

Change in soil test P following long term P fertilization strategies

Year 1 Report
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Objectives

1. Complete final summary of the AFREC long-term phosphorus study for peer reviewed publication and integrate the long-term project data into extension programming
2. Complete the revision of three current phosphorus related extension publications
 - a. Understanding phosphorus fertilizers
 - b. Phosphorus transport and availability to surface waters
 - c. Agronomic and environmental management of phosphorus
3. Complete work on new extension publication “Managing phosphorus profitably” (tentative title)
4. Develop a series of modules on phosphorus management used for oral extension programming using power point
 - a. Nature and chemistry of phosphorus in soils
 - b. Soil testing theory and phosphorus best management practices
 - c. Profitable management of phosphorus fertilizers
 - d. Environmental implications of phosphorus management
5. Further develop a database containing phosphorus response in corn and soybean production systems to:
 - a. Identify critical soil test levels based on currently used phosphorus soil tests
 - b. Outline probability of response to P based on current P test calibrations
 - c. Define expected average yield increase to P fertilizer based on soil test P categories

INTRODUCTION

Commodity and fertilizer price fluctuations and water quality concerns have increased the need for basic soil fertility outreach. Nitrogen has been a large target due to national water quality concerns with eutrophication in the Gulf of Mexico. Phosphorus is a major issue in Minnesota due to the impact of excess P on water quality in freshwater systems. Phosphorus is also a nutrient that needs to be supplied to crops grown in Minnesota. Since fertilizer can represent significant input costs, knowing how soil tests are correlated and calibrated and at what point P becomes an environmental issue is important to ensure the nutrient is being managed efficiently and profitably.

The 4-R nutrient stewardship program is gaining momentum across the country due to increased public pressure on sustainability. Minnesota has been ahead of other states in the adoption of best management practices (BMPs) for nitrogen outlining regional BMPs in a series of publications. However, there is no set BMPs for phosphorus at this time. While we are not suggesting regional specific BMPs for P, outlining practices benefits and drawbacks is important for helping farmers generate site specific management

options for P. Tools such as web based outreach material and in-person oral programming targeted to P best management practices is a good first step in 4-R nutrient stewardship.

The target audience for this project is farmers, government agencies, and ag. professionals. The update to the publications would be released to the general public via the Extension Nutrient Management Webpage. The in-person extension material would be generated for use at the farmer level. At this point we are not planning specific events for the upcoming year, rather the completion of material for future use. The AFREC research funds provided for past research has been instrumental in funding key projects which need to be summarized further into outreach material. The outreach coordinator funding provided by AFREC starting in 2017 has been successful in increasing the level of information released based on current projects. We are proposing to further work with the outreach projects but focus on mining information already available to specifically focus on phosphorus management.

The size of our target audience is unclear at this time. As previously stated, the nutrient management webpage currently receives around 500,000 page views annually. Phosphorus related material extension material tends to be near the top of accessed material on the website. For in-person outreach, the power point material we wish to generate would follow similar outline as the current Nitrogen Smart Program with a focus on fundamentals of P in the soil, P best management practices, and environmental issues related to P. Most extension programs provide a wide range of topics but we have found that focusing on a single topic can be successful. The Nitrogen Smart Program has had very positive feedback related to the focused material. The advantage to developing a phosphorus program is to have material that can be utilized by multiple extension educators including state faculty and regional or local educators to deliver a common message across the state of Minnesota.

MATERIALS AND METHODS

This project differs from the current funded AFREC nutrient management extension outreach project. While we are proposing to leverage the outreach coordinator position to help with any materials released to the public, the primary focus of this grant is to hire an individual to help with piecing together information from various sources to develop outreach material. This time of data mining is time consuming and would hinder the outreach efforts for the outreach coordinator position. Time would also be needed by Drs. Daniel Kaiser and Paulo Pagliari to help finalize some of the extension publications to be completed by the end of this project.

For this project we would utilize existing material on phosphorus management to summarize current and past research on phosphorus management and develop materials used for education. Focus 1 will be on summarizing work for the AFREC long-term P project originally submitted by Albert Sims. The project is currently complete and Karina Fabrizio has been working part time on completing journal publications related to this research. We currently are working on three publications focused on 1) Phase 1: buildup; 2) Phase 2: P strategy comparison; and 3) Summary of soil test changes over time. The ALP summary will be conducted through a team of researchers and with outside

consulting. The core team from the U of M will include the principle researchers involved with the project (Drs. Kaiser, Sims, Stroock, and Rosen and Jeff Vetsch), Karina Fabrizzi who has been working with the project data and has started a framework for the peer reviewed publication, Dr. Paulo Pagliari, and outside consulting by Dean Fairchild and Paul Fixen (formerly with IPNI). The team will be responsible for working with Karina getting the publications ready to be submitted to a peer reviewed journal as well as getting the data together to be released through outreach material through U of M Extension channels.

We will also be jointly authoring a new extension publication and revising three current publications related to phosphorus management. Data from the long-term study will be used in this publication and these publications will be one of the primary outreach components geared towards farmers and state agencies in Minnesota. We realize the peer reviewed journal publications are not a good outreach tool for a general agricultural audience but they are the first step needed to get a summary of the data put together. Funding is requested for subcontractors to help with the final reviewing and editing of any journal publications being submitted.

The second major component is developing an extension program related to basic fundamentals of phosphorus management. Part of this series is developed and has been presented at the Southern Research and Outreach Center Winter Crops Days in January of 2017 and at the Nutrient Management Conference in February 2018. The program we would develop would be peer reviewed similar to the current Nitrogen Smart Program. We are looking to develop a higher quality set of presentations that can be presented by multiple individuals. The advantage of jointly developing the material is that we can keep the message identical no matter who is presenting the material. The program would be comprised of 1) basics of P behavior in soils; 2) P fertilizer fundamentals and philosophies; and 3) P and the environment. The material would be developed around current projects with the AFREC long-term P project the center piece of area 2. This program would increase exposure of the project to farmers, consultants, retailers, and state agencies to AFREC and some of the long-term projects which have been funded.

The third part of this work would be conducted by Daniel Kaiser and Karina Fabrizzi and would involve the development of a P response database which can be updated annually to continually add in pertinent data as it is being collected. Dr Kaiser currently has a database started which includes information from several AFREC grants. It would be beneficial to add in more study information from more locations to broaden the scope of the database. The database itself is focused on yield of plots without P compared to areas with P and contains relative yield without P, soil test P (Olsen and Bray), and if the site was responsive. This data can be used to relate relative yield produced by the control versus respective soil tests, can be used to calculate probability of response (% time P measurably increased yield), and magnitude of response based on soil test classification. A separate database is also being maintained which tracks the concentration of P in corn and soybean grain. The probability and magnitude of response data as well as the grain P removal data will be used to update current guidelines.

Summary of 2018 Activities

Objective 1 - Complete final summary of the AFREC long-term phosphorus study for peer reviewed publication and integrate the long-term project data into extension programming

Karina Fabrizzi is currently working on two publications which will be submitted in 2019 to Soil Science Society of America Journal. Working on this paper has been the starting point in summarizing the AFREC long-term P project. When we are done with the drafts, data will be translated back into non SI units and will be utilized for the extension publication in Objective 3. Currently, the work from phase 1 of the study has been summarized and the first draft of the publication has been sent to Albert Sims and Daniel Kaiser to initial review. The phase 2 publication is being drafted and will be sent out to Daniel Kaiser for initial review. Once the initial reviews are completed a second draft of each publication will be sent out to a larger group for review. Daniel Kaiser met with Paul Fixen and Dean Fairchild in August 2018 to discuss plans for the publications. We have not involved Paul at this point with reviewing the early work as the intention was to complete a better polished version of the journal papers first. Karina is working full time until the summer and is planning on finishing the first draft for phase 2 before summer 2019.

Objective 2 - Complete the revision of three current phosphorus related extension publications

This part of the project has been put on hold due to the revisions in the extension website which started in Spring 2018. The revisions are completed and Daniel Kaiser has been in discussion with Paulo Pagliari and Lindsay Pease about revisions to the current publications. Lindsay is working on P environmental issues and was brought on to this project due to her background. The current plan is to start work on Understanding P fertilizers during Summer 2019. We may further delay the two P environmental works until later to allow for Lindsay to complete work on new projects which may be used in the revision of the publications

Objective 3 - Complete work on new extension publication “Managing phosphorus profitably” (tentative title)

The current plan for objective 3 is to start working on the publication following the completion of the first draft for the phase 2 publication in objective 1. Daniel Kaiser has met with Karina Fabrizzi to discuss a general plan for the new extension publications. While the primary focus of this funded AFREC project is on phosphorus we are considering focusing the new publication on P and K as a project led by Jeff Vetsch was completed recently on K which has some similar objectives to the AFREC P project. The new publication is slated to focus on how our guidelines are developed and pros and cons of different management scenarios. The data from the AFREC funded projects will then be centerpieces in some of the discussion of the pros and cons of the different management philosophies. The delays in this publication have allowed us to collect additional data which will be useful in the discussion in the final product. We have been utilizing data collected in the AFREC projects for news releases since this study was established in 2018.

Objective 4 - Develop a series of modules on phosphorus management used for oral extension programming using power point

The presentations for objective 4 currently exist but the current presentations will need to be revamped to follow some of the information we are trying to summarize for Objective 3. The plan for this work would be to begin following completion of the draft extension publication in objective 3. It is likely that Lindsay Pease will be brought on to help develop the P environmental piece for this part of the study.

Objective 5 - Further develop a database containing phosphorus response in corn and soybean production systems to:

The P response database has been updated through the 2017 growing season. I just finished summary on most of the P data from 2018 but have not had time to compile it in the database. The 2018 data will be compiled by the end of May as the data will be used for a report to the Minnesota Soybean Research and Promotion Council.