project is to combine the field operations of strip tillage and manure application into a one pass system while improving soil health and ensuring a sustainable manure application method. I believe that by banding the manure in the strip, application rates can be reduced and that we can be more efficient with our manure. I hope to determine if combining the field operations of strip tillage and manure application into a one pass system will promote soil health, reduce nutrient loss, increase yields and allow the farmer to complete field operations in a timely fashion while adopting new farming technologies.

Inter-seeding Cover Crops While Applying In-Season Nitrogen

Keith Hartmann

The statements, "Cover crops won't work here" and "You are planting weeds into your corn" have turned into questions such as, "Where can I get the seed?" and "What is the best method to plant it?" since I applied for the first Innovation Grant. The change to these kinds of questions from fellow farmers inspires me to replicate my 2016 and 2017 MN Corn Growers Innovation Grant research of inter-seeding cover crops into V6 corn while applying in season nitrogen in the same pass across the field. This project will demonstrate an efficient and effective way to seed a cover crop during a side-dress nitrogen application. I will be applying this practice to 110 acres of corn. Within those 110 acres will be replicated strip trial plots where I will be weighing corn grain yield, performing stalk nitrate tests and soil nitrate tests. These tests are to ensure that the cover crop isn't negatively affecting the primary corn crop in any way. I will continue to use pre-emerge and post-emerge herbicides with residual characteristics to test cover crop tolerance and to demonstrate that weed control won't be sacrificed in order to establish these cover crops. Using the same management practices as a typical corn farmer is important to making this a sustainable practice.

Sulfur Application at Nitrogen Side-dress and Cover Crop Planting

Brian Ryberg

Our goal is to determine which level of overall Sulfur has the best ROI based on yield and which level provides no additional response to yield. We are interested in working with Sulfur and its effects on Nitrogen uptake. We have seen a definite advantage to using more Sulfur and we are wondering if we could see more benefits in our banded situation with our strip till system. There is an obvious relationship between Sulfur and Nitrogen on yield. We will be testing different levels of Sulfur (S) or ammonium thio-sulfate (ATS) added into our 32% nitrogen solution at side dress time around V-5 to V-6. Our corn acres already have an application of ammonium sulfate (AMS) applied in the strip this fall so our trial would be in addition to what is applied already. Our side dress applicator is a 36 row machine with rows spaced at 22" (0.56 m). We will be doing this on a large farm to do some replications. We will make one round, 72 rows, with no added ATS, then add additional ATS for each of several rounds after that and then repeat the procedure. These "blocks" of different ATS levels will easily be identified on a yield map and we will also have a weigh wagon to determine yield on these strips at harvest.

Evaluating Optimum Inter-seeding Dates for Soil Health and Weed Control

Matt Alford

Our farming operation consists of 1,320 acres located in Faribault County seven miles east of Blue Earth, MN. We currently raise corn and soybeans and are looking for the best way to integrate cover crops into this production system. We have been strip-tilling since 2009 and we believe that cover crops can help us achieve our soil health and sustainability goals. The benefits of cover crops are numerous, and we have witnessed many of them first hand. Establishing cover crops in the northern corn-belt can be a challenge. Inter-seeding cover crops while applying nitrogen is the best way to address this issue. This is considered a novel practice in our area as it consists mostly of heavy tillage. In a marginal farming economy, farmers are looking at maximizing every dollar on their operation and cover crop seed and application are not any different. Combining a side dress application of nitrogen along with cover crop seeding is a very efficient way of reducing trips through the field and ultimately leading to more profitability and cover crop adoption. This project will give insight into both issues and provide farmers with real field-scale data showing how this practice can be implemented. I will add a Hiniker cover crop seed box to our already existing side dress unit. The unit is a forty-foot 7x7 toolbar consisting of sixteen soil warrior "mini" units. The soil warrior units employ a wavy lead coulter and two containment coulters. The liquid nitrogen is applied directly behind the lead coulter and the containment coulters cover it with soil and residue. The cover crops would be applied in front of the toolbar and the containment coulters would essentially "plant" the seeds. This seeding method would achieve optimum seed to soil contact allowing the use of lower seeding rates, wasting less seed and money.

The theory of this experiment is early established cover crops can out compete much of the weed pressure that would arise throughout the growing season. The cover crop mix we will be using is 10 lbs. annual ryegrass, 1 lb. radish, 1 lb. rape, 3 lbs. buckwheat and 4lbs cowpeas per acre. This mix is designed so that it contains a cool season grass, cool season broadleaf, warm season broadleaf, warm season legume and the corn it will be planted amongst is a warm season grass. A diverse mix such as this, can aid in weed control and add many benefits to a conservation farming system. The experiment will be conducted on full length rows in sixteen row blocks. A control plot on both sides of the trial will use pre and post-emerge herbicides and no cover crops. Three of the blocks

will be inter-seeded while applying nitrogen. Each block will be seeded at different growth stages of the corn. Corn growth stages will be identified using the leaf collar method. The first test will be applied at V-3 (treatment #1), the second at V-5 (treatment #2) and the third at V-7 (treatment #3). An additional check plot will be evaluated in which we only apply pre-emerge herbicide and not inter-seed (treatment #4). This will provide a comparison to evaluate the weed control that the cover crops are providing in each treatment. The controls as well as the weed control check plots will all receive a sidedress application of nitrogen at approximately V-5, or when the rest of the field is applied. While sidedress nitrogen timing is an additional variable between the treatment plots, controls and weed checks, this small time difference has been proven to have no statistical difference on yield. All treatments, control plots and weed check plots will be replicated one additional time. One corn hybrid will be planted across the whole area and this experiment will be in a uniform part of the field to help minimize any variances in soil type or elevation.

Economic and Agronomic Study of Various VRN Programs

Les Anderson

The purpose of this project is to evaluate some of the Variable Rate Nitrogen (VRN) programs against a check to see if they can reduce the amount of N per bushel of corn produced and to see if there is enough economic return to pay for the program. The field is about 68 acres (27.5 ha) in size, naturally well drained with no tile, and is very uniform consisting of mainly one soil type, with soybeans as the previous crop. We will compare VRN programs from Winfield, Climate, and Premier Crop/ AYS against a check. The strips would be 80 feet (24.4 m) wide, about 1200 feet (365.8 m) long, with a 40 foot (12.2 m) planter making two passes, planting a single variety. We will only harvest the inner 40 feet (12.2 m) of the 80 foot (24.2 m) pass for yield measurement. I will identify and assign the plots in the monitor, at time of planting to aid in accuracy. Headlands and borders will not be used in the study. Urea would be the source of N. The entire field would be spread prior to planting with 80 pounds (89.7 kg ha^{-1}) of N plus sulfur. The check would be 70 pounds (78.5 kg ha^{-1}) of N plus sulfur side dressed, with the other 3 treatments being planted in succession, resulting in 8 replications across the field. Agrotain would be added if conditions warrant.
Todd Anderson and Dan Jilk from Ag Partners and I will set up the plot and they would load the prescriptions and apply the fertilizer. I will combine the plot, using a calibrated Ag Leader monitor to record the data. We will analyze the data at the plot

level and at the field level. We will compile the data and provide the results looking at pounds of N per bushel, and cost, both on an acre basis and bushel basis, including the cost of the VRN program.

In-season Potassium and Nitrogen Application Based on Crop Demand Curve, Soil and Tissue Sampling

Kevin Poppel and Kate Stenzel

As an essential nutrient potassium (K) plays a critical role in corn plant development and chemical processes. As a result of the number of roles it plays in the plant, potassium uptake and utilization often interacts with the availability and uptake of other nutrients. Potassium specifically affects the uptake of nitrate nitrogen into the plant. According to research done by the International Plant Nutrition Institute, higher yields and nitrogen utilization is improved with adequate potassium levels. There is also greater yield response to nitrogen applications when K is sufficient as well as improved crop response to K when nitrogen is sufficient. This interaction is also observed over years of tissue sampling through the entire Central Farm Service territory. That work showed a significant number of samples showing deficient or responsive nutrient concentrations within the plant of both potassium and nitrogen. In order to maximize yield potential a critical balance between the two nutrients must be achieved.

An improvement in nitrogen use efficiency has been observed by making split nitrogen applications that closely follow the nitrogen demand curve for corn. The goal for the improvement is also to maintain maximum yield potential. Since potassium and nitrogen are both essential nutrients to the corn plant and yield potential and are so closely correlated, an improvement in potassium efficiency would likely be observed if potassium was applied more closely to match the nutrient demand curve. By identifying a critical balance between these nutrients, the goal is to maximize nutrient efficiency without sacrificing yield. Based on previous nutrient research theories, a yield advantage is possible if the correct ratio is achieved.

Eliminating Soil Erosion Using a Three Crop Rotation and Extensive Cover Crops

Brock Olson

The objective of this project is to develop a crop rotation that significantly reduces

nit rate loss and soil erosion compared to the traditional corn-soybean rotation while maintaining profitability in Southeastern Minnesota. A proven method to decrease soil erosion and nitrate loss is through the use of cover crops. Cover crop use in northern mid-west states is more difficult due to the shorter season; the cover crop that has proven itself fairly reliable in this cold climate is winter rye. In recent years some have planted winter rye following corn harvest, then planted soybeans the next spring without negative yield effects winter rye will reduce soil erosion, reduce nitrate loss, and improve soil structure and health. Unfortunately winter rye before corn planting hasn't had such good results, even when terminated 10 days before corn planting. Corn crops are often well behind visually and can have measurable yield reductions. One possible solution to this is to use cover crops that winter kill, the residue from the cover crop will reduce erosion and nitrate loss, but not negatively impact the subsequent corn crop. Adding a 3rd crop to the corn-soybean rotation can allow for more cover crop benefits by allowing additional cover crop growth before winter kill, without negatively affecting corn yields. This project will investigate the possibility and profitability of this 3rd crop in the rotation.

Yield Costs or Benefits Associated with Different Conventional and Vertical Tillage Practices

Kent Luthi

Proper tillage seems to be a never ending struggle for farmers across America. Fred Below, University of Illinois, states that tillage is only number 5 of the 7 wonders of corn production; however, improper tillage can be detrimental to corn growth and yield. To address the costs of improper tillage, we would like to put a few different tillage practices to the test in our own backyard. This will create yield data for area growers to compare when struggling to decide what is right for their operation and to understand the cost associated with malfunctioning tillage tools.

In the fall of 2017, we put in tillage plots across three different farms with three different tillage scenarios: 1.) 7 inch standard points, 2.) 14 inch 360 Yield Center Bullet points, and 3.) a control where we ran no shanks down with only the front disks doing slight mixing (vertical tillage will be used in future years). We plan to determine any difference in soil fracturing and residue incorporation between the three of them before and after winter freeze. We will include the economic cost of tillage skips or malfunctioning shanks due to sheared bolts for each tillage treatment. Jodi DeJong Hughes from University of Minnesota Extension (Willmar office) and Dorian Gatchell

with Minnesota Ag Services will be helping us with proper plot protocol and data collection. They will also be assisting us with tools such as a soil penetrometer for testing density. We also will be working closely with Precision Ag 360 to use tools such as 360 SOILSCAN™ and Climate FieldView™ to track nitrogen availability in each test strip and data collection point. We hope by replicating this project over multiple areas and multiple years we can see what difference there may be robbing yields or not and whether or not deep conventional tillage is always beneficial in different crop rotations.

Real Time Liquid Manure Testing and nutrient Management

AJ Krusemark

This proposal is intended to test the nutrient analysis of hog manure in order to adjust application rate on a load-by-load basis with a goal of applying the manure using a variable rate prescription.

Building on the information learned through nitrogen management trials in 2017, this project will focus on improving the precision of application rates of injected liquid hog manure to minimize risk of nitrogen losses. Application rates will be targeted to achieve required phosphorus levels, with remaining nitrogen requirements met through side dress or other in-season application methods. Nitrogen modeling programs will be used to prescribe in-season applications with residual nitrate tests conducted to ensure over-application has not taken place.

Nutrient analysis testing will be conducted in one-foot increments throughout the profile of the pit. Additionally, on one pit, each load will be analyzed. Analysis will be conducted on-farm and repeated in a laboratory for each sample to ensure accuracy. This data will be compiled and analyzed in the first 2 growing seasons to be used to develop variable rate application capability for year 3.

Comparing Economic Benefit of Variable Rate Nitrogen Systems

Sam Peterson

Split application of nitrogen has gained acceptance by growers on more corn acres as a way to potentially increase nitrogen efficiency, crop yields, net profit, as well as decreasing nitrogen loss. This typically means applying a portion of nitrogen pre-plant, followed by a seasonal application (top-dress)

at the V4 to V7 growth stage.

Recently, a number of variable rate nitrogen (VRN) systems have been developed to further refine the rate of nitrogen applied during top-dress. The rate of top-dress nitrogen depends on a number of factors: yield history, soil type, environmental conditions prior to top-dress, satellite imagery and soil nitrate test levels. This proposal compares replicated farm scale strip trials of 3 VRN systems (Encirca®, NitrateNow, R7®) to a planned flat rate (check strip) of top-dress nitrogen on a 335 acre (135.6 ha) field of corn following corn . The trial is trying to answer both of the following questions. Which VRN system creates the best economic bottom line when factoring in nitrogen rate and corn yield? Is there an economic return to the added cost (typically $8-10/acre ($19.8-24.7/ha)) of the VRN systems versus a uniform rate of top-dress nitrogen?

Advisor Brad Carlson, with the University of Minnesota Extension will oversee the strip trial design, receive and merge nitrogen records from the four treatments into one prescription for topdressing. He will also evaluate yield data and complete a yield and economic analysis.

Drip Irrigation and Nitrogen Management

Brian Velde

The demonstration site has been in a corn soybean rotation with conventional tillage. The field is well drained and has been grid sampled for fertility levels. The field has 13 years of yield data and Real Time Kinematic (RTK) is used for planting consistency. The demonstration site is currently permitted for 58 acres (23.5 ha) of irrigation or 9.6 million gallons (37,097 m^3) of water per year to be pumped from the Yellow Medicine River with the Minnesota Department of Natural Resources (MN DNR) permit# 2016-0797. A drip irrigation system has been designed by Maxwell Irrigation. The system has been installed by NutraDrip Irrigation Systems. The drip irrigation system consists of 6 different zones approximately 9.5 acres (3.8 ha). The zones have the ability to apply different rates of water and nitrogen within those zones. Within the zones, drip tape was installed every 5 feet (1.5 m) at 16 inches (0.4 m) deep using RTK. This RTK spacing will allow every corn row to have an irrigation/fertigation application done within 15 inches (0.38 m) of the corn roots. The site will have a weather station that will track wind, temp, rain, humidity, solar radiation and

GDU's. Two soil probes will be installed to measure soil moisture in different soil types.

The (TO) check will consist of three strategically placed 60 feet (18.3 m) wide non-irrigated blocks with 100% pre-plant nitrogen strips running the length of the trial.

Treatment 1 (Tl) will consist of six, 9.5 acre (3.8 ha) zone blocks that will have subsurface irrigation and nitrogen application based on in-season crop needs. There will be a statistically quantifiable randomized treatment design with the treatments. In-season tissue samples will be collected from VS to tassel for nutrient analysis and estimates of photosynthesis/ chlorophyll will done by Centrol Crop Consulting using a chlorophyll Soil Plant Analysis Development (SPAD) meter. Yields will be measured using a yield monitor. We will use paired comparison to analyze the data. The data that's not normally distributed, we will use non-parametric analysis. Within the replicated strips we will use sampling points in the different soil types.