Project/Activity Number: NC1195
Project/Activity Title: Enhancing nitrogen utilization in corn based cropping systems to increase yield, improve profitability and minimize environmental impacts
Period Covered: March 7, 2018 to March 6, 2019
Date of This Report: March 31, 2019
Annual Meeting Date(s): March 5-6, 2019 in Kansas City, MO

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Brief summary of Minutes of Annual Meeting:
The 2019 meetings were held March 5-6 in Kansas City, MO at the Fairfield Inn & Suites.
- Administrative Update: Kendall Lamkey gave the Administrator Advisor's report. He explained the criteria for our Project review, and discussed how to improve our reports.
- State report highlights: All meeting attendees gave 15-30 minute presentations on their work, followed by rich discussions regarding various results obtained using different tests of soil health and their relation to N dynamics in cropping systems.
- Key Discussions: a) various tests of soil health and their relation to N soil dynamics; b) a large data set with 56 site-years that had analyzed for N response and its prediction.
- Future publications and research: a) Multi-authored paper soil N tests and their ability to predict N response in trials in the North Central region (dataset from the NC1195 committee). b) Future opportunities for research across the region and using the archived soil collection.
- Renewal of our project: In seeking to renew our Project, we discussed proposal plans, in relation to deadlines in 2020: Intent, Sept. 15; Objectives, Oct 15; and Completed, Dec 1.
- Meeting in 2020: The group agreed to hold the next meeting on March 3-4, 2020 at Fairfield Inn and Suites, Kansas City, MO.
- Executive Committee: The current Secretary, Ann Russell, will be the Chair in 2020 and the current Member-at-Large, Sindhu Jagadamma, will be the Secretary. Xiaofei Li was elected the Member-at-Large for 2020. Marshall McDaniel will be the past-Chair.

Key Discussions: These focused on the Objectives of the Project and ideas for the renewal proposal.
1. *Gain a more thorough understanding of the influence of macro- and micro-scale ecosystems and landscape properties on soil N dynamics.*
    a) We discussed evaluation of the Haney soil health nutrient tool (HSHT) for its potential in determining corn nitrogen recommendations, based on research results from a study conducted at multiple sites across eight Midwest states. Two components of the HSHT not directly used in

the HSHT N recommendation for corn, the soil health calculation, or soil health score, and the Solvita carbon dioxide (CO_2)-Burst lab test, accounted for the most variation in economic optimum N rate (EONR). Both accounted for over one-half of the variation in EONR for N applied at planting or as a split application. With additional research, these two components may help improve N recommendations for corn in the Midwest, especially the Solvita CO_2-Burst test because it costs less to conduct this test, in comparison with the soil health score.

b) Similar to other soil measurements, mineralizable C had multiple sources of variability: spatial, temporal and analytical. Mineralizable C had a twofold to 20-fold greater inter-laboratory variability than other commonly used soil tests, leading to a high degree of uncertainty associated with the interpretation of results. Procedural differences, such as sieve size and the method of rewetting, significantly influenced measurements of mineralizable C. This underscores the need for the development of a standardized and universally adopted protocol. Capillary rewetting consistently suppressed mineralizable C relative to rewetting with a specific amount of water and is therefore is not a recommended approach. The findings show these sources of variability are soil-specific and may be a substantial hurdle to a repeatable measurement of mineralizable C and to its utility as a robust soil health metric. In a commercial setting, this analytical variability can result in unreliable and/or inconsistent recommendations when using a single measurement. If additional analytical replicates were to be suggested, this would increase the cost of analysis and may serve as a financial barrier for growers.

2. *Explore optimization of nitrogen management practices through interrogation of corn nitrogen use efficiency datasets from studies conducted across the North Central region.*

A large data set with 56 site-years was analyzed for N response and factors that may predict N response. The availability of a robust soil N test is key to optimizing yields, while also preventing over application of fertilizer N. Some field sites, for example, show no yield response to fertilizer N addition but still have high yields. A test that predicts when a site will respond to N fertilizer, but has high yields, is crucial to understanding what factors contribute to these high-yielding sites and how N application can be reduced based on that knowledge. A multi-authored paper will report results of these soil N tests and their ability to predict N response in trials from around the North Central region (dataset from the NC1195 committee, formerly NC218). We discussed the tasks remaining and their timeline for completion of this manuscript. We also discussed future opportunities for research across the region in this area. Using the archived soil collection from the previous Project.

3. *Develop nitrogen management decision-making tools for crop advisers and growers.*

The online Corn Nitrogen Rate Calculator (http://cnrc.agron.iastate.edu/) N response database was updated with new research data for corn following soybean and continuous corn. The CNRC web site had 103,084 page views and 12,523 unique visitors in 2018 alone. The website Nitrogen Model for Iowa Agricultural Systems, developed for the general public (https://www.nrem.iastate.edu/nmodel/), became live in late May 2018. Users can download the model and use output from simulations to evaluate yield, nitrate loss to streams, denitrification, and soil organic matter changes under different management types, and thus develop solutions that optimize yield while reducing pollution and increasing soil organic matter. One manuscript on this model is in preparation. With two websites successfully underway, this proposed milestones for this objective have been met, so there was little discussion of this topic.

State Reports:
- Rhae Drijber: *Crop rotation and nitrogen effects on microbial communities in maize agroecosystems*
- William Horwath: *Soil respiration and oxidizable C to predict N mineralization*
- Carrie Laboski: *NUE and potential environmental outcomes associated with N application timing for corn.*
- Xiaofei Li: *Spatial econometric models in corn nitrogen response estimation*
- Marshall McDaniel: *Glycerin as a 'liquid cover crop'*
- Jeanette Norton: *Short-term nitrogen fertilization affects microbial community composition and N mineralization function in an agricultural soil*
- Hanna Poffenbarger: *Optimizing nitrogen fertilization practices for corn following cover crops*
- Ann Russell: *Corn-soybean rotations enhance soil organic matter decomposition: The roles of litter quality and priming*
- John Sawyer: *Residual effect of long-term nitrogen fertilizer application*

Committee Business

The following summarizes issues discussed during the business part of the meeting.
- Executive Committee. Our 2020 leadership will be: Chair, Ann Russell; Secretary, Sindhu Jagadamma; Member-at-Large, Xiaofei Li; and Past-Chair, Marshall McDaniel.
- Future NC1195 meeting location and date: Members voted to continue meeting at the Fairfield Inn & Suites, Kansas City, MO. The meetings will be held March 3-4, 2020. It was proposed that the meeting start at 1 pm on March 3 and end at noon on March 4. A poll with be sent to participants to determine whether to make the change in timing.
- NC1195 Annual Reporting. We discussed how to improve these reports.
- Renewal proposal: We discussed the milestones and timing for writing the renewal proposal.

Assigned Responsibilities/Deadlines/Target Dates:
- Complete research on soil N testing and N response across diverse soils, the residual effects of long-term N application on soil N supply and crop yield response in corn cropping systems, and N rate and tillage effect on corn yield by September 2020 (McDaniel, Sawyer, Laboski, Drijber, Horwath).
- Submit publications by March 2020 (McDaniel, Russell).
- Examine interactions that can occur between N mineralization and fertilizer application rates by March 2020 (Iowa State).
- Present research findings at professional conferences in 2019 (All).

Publications: Please see the attached file.

Educational Aids

Iowa State University Extension and Outreach publication CROP 3154. 2018. Use of the end-of-season corn stalk nitrate test in corn production. https://store.extension.iastate.edu/Product/5089

Iowa State University Extension and Outreach publication CROP 3073. 2018. Nitrogen use in Iowa corn production. https://store.extension.iastate.edu/Product/Nitrogen-Use-in-Iowa-Corn-Production

Website:

Nitrogen Model for Iowa Agricultural Systems https://www.nrem.iastate.edu/nmodel/