# Mississippi Corn Promotion Board
# 2018 Progress Report

**Project Title:** Spatio-Temporal Variability of Soil Health Parameters in Mississippi Corn Production Settings

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## Project Summary (Issue/Response)

Issue:

Land managers in Mississippi must account for the deterioration of soil health as they develop best management plans for either the application of fertilizer to crops or implementation of other soil related management (i.e. tillage). This problem is of growing importance as current commodity prices demand that producers maximize the efficiency of their production systems in order to return a net profit. Soil health has received attention lately as a requirement of more sustainable corn production systems. Unfortunately, there are a number of viewpoints available when defining which soil measurements should be used when defining soil health. An important aspect when making this definition is the link between the soil measurement and crop yield. This proposal attempts to establish the relationship between corn growth and yield and those soil measurements available to producers that are commonly considered to be soil health parameters. We also propose to determine the optimum time to measure these soil properties such that they relate well to corn yield as well as reflect soil health. Thirdly, we propose to determine the effect of cover crop management systems on soil physical and chemical properties and corn growth and yield

Response:

Three fields split into cover- and non-cover crop production systems were sampled in the Spring 2018 from two depths (0-3 and 3-6 in) on a 1 Ac grid. Samples were analyzed for macro- and micronutrients, pH, electrical conductivity, soil texture (sand, silt, and clay content) and total C and N. These measurements are commonly available from most soil testing laboratories and are considered to be soil health parameters. Samples were also analyzed for active C and microbial diversity which are considered to be indicators of soil health/biological activity. Soil samples were also collected (0-6 in) just before tasseling and analyzed for macro- and micro nutrients, pH, and electrical conductivity. In conjunction with the midseason soil sampling, plant height, dry matter yield, and nutrient uptake was collected. Corn yield at the end of the season was collected with commercially available yield monitors. Plant characteristics were correlated to soil physical/chemical measurements to determine if relationships existed. Soil measurements are currently being correlated to microbial diversity and active C to determine if the chemical/physical properties relate to the biological properties. Temporal changes in the soil physical/chemical measurements are also being determined.

## Project Results/Outcomes

This first year of sampling resulted in over 700 soil samples and over 30 different soil measurements often at two depths, creating a database of values not often found in collections from a single study. Some measurements (i.e. soil texture, total C and N) are continuing as they are time consuming and labor intensive. Preliminary results are field specific but do show some trends that need further investigation.

Yield relationships to soil chemical and physical factors

While these results are based on only one year of data, the influence of micronutrient fertility from the spring sampling, particularly boron, appeared in each field. In all three fields in this study, higher boron levels were associated with higher yield.

# Project Results

Copper, manganese and iron also were related to higher yield values; however, the influence of these micronutrients were field specific but were positively correlated with corn productivity. The appearance of the micronutrient influence is a trend that needs investigating. Traditionally, micronutrients are not included in standard soil tests but are generally available for a separate fee. These results tended to be consistent within fields across cover management systems. If these nutrients continue to be correlated to yield, then management plans should be adjusted accordingly. It is interesting that these micronutrient/yield relationships weren't apparent from the micronutrient levels collected in the midseason samples.

Effect of soil physical and chemical properties on active carbon

Active carbon is a commonly used measure of soil health, therefore, it would be beneficial to know how it is affected by the measured soil properties. Active carbon levels were higher in those portions of the field under cover crop management systems in all three fields in the study. This suggests that soil health has improved fairly quickly in each field. There did not appear to be a relation between active carbon and corn yield. This effect may take longer to develop. Active C/soil property correlations were field and management specific with some fields having no correlation between the two. Where correlation did exist, pH, potassium, phosphorus, and boron tended to be important.

Spatial variability

Preliminary geostatistical analysis indicates spatial variability is present in all three fields in all of the variables measured. There did appear to be more variability in micronutrient measurements and less variability in macronutrients and pH. In general, macronutrient measurements (Ca, Mg, K, P) and pH exhibit the least amount of spatial dependency as these nutrients have a history of broadcast application at rates that tend to remove natural trends. In addition, each of the fields has been leveled to enhance irrigation management further removing natural tendencies. Micronutrients; however, do show spatial dependencies with samples located closely together being more correlated than those further apart. This spatial dependence will need to factor into management plans should the micronutrient influence prove to be consistent over growing seasons.

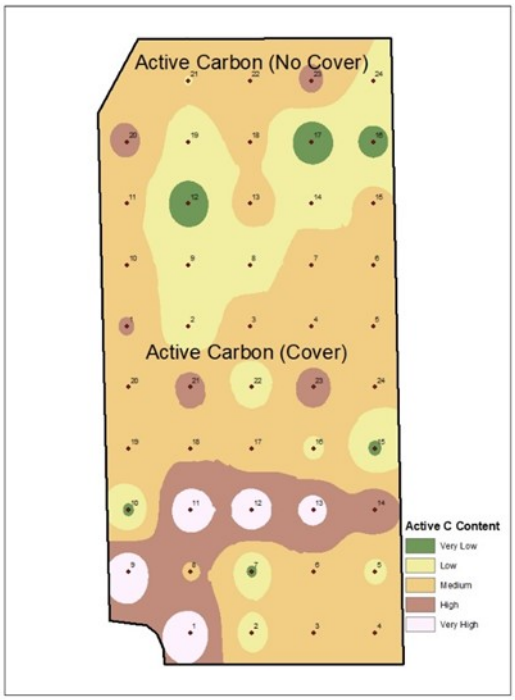


Fig.1 Example of active carbon levels and spatial variability in cover and non-cover crop management systems.

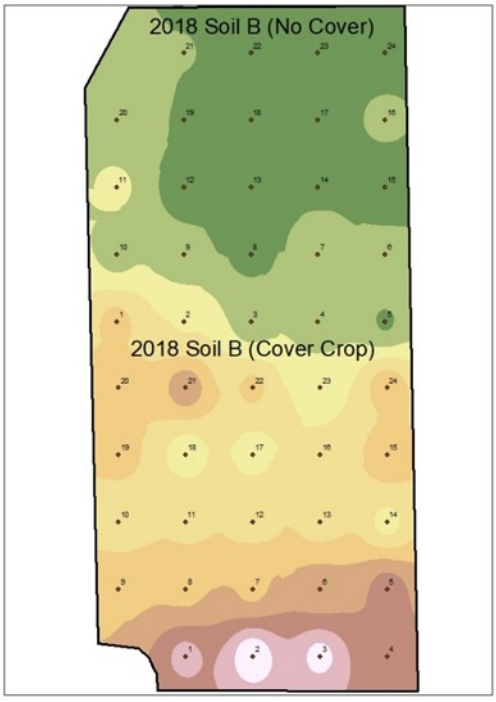


Fig.2 Example of boron levels and spatial variability in cover and non-cover crop management systems.

# Project Impacts/Benefits

The first year of this project established a database of spatial and temporal soil physical and chemical data, soil heath data, and plant nutrient uptake, dry weight, height, and yield data rarely found in a single study. This data has provided insight on the first year of the study investigating the use of this soil data in the definition of soil health parameters in best management plans for corn production. This database will continue to provide information on how soil chemical and physical factors can be affect soil health factors such as microbial diversity and active C while also managing crop yield.

The preliminary analysis of the data has already shown the importance of micronutrients on increasing crop yield and the spatial dependency that will be need to be understood before developing management plans. The importance of soil micronutrient fertility, while known, has largely been ignored due to cost relative to impact on yield. This view may need to change as producers are working to increase yields obtainable.

# Project Deliverables

The findings from the first year of this project have been used in an advanced soil fertility class to demonstrate the relative effect of soil chemical and physical properties on crop yield and the effects of spatial variability on management plan development. There are also plans to use this data in a Geospatial Agronomic Management class in similar ways.

This data will be presented in extension publications, presentation, and referred manuscripts after a second year of data is collected