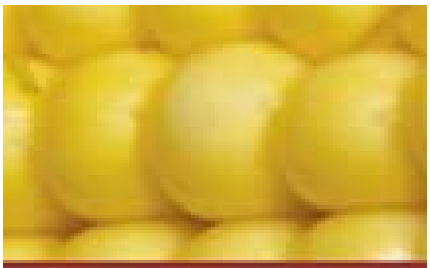
Mississippi Corn Promotion Board
2012 Progress Report



Project Title: Validation of Soil Management Zone Determination for Efficient Corn Production

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Project Summary (Issue/Response)

This study proposes to validate the use of apparent soil conductivity (EC_a) to delineate soil management zones that lead to directed soil sampling. Soil EC_a is a quick and reliable measurement that is influenced by a number of yield- affecting soil properties. The EC_a measurement depends on clay content and type, organic matter content, cation exchange capacity, soil moisture and water content. While soil EC_a does not measure any one soil property, it does delineate soil differences within a field and has been found to relate to crop yield in some cases. Soil sampling methodology used in precision agriculture generally involves collecting a large number of samples from a grid in the field. This is costly and time consuming. The use of surrogate datasets that have been shown to be related to yield to direct sampling efforts can reduce the number of samples collected while maintaining the integrity of the soil data and thus, reduce the cost. Soil management zones were delineated using EC_a on two corn fields located in Bolivar County, MS. Previous research on these fields has indicated that corn yield is related to the EC_a dataset. Management zones were constructed by clustering similar EC_a data into distinct areas within each field. Soil samples taken from these management zones were compared for spatial variation in their properties and relation to corn yield from those same zones. In addition, Variable rate P and K fertilization patterns were developed for, and applied to the fields. Yield data was collected by commercially available monitors at time of harvest. Variability of soil data were compared within and across zones to determine if significant differences exist. In addition, soil data within each zone will be compared with corn yield to determine the applicability of the delineation technique to improving the efficiency of corn production

Project Results/Outcomes

Soil EC_a data were used to delineate directed soil sampling maps for two fields located in Boliver Co, MS. Soil data were clustered into distinct areas of the field based on Jenks optimization method. This clustering method determines the best arrangement of values into different classes be reducing the variance within classes and maximizing the variance between classes. This clustering resulted in three distinct zones in each field (Fig.1). These zones were then used to direct soil sampling efforts. A minimum of three soil samples and a maximum of seven samples were collected for each zone in each field. This directed sampling reduced the number of samples from 26 (based on a 2.5 Ac grid) to 15 in Field 1 and from 20 to 11 in Field 2. Based on current charges by the MSUES Soil Testing Laboratory, this reduction in sample numbers would save $66 in Field 1 and $45 in Field 2 for routine soil analysis Soil samples were analyzed for MS soil test extractable K, P, Ca, and Mg, lime requirement,

Project Results

pH, and total C and N. Variable rate application maps for P and K were developed from the samples collected in the EC_a determined zones. No lime was required in either field. Phosphorus and K were applied at rates recommended by the MSUES extension service by a commercial applicator. In the first field, EC_a was only related to soil texture and elevation. Yield closely matched directed sampling zones determined by soil EC_a (Fig 2.). In this field, higher yielding areas correlated to zones with lower EC_a measurements. These areas also had lower clay contents. Previous research in this field indicated plant available water was the most important soil factor influencing yield. We feel the lower clay contents in these areas resulted in more plant available water. These results seem to verify those findings in that the zones identified by the EC_a are again related to water characteristics of the field. In the second field, EC_a was related to Ca, K, Mg, P, and total N. In this field, these soils factors clustered similarly to the zones determined by the EC_a measurements. Yield in this field, however, did not appear to be related to the EC_a measurements. There are several potential reasons for this lack of agreement when compared to the first field. There is much less variability in both texture (clay content) and elevation leading to less variability in plant water availability and consequently, yield. Variability in the EC_a measurements however was quite high indicating some other soil property or properties were dominating the measurement. The effect of the VRA applications of P and K are still being analyzed in both fields.

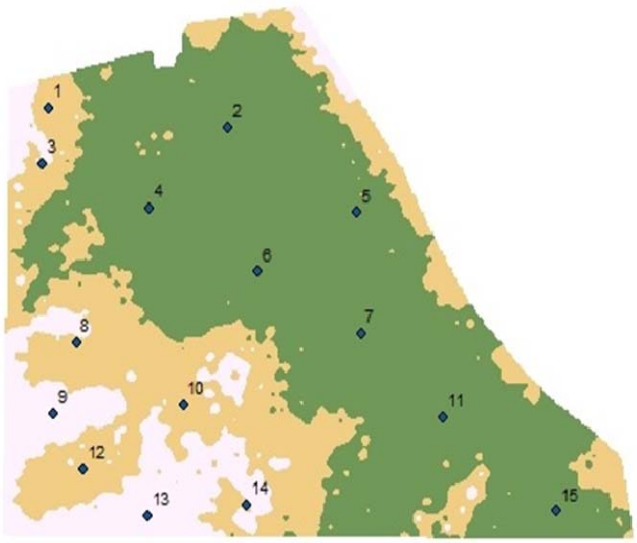

Figure 1. Soil ECa Zones and Soil Sampling Points

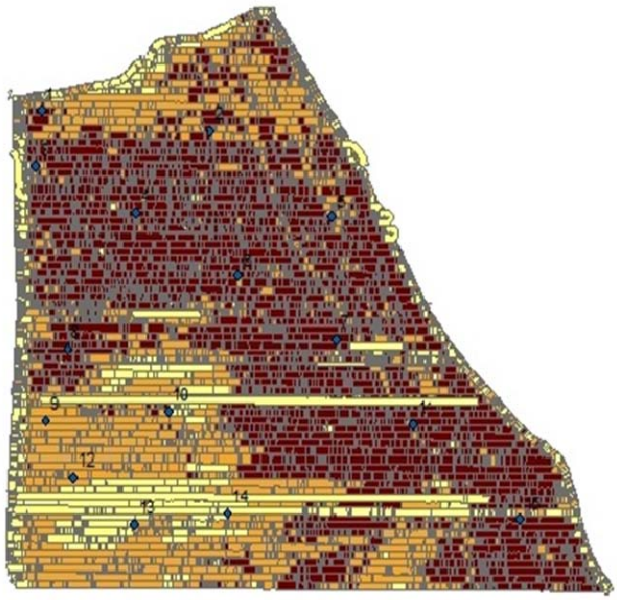

Figure 2. 2012 Corn Yield

Project Impacts/Benefits

This research has shown that soil apparent electrical conductivity can be an aid in management zone delineation where variability in soil texture and elevation occur. This measurement seems to indicate that this method of delineation works well when yield is limited by plant water availability. This research has also shown than in fields where there is low variability, soil electrical conductivity may have limited use in management zone delineation. However, these low variability fields may not require site-specific crop/soil management. In areas of higher variability, this method of delineation can provide a quick and reliable way to determine soil management zones that relate well to corn yield at lower cost than soil management zones determined from samples collected from an arbitrarily determined grid. Our research has shown that nutrient management alone may not lead to increased yields and that often plant available water content has been of more importance to yield. This study has also shown that directed soil sampling using management zones determined by apparent electrical conductivity can lead to a reduced number of samples while still describing the fertility status and changes within a field. This reduction in soil numbers translates to reduced cost for sample analysis.

Project Deliverables

Cox, M.S. and P.D. Gerard. 2012. Crop and Soil Management Zone Delineation Based on Soil Property or Yield Classification. Agric. Sust. Rev. In Press

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