FACT SHEET FOR PARTNERSHIP FIELD VALIDATION TEST

Midwest Regional Carbon Sequestration Partnership (MRCSP)

NETL Cooperative Agreement DE-FC26-05NT42589

DOE/NETL Project Manager: Lynn Brickett,
Lynn.Brickett@NETL.DOE.GOV

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Terrestrial Sequestration Field Test: Croplands

Test Locations:

First location in 2006:
Thirteen cropland plots over several of the seven states in the MRCSP region, primarily Ohio, Indiana, and Michigan

Second Location in 2007:
Eleven paired cropland fields across Ohio, Kentucky, and Pennsylvania.

Third Location in 2008:
Five paired cropland fields across Michigan, Ohio, and Pennsylvania.

Amount and Source of CO_2: Not applicable due to this being a terrestrial field test to determine and validate rates of sequestration using different agricultural methods.

Field Test Partners: The Ohio State University
Ohio Corn Marketing Program
Ohio Soybean Council

Summary of Field Test Site and Operations:

Thirteen sites in 2006 from twelve Major Land Resource Areas (MLRA's), 11 sites in 2007 from 11 MLRA's, and 5 sites in 2008 from 5 MLRA's of the MRCSP region have been selected to collect soil samples from three predominant land uses, namely till, no till and woodlot. Soil samples were collected from five different depths 0-5 cm, 5-10 cm, 10-30 cm, 30-50 cm, and >50 cm in four replications 100 m apart. These samples were

analyzed for total carbon (C), nitrogen concentrations (N) and soil physical quality (e.g., structural stability, plant available water, texture, shrinkage, soil compaction, soil hydraulic properties, soil aggregate properties). Three sites based on different parent material: Glacial Till (Coshocton), Till plain (Delaware), and Glacial Lake Plain (Henry county) located in Ohio, were selected to assess the historic carbon loss by cultivation. An additional 144 soil samples and 24 plant residue samples were also collected for measuring additional soil physical properties. Geospatial analysis and pedometrics are being conducted with the aim to predict soil carbon stock in relation to readily available data, such as land use (woodlot, no till, and conventional till), digital elevation model, soil reflectance, and weather data (temperature and precipitation) for the whole MRCSP region.

Research Objectives:

- Demonstrate terrestrial carbon sink capacity for predominant land use systems.
- Develop a credible measuring and monitoring protocol to evaluate carbon (C) sink capacity in biota and soil.
- Assess the cost of C sequestration with regards to management and input, and compare economic efficiency of different systems.
- Determine how C sequestration from MRCSP activities could be incorporated into existing schemes of trading C credits.
- Assess mechanisms of C sequestration with regards to land use.
- Assess the soil-profile C distribution to determine C storage within the topsoil and subsoil.
- Evaluate historic C loss and assess the old vs. new C in soil.
- Establish relationships between soil C and soil physical quality.

Summary of Modeling and MMV Efforts:

Measurement Technique	Measurement Parameters	Application	Reference
Dry combustion method (900°C) - CN analyzer (Vario Max, Elementar Americas)	Total Organic Carbon (%) and Total Nitrogen (%)	Measure soil organic carbon and nitrogen content in all samples.	Nelson and Sommers (1996)
Dry combustion and isotopic separation	Total carbon (%) and $\delta^{13}C$	Measure soil carbon and $\delta^{13}C$ as well as plan residue carbon and $\delta^{13}C$	Boutton (1991) and O'Leary (1993)
Core method	Bulk density	Determine the density of the bulk soil	Grossman and Reinsch (2002)
Static hand cone penetrometer (Eijkelkamp, Giesbeek, The Netherlands)	Cone index	Determine the resistance of the soil to cone penetration as a means to evaluate soil compaction	Lowery and Morrison (2002)
Crushing method	Tensile strength of aggregates	Determine the tensile strength of individual soil (5-8 mm, 2-5 mm, and <2	Dexter and Watts (2001)

		mm diameter) aggregates	
Clod method	Aggregate density	Determine the density of discrete (5-8 and 2-5 mm diameter) aggregates	Grossman and Reinsch (2002)
Tension table and pressure plate apparatus	Moisture retention of aggregates	Determine the capacity of aggregates (5-8 mm, 2-5 mm, and <2 mm diameter) to retain water	Dane and Hopmans (2002)
Wet-sieving method	Aggregate stability	Quantify the percentage and mean weight diameter of water-stable aggregates	Nimmo and Perkins (2002)
Hydrometer method	Soil texture	Determine the particle size distribution	Gee and Or (2002)

Accomplishments to Date:

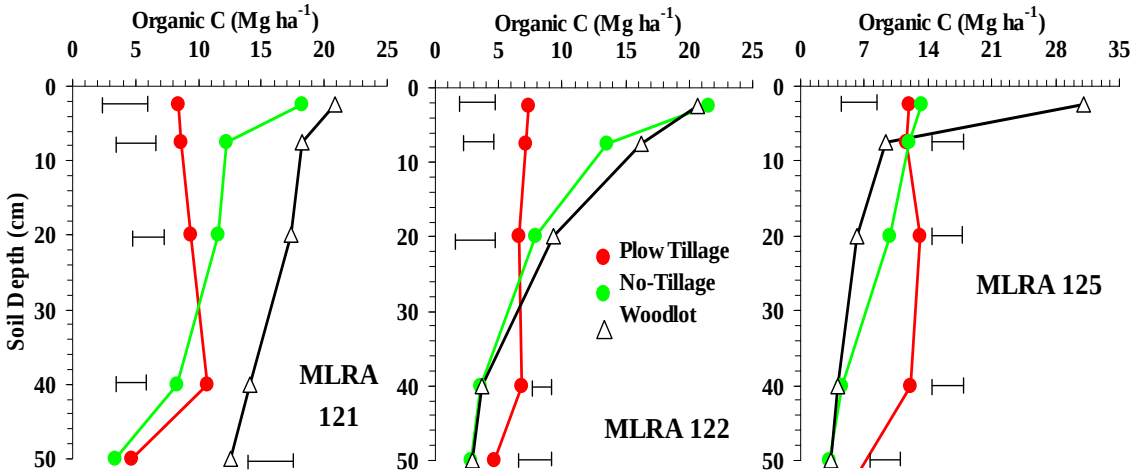

Figure 1. shows examples of measurements of soil organic carbon taken from three of the 13 MLRAs being tested in the croplands study. This figure shows that no-till generally stores more carbon in the top soil than conventional till. The magnitude of the beneficial impacts of no-till on carbon storage depends on soil type and management.

Geospatial Analysis

- A total of 2150 georeferenced carbon data points from MRCSP region are being used in the analysis.
- Digital Elevation Model (DEM) of 30 m pixel resolution for the study area has been prepared using the seamless data of USGS to gather the different data layers. Thirty years average annual temperature and precipitation data have been collected for the seven states.
- Likewise, a land use map for the entire MRCSP region has also been collected from the USGS data base.

Target Sink Storage Opportunities and Benefits to the Region:

- There is an estimated 10.7 million hectares of prime non-eroded cropland in the MRCSP region. It is estimated that 22.5% or that land area is already practicing no till and will likely remain in that mode. The remaining 77.5% or 8.3 million hectares is potentially amenable to adopting no till or reduced tillage practices, which, if adopted on these lands, would result in an estimated 55 to 74 million additional tons of carbon sequestered over a 20 year period for the MRCSP region. This is equivalent to 200 to 270 million metric tons of CO_2.

- Conversion of cropland to no till and reduced tillage practices also yields benefits of placing land use in more sustainable agricultural practice.

- When carbon markets become more fully developed, the stored carbon may be sold as a carbon dioxide offset, which will earn additional income for landowners. This Phase II research will lay valuable groundwork for helping to quantify the amount of carbon stored in soils typical of the MRCSP region.

Peer Reviewed Publications:

- Blanco-Canqui, H. and R. Lal 2008. No-tillage and soil-profile carbon sequestration: an on-farm assessment. Soil Sci. Soc. Am. J. 72:693-701.

- Chatterjee, A., R. Lal, and H. Blanco-Canqui 2008. On farm assesment of tillage impact on soil carbon sequestration and associated soil quality parameters. Soil Tillage Res. (Submitted).

- Christopher, S.F., R. Lal, and U. Mishra. 2008. Regional study of no till effects on carbon sequestration in the Midwestern U.S. Soil Sci. Am. J. (In Press).

- Mishra, U., R. Lal, B. Slater, F. Calhoun, D. Liu, and M. Van Meirvenne. 2008. Predicting soil organic carbon stock within different depth intervals using profile depth distribution functions and ordinary kriging. Soil Sci. Soc. Am. J. (In Press).

Cost*:

Total Project Cost: $23,745,399

DOE Share: $17,458,272 (73.52%)

Non-Doe Share: $6,287,127 (26.48%)

(*) Costs are for overall MRCSP Phase II project