



Northern NY Agricultural Development Program 2004 Project Report

Soil Health and Conservation Agriculture in Northern New York

Project Leaders:

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Collaborator(s):

Michael Davis: Manager of Cornell research farms at Willsboro and Miner Institute.

CCE collaborators: Peter Barney (St. Lawrence County), Michael Hunter (Jefferson County), Jennifer Beckman (Lewis County), Anita Deming (Essex County), Carl Tillinghast (Franklin County) and Mathew Cooper (Franklin County)

Grower collaborators: Sam Hendren, Eric Leerkes and Chris Spaulding (Essex County); Dennis Egan, Ralph Child and Doug Malette (Franklin County); David Fisher, Dan Chambers and William White (St. Lawrence County) Don Nohle (Jefferson), Marc Larabee and Bernhard Gohlert (Lewis County).

Background:

Many growers in NYS and the NE region have become aware of losses in crop productivity and farm profitability associated with a gradual deterioration of soil quality and health that cannot be remedied by simple “quick fixes.” Processes that cause such losses include soil compaction, erosion, loss of organic matter from intensive tillage, and lack of soil building practices such as cover cropping and organic matter additions. Because of this, there is increased demand by growers for assistance in determining the

quality status of local soils and developing guidelines for more sustainable and practical soil management alternatives. This occurs at a time of major breakthroughs in our understanding of soil ecology that can be used to integrate new approaches to soil management. This is an optimum time to work with the grower community, as their awareness of the link between soil quality problems and loss of farm productivity is increasing. We are therefore developing a research and outreach effort to bring this issue to the forefront in NNY and link the physics, chemistry and biology of soils. During the course of this project we will conduct a quantified assessment of soil health status on research and commercial farms in Northern New York. In addition, we will provide educational programs on soil health management and conservation agriculture for farmers in the region.

Methods:

Research activities:

The objective is to assess soil health on two research farms (Willsboro, Miner) and ten commercial farms in NNY using new methodology on the testing of soil quality. We will test a newly-developed set of procedures for field and laboratory measurements of soil health that provides standardized and inexpensive analyses of soil properties that are critical to soil health assessment and the needed remedial practices. First, they will be tested on Cornell University's long-term tillage plots at the W.H. Miner Institute and the Willsboro Farm. At the former farm, Professor Robert Lucey established long-term tillage trials over thirty years ago. Treatments include a factorial design of maize under no-till and plow-till, and under silage and grain harvest management. This experiment provides a unique opportunity to evaluate the long-term soil health effects of these practices. The Willsboro tillage trial was established in 1992 and involves zone-till, ridge-till and plow-till. This experiment also allows for the long-term benefits of conservation practices. Additionally, we will identify ten commercial farms from throughout NNY for soil health assessment.

We plan to perform soil physical, chemical and biological tests that are relatively inexpensive to obtain, yet provide scientifically meaningful results for long-term soil quality monitoring. Soil biological analyses include potential decomposition rate, soil-borne disease assays; number, functional types, and/or community structure of arthropods and nematodes; earthworms; particulate organic matter; and potentially mineralizable nitrogen; Soil chemical analyses include active and total organic matter, cation exchange capacity, macro- and micro-nutrients, pH, and others. Soil physical analyses include field-measured infiltration using the Cornell Sprinkle Infiltrometer and soil strength using penetrometers, as well as the following laboratory measurements: wet aggregate stability (using a newly-developed rainfall simulation method), bulk density; soil strength at standardized 0.3 bar soil water potential; saturated hydraulic conductivity; total water-holding capacity; macro-, micro-, and mesoporosity (each category has unique sensitivity to soil management and affects water availability in unique ways); and residual porosity. Biological, physical and chemical properties will be evaluated for integrated soil health assessment.

Education and Outreach Plan:

The objective of this component is to develop an educational program for the entire NNY region on soil health management. We will develop educational efforts using winter meetings and field days. Winter meetings will involve education on soil health management, including distribution of copies of the book *Building Soils for Better Crops*, co-authored by the PI. This will allow farmers to become better aware of processes affecting soil health, and management approaches towards conservation agriculture. We will also use a set of field demonstration tools in grower field days. This will include the Cornell Sprinkle Infiltrometer and inexpensive soil penetrometers. We will also further develop an educational tool that uses a rainfall simulator to demonstrate the processes of aggregate breakdown, slaking, and surface sealing. Multiple units of these three pieces of equipment will be distributed among extension field staff for use in educational activities, as described earlier. We will also develop field procedures for the use of Visual Soil Assessment (VSA) methods, similar to those developed by Shepherd in New Zealand.

Results: Research

The first year of this project has focused on collection of samples from the controlled research and growers' sites. A total of 330 samples were collected in 2004 from the controlled research sites at Chazy and Willsboro while 60 samples were collected from grower sites. These samples were collected for analysis of different soil properties. At this time, these samples are still in the laboratory undergoing analysis, which will be completed by spring. This coming spring and summer, we will share the results with the growers during field days.

Preliminary results from Chazy and Willsboro experimental sites are presented in Table 1. The wet aggregate stability was able to distinguish consistently between soil management of long term practices in Willsboro & Chazy. Treatments with no-till and/or good organic matter management consistently had higher wet aggregate stability than continuous plow-till treatments at both locations. Wet aggregate stability will therefore be one of the properties to consider for rapid assessment of soil health. Several other soil properties are currently being analyzed in the laboratory. The eventual goal is to identify and fine-tune few indicator properties that can be used in rapid assessment of soil health.

Results from growers' field across different NNY counties (Figures 1-3) show that the total porosity, water percolation rates and soil aggregate stability were higher in sod soils compared to soils that were chiseled and/or disked. Penetration resistance was also lower in sods compared to chiseled or deep-ripped soils (Figure 3). This indicates that these soil physical measurements can distinguish between various management practices. Another important observation from figures 1-3 is that the range of values obtained for different soil properties can vary with soil type. We are presently working on how to interpret these properties in different soils thus incorporating them into the framework of soil health assessment.

Results: Outreach

Four field days were held during the summer and fall of 2004 in Lewis county, Jefferson county, St Lawrence county and Franklin county respectively. These field days featured active discussions on soil health. There were also demonstrations of soil health sampling techniques and field measurements. Plans were developed for soil health demonstration sites in Jefferson and St. Lawrence Counties, including factorial replicated treatments involving tillage and cover cropping methods.

Some project leaders also visited grower' farms to provide advice on practical ways to improve soil quality on their respective farms. A total of 13 growers were visited in different northern New York counties.

Table 1: Soil quality under different soil/crop management practices at controlled research sites (Willsboro and Chazy, NY).

Willsboro, NY					
Drainage Plots (1996-)		Dry Aggregate Size Distribution (%)		Wet Aggregate Stability (%)	
		0.25- 2mm	2-8mm	0.25-2mm	2-8mm
Soil	Crop				
Muskellunge clay loam	Continuous corn (PT)	34	61	22	35
Muskellunge clay loam	Corn after Orchardgrass	23	74	70	55
Cosad sandy loam	Continuous corn (PT)	61	31	23	29
Cosad sandy loam	Corn after Orchardgrass	66	25	39	42
Tillage Plots (1992-)					
Kingsbury clay loam	Plow till (PT) corn-soy	23	74	33	26
Kingsbury clay loam	No-till (NT) corn-soy	21	77	62	60
Chazy, NY					
Tillage Experiment (1972-)		Dry Aggregate Size Distribution (%)		Wet Aggregate Stability (%)	
		0.25- 2mm	2-8mm	0.25- 2mm	2-8mm
Soil	Tillage system				
Raynham silt loam	Plow till (PT) corn grain	37	57	9	23
Raynham silt loam	Plow till (PT) corn silage	34	60	8	16
Raynham silt loam	No-till (NT) corn grain	30	65	29	54
Raynham silt loam	No-till (NT) corn silage	40	52	23	42

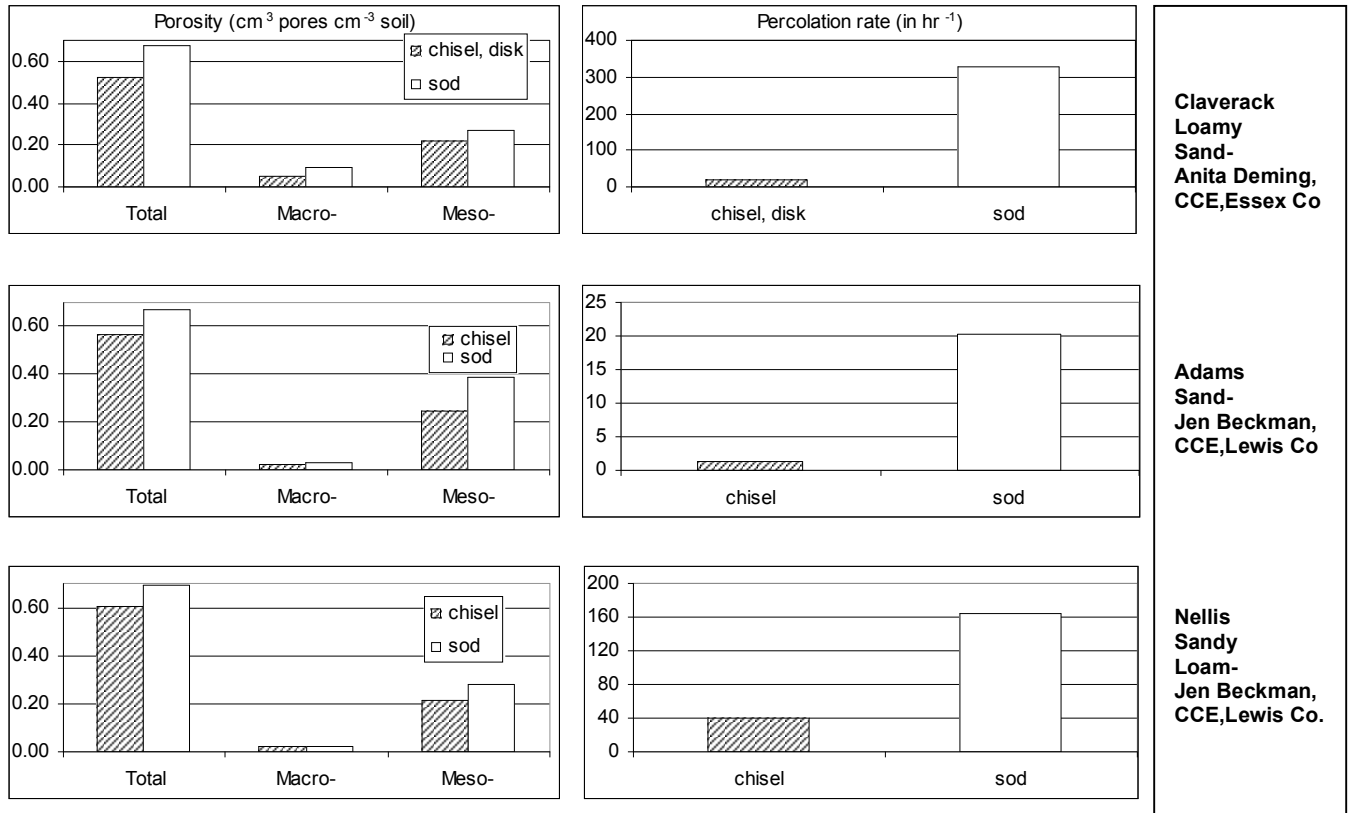


Figure 1. Porosity and percolation rates in some sandy soils of Northern New York State.

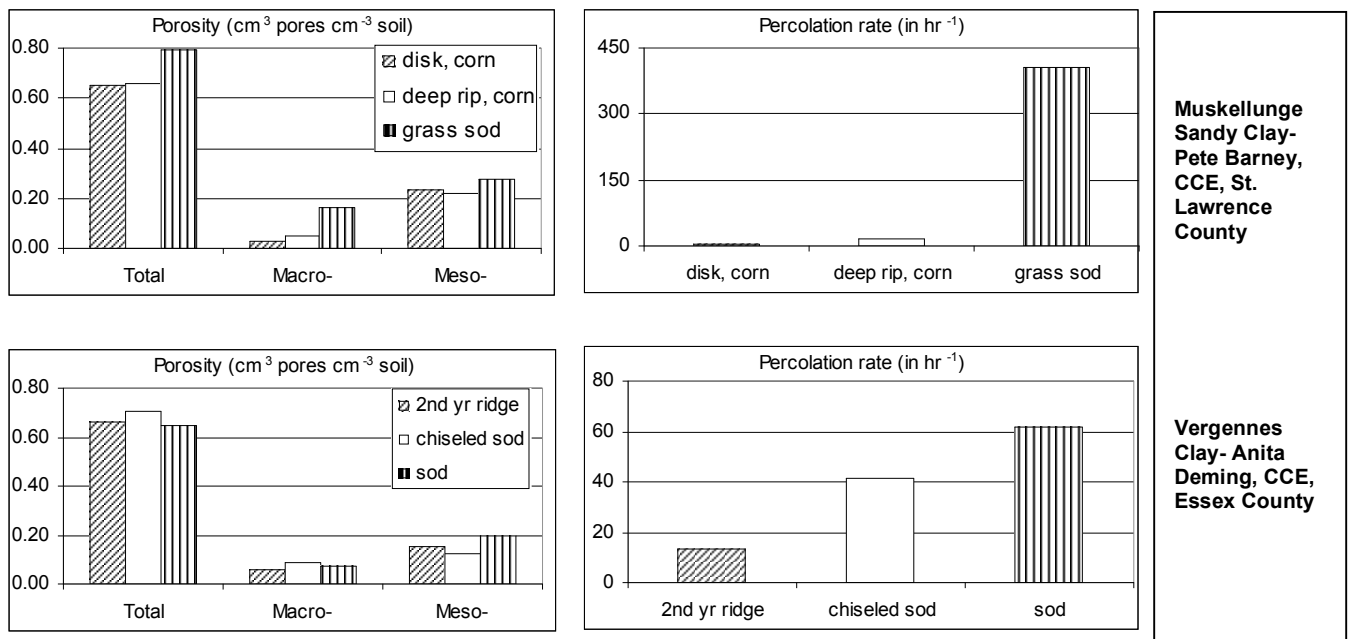


Figure 2. Porosity and percolation rates in some clayey soils of Northern New York State.

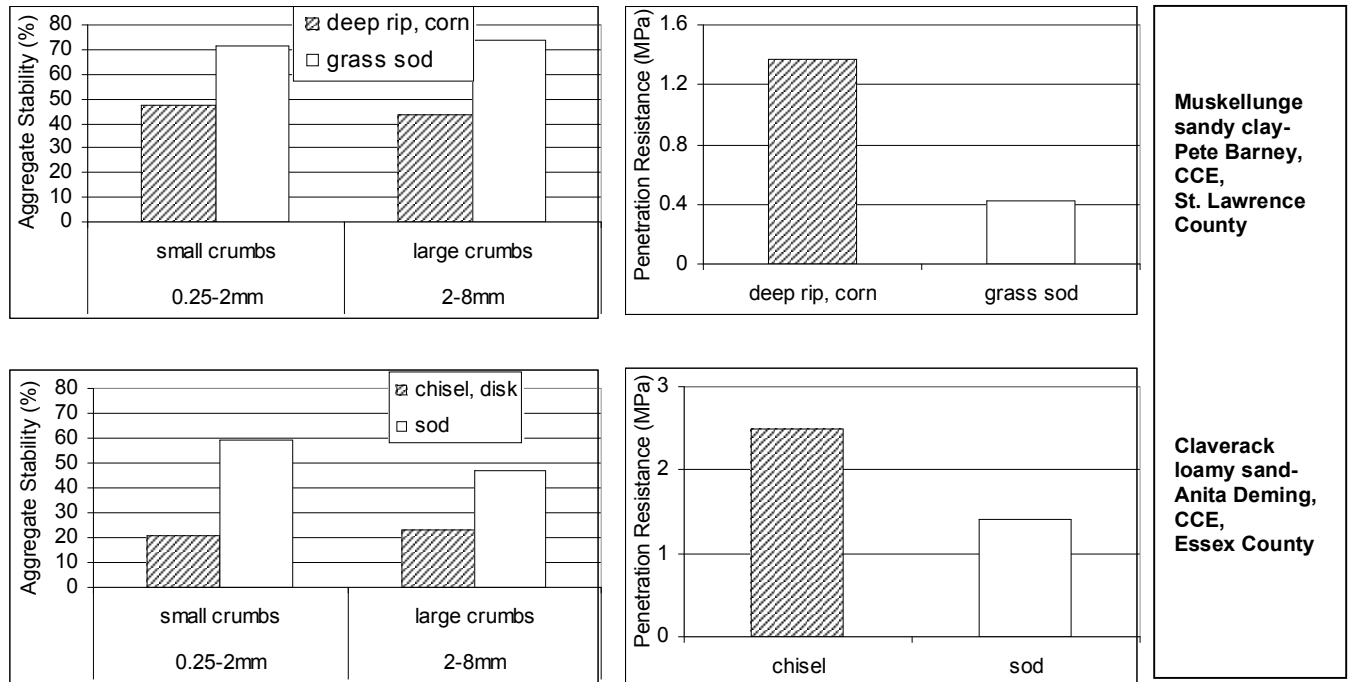


Figure 3. Soil aggregate stability and penetration resistance in some soils of Northern New York State.

Conclusions/Impacts:

The project is still working towards fine-tuning a soil health assessment protocol for northern New York. However, numerous field days and visits to growers have increased awareness on soil health issues. Growers are gradually getting aware of the need to improve soil management on their farms using strategies such as reducing tillage, making use of cover crops and using deep tillage to alleviate soil compaction problems.

Next steps:

The project will continue to focus on developing a quantitative soil assessment protocol which will be rapid and can be made available at an affordable fee. To be able to achieve this, analysis of samples collected during 2004 will be finished. The data collected will be statistically analyzed and interpretation will be done. More samples from growers’ sites will also be collected in 2005 to validate soil health assessment protocol. Soil health demonstration sites will be established in Jefferson and St Lawrence counties in collaboration with the extension staff in those regions. These sites will serve as focal points for grower field meetings. More outreach activities are being planned for 2005 and 2006 to further the awareness of growers on soil health. Results of soil health assessment measured from growers’ fields will be shared both on individual basis and in field meetings.

For More information:

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Northern New York Agricultural Development Program:

The Northern New York Agricultural Development Program provided funding for this soil health research project. The Northern New York Agricultural Development Program is a farmer-driven research and education program specific to New York state's six northernmost counties: Jefferson, Lewis, St. Lawrence, Franklin, Clinton and Essex.

Thirty-three farmers serve on the Program board led by Co-Chairs Jon Greenwood of Canton (315-386-3231) and Joe Giroux of Plattsburgh (518) 563-7523. For more information, contact Jon, Joe or R. David Smith at 607-255-7286 or visit www.nnyagdev.org # # #