USDA

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The World's Oldest Cotton Experiment: Relating Soil Quality Properties to Electrical Conductivity Mapping

Why Does it matter?

Developing rapid and easy methods to identify variations in soil properties across a field would benefit producers by enabling them to better manage their fields on a site-specific basis, better matching economic inputs to production capabilities. The 'Old Rotation' is the world's oldest cotton experiment (ca. 1896). The long-term management decisions used on the 'Old Rotation' make it an ideal resource for testing new methods for mapping soil spatial variability.

What was done?

We pulled a *Veris® 3100 Direct Contact Sensor* across the 'Old Rotation' and generated a geo-referenced (GPS linked) map of soil electrical conductivity for the site. We also intensively sampled the site on a grid with geo-referenced points for soil chemical and physical properties known to be good indicators of soil quality. These properties included measurement of soil organic carbon (SOC), soil pH, plant nutrients, and soil texture.

What was found?

Historically, more intensive rotations which used small grains, corn, and a winter cover crops of crimson clover resulted in the highest cotton yields on the 'Old Rotation'. These rotations had higher soil carbon but lower soil phosphorus and magnesium levels than other cropping systems. Soil electrical conductivity was more highly correlated with clay and phosphorus than other soil properties. Unfortunately, with the exception of phosphorus, the relatively poor and variable relationships between soil chemical properties and electrical conductivity suggest that mapping plant nutrients and SOC using electrical conductivity is not as easy as hoped, due to the influence of clay and water content.

What is the impact?

Historical cropping systems used in the 'Old Rotation' demonstrated the benefit of using intensive crop rotations with wheat, corn and winter legume cover crops to increase soil carbon (organic matter) and improve soil quality and productivity. This information can be used by soil scientists and agencies like USDA-NRCS to more reliably interpret the usefulness of electrical conductivity mapping as a rapid means to determine the natural variability in soils. The information was also used to validate the benefits of cover crops and intensive rotations in the long-term and calibrate the USDA-NRCS Soil Conditioning Index, used in the Conservation Security Program.

Research Team and Contact information

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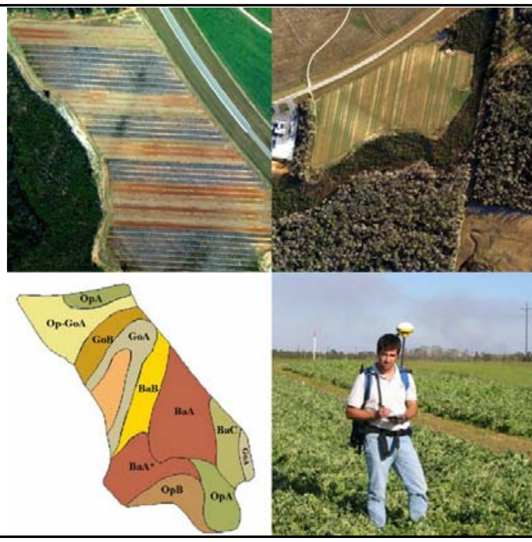
Impacts of Landscape Attributes on C Sequestration During the Transition from Conventional to Conservation Management Practices on a Coastal Plain Field.

Why Does it matter?

Many of the soils in the Southeast are depleted of organic matter (soil carbon) due to long term conventional tillage management practices. Conservation tillage systems may improve soil quality by leaving more organic matter from residues in the soil. Field-scale information on the rate of change in soil carbon when transitioning to conservation systems is necessary to properly evaluate the impact of these practices on carbon sequestration to mitigate global change, and to determine the economic benefits of these systems on agricultural productivity.

What was done?



We evaluated a conventional system and a conservation system in a corn-cotton rotation; with or without dairy bedding manure on a 20 acre field. In the conventional systems, tillage consisted of chisel plowing/disking + in-row subsoiling; no cover crop was used in winter. Conservation systems consisted of only non-inversion in-row subsoiling plus winter cover crops to provide 4 to 6 tons/acre of residue for complete soil coverage. Management practices were arranged so as to cross the maximum landscape variability in the field.

What was found?

We found that 50% of the variation in soil carbon in the field could be explained by topography (field elevation changes), field slope, silt content, and field-mapped electrical conductivity. After one crop rotation cycle (30 months), we found that conservation and conventional tillage systems with dairy manure fertilizer increased soil carbon by approximately 50% compared to conventional tillage systems without dairy manure. However, conservation systems with dairy manure increased soil organic carbon by 157%.

What is the impact?

We demonstrated that easily measured field topography features and electrical conductivity can be used to better estimate soil carbon distribution in agricultural fields. We determined the potential to sequester C using high-residue producing conservation systems and manure is scale dependent, and is higher than previously expected for degraded soils in the southeastern USA. The information can be used by researchers, action agencies like USDA-NRCS, and policy-makers to better evaluate the effect of soil management practices on carbon storage and to better estimate carbon storage in agricultural systems for potential monitoring of carbon storage in carbon trading programs.

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Research to Protect Natural Resources and Sustain Agriculture in the Southeastern USA