

Northeast SARE 2007 Annual Report

Project Number: LNE06-235 (USDA 2006-38640-16700)

Project Title: SOIL HEALTH ASSESSMENT FOR SUSTAINABLE LAND USE AND PROFITABLE CROP PRODUCTION IN THE NORTHEASTERN USA

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Summary

Intensive crop production in the Northeast region has often resulted in soil degradation, contributing to reduced crop yield, increased production inputs and lower farm profitability, thus there is increased interest in soil health. Our Cornell Soil Health Team has made significant progress in increasing soil health literacy, developing a cost-effective protocol for soil health assessment, facilitating soil health demonstrations by growers, and promoting multi-disciplinary research and outreach. To build on this progress and momentum, our team of growers, extension educators and academic staff in New York, Maryland, and Vermont aim to continue to network as a team to provide soil health programs and research collaborations in the NE region.

We plan to reach 1500+ producers via surveys, participatory trainings, field days, annual meetings and web-based and written materials. The soil health status of 50+ fields in MD, VT, and NY will be assessed annually using the developed assessment protocol. The team will also investigate the mechanisms contributing to improved soil health status by implementing recommended management practices (rotation, cover crops, tillage systems, etc.) and evaluating visible-near infrared sensing as a potential rapid assessment tool of soil health. Another major objective is to develop a web-based, accessible database for NE soils and decision making software to assist in selecting what to test and interpreting the results.

Our final targets will be that 200+ growers will have assessed the soil health status of their fields and 100+ will have implemented a long-term soil health management program. Targets will be documented by mailed surveys, personal interviews and on-farm visits. The direct beneficiaries are vegetable, cash grain, and dairy producers, whereas indirect beneficiaries are rural communities and consumers.

Performance Targets

- Of the 1500 growers that will be reached in New York, Vermont and Maryland; 200 will have their soils assessed using the developed soil health protocol in New York and Maryland, and 100 growers will implement a long-term improved and sustainable soil management program (including reduced tillage system(s), improved crop rotation(s), new cover crops and/or compost and green manure applications).
- A web-accessible database of regional soil health data will be made available for researchers and extension educators to conduct query-based research and data analysis.
- Decision support software will be developed to aid in: (i) determining an optimal site-specific set of soil physical, chemical and biological parameters to test, (ii) interpreting the results obtained and, (iii) providing guidelines on needed interventions.

Milestones (Progress)

- **Identification of participating growers and sites to be sampled in Vermont, Maryland, New York, and possibly other states.**
We have identified new participating growers in NY, VT, PA and MD and sampled their fields to assess their soil health status. During 2007, a total of 289 fields (___#___ samples)

were sampled (NY-114 fields; VT- 68 fields; MD- 59 fields; PA- 48 fields) as a part of the NE-SARE project. Growers in these states are becoming more aware of the need to establish soil health baseline data for their fields and identify constraints, if any. Through our various educational outreach activities, we have emphasized a holistic approach to soil management for sustainability and environmental conservation. Additional indirect contact and awareness with growers is being made through other researchers' use of the Cornell Soil Health Test in their research projects and on-farm grower demonstration trials.

- **Finalization of the recommended soil health assessment protocol and uniform sampling procedures to be used in the Northeast region.**

In 2007, we started offering the Cornell Soil Health Test on a fee-for-service basis for anyone interested and we were able to subsidize New York growers through cost sharing grant provided by the New York Farm Viability Institute. The selection of soil health indicators and the protocol for field sampling were finalized and the interpretative framework was developed. The indicators that comprised the 2007 Cornell Soil Health Test were: aggregate stability, available water capacity, surface and subsurface hardness, organic matter, active carbon, potentially mineralizable nitrogen, root health assessment and the standard chemical nutrient analysis. The soil sampling protocol consisted of making five sampling stops per sampling unit/field and collecting paired samples at each location along with a penetrometer reading recorded at two depths. So one submitted soil sample (approx. 2 L) consisted of 10 bulk soil sub-samples and one completed grower and sample information sheet with penetrometer reading. The end product of our soil health assessment for a field is presented in the auto-generated Cornell Soil Health Test Report. The Cornell Soil Health Test Report shows the results and interpretations of the measured indicators, highlighting soil constraints that are limiting from both agronomic and environmental perspectives. The test reports were generated and sent to respective growers and the county educators. The growers' reports were often used as a focal point in our outreach activities conducted in 2007.

- **Processing of the collected soil samples in the region at Cornell and holding joint meetings to discuss the results ending with a consensus on the interpretation and recommended guidelines for appropriate interventions.**

Our team members have continued to meet regularly to refine our interpretations of soil health and to provide guidelines for addressing soil health constraints identified on various fields in the Northeast. Our accumulated soil health database established in 2003 has served as a crucial tool to understand the performance of the measured indicators under different management practices. We still continue to query and analyzed our database for better understanding and more focused interpretations of our soil health assessment. A joint meeting is scheduled to be held in conjunction with the NYS Fruit and Vegetable EXPO in Syracuse, NY in February 2008.

- **Organization of annual field days and soil health training sessions for growers, CCA and extension educators in each participating state.**

We held several field and grower focused meetings in NY, MD and VT. Team members from different states worked together in presenting and sharing soil health results.

Growers were able to ask questions on issues and topics related to soil health management. We conducted 7 grower meetings/field days in NY, 6 in VT and 1 in MD in 2007. A total 284 growers attended the six meetings conducted by the Vermont Soil Health group and a total of 115 professionals were trained on how to use the new Cornell Soil Health Test. In addition, we conducted two soil health training sessions during

February 2007 in NY and VT attended by extension educators, CCA and crop consultants. A number of the attendees were from private laboratories seeking to incorporate soil health testing into their services. The newly published Cornell Soil Health Assessment Training Manual served as the resource document for these training workshops.

Articles describing principles of soil health and the soil health assessment methods were featured in Maryland Cooperative Extension newsletters and on the website of Future Harvest in spring. Researchers in the Sustainable Agricultural Systems Lab at the USDA-ARS Beltsville facility were trained in the soil health assessment and now include it in their sampling protocol. Two sessions on soil health and cover cropping systems were presented to 120 crop advisors, farmers, and extension educators at the annual Mid-Atlantic Crop Management School on November 13-14. An intensive soil health workshop designed for farmers was developed for delivery on January 18 2008 at the annual Future Harvest conference in Hagerstown, MD.

- **A multi-state annual conference on soil health hosted by one of the cooperating states for improved networking and coordinated soil health outreach.**

This year, rather than holding a joint multi-state conference, members of our team have participated in several regional and national meetings. In 2007 Cornell Soil Health Team members traveled regionally to participate in grower meetings, field days and workshops held in Rhode Island and Vermont to present and demonstrate various aspects of the new Cornell Soil Health Test. We feel this method has been very effective in reaching the local audiences of each state as well as facilitating networking between university, cooperative extension, and other agricultural service providers within the Northeast. Collaborators in Vermont and Maryland will be participating in the soil health sessions at the NY Empire Fruit and Vegetable conference in February 2008.

- **Development of private-sector services for soil health assessment on a fee basis.**

We have demonstrated the need and utility of the Cornell Soil Health Test and are offering it on fee-for-service basis in 2007. A Soil Health Assessment Training Manual was released in February 2007 and made freely accessible on the Soil Health website (<http://soilhealth.cals.cornell.edu>). A number of private laboratories are already engaged in discussions on how to incorporate the Cornell soil health test as part of their services. Several representatives of privately owned laboratories attended our soil health training workshop held in February 2007. We hope that within the next two years, at least a regional laboratory will be able to offer the test to growers.

- **Development of a web-accessible database for the regional sharing of information relevant to soil health.**

We are currently analyzing our database and developing appropriate software interface to provide a web based information services for growers in the Northeast. We plan to present web-based soil health information on different management scenarios and soil types that are captured in our database of soil measurement. We hope to activate this service on our soil health website before the end of 2008.

- **Development of software and a web-based user interface for determining what soil health parameters to evaluate and for the interpretation of results and guidelines of solutions.**

We are working on streamlining and optimizing the soil health indicators that need to be measured for different management systems. However, we need to collect another year of soil health data in order to effectively streamline the indicator selection for various soil management needs in the Northeast. We hope to develop the algorithm for management-

specific indicator selection by the end of 2008, while the testing and refinement will be performed in 2009.

- **Determining the mechanism(s) contributing to soil health improvement by implementing promoted soil management practices.**

We have several replicated field trials in NY, VT and MD focusing on how soil health is affected by applying specific inputs or management practices. The specific effects of tillage, cover crops and crop rotations on soil health are being evaluated in research and demonstration trials. In NY, two trials are dealing with the impact of on crop rotation, three trials on reduced tillage and one trial on cover crops. The trials in VT and MD are focused on tillage and cover crops.

In 2007 significant differences in snap bean yield were observed in the **IPM systems comparison trial**. Total plant and pod weight were highest in the IPM future plot that was managed using scouting and thresholds for pest management as well as cover crops and season-long soil building crops compared to the IPM present (no season-long soil building crops), conventional and organic plots. Yields were lowest in the organically managed plot due to poor stand establishment. There were no significant differences in marketable pod sieve size between the plots (3.97 to 4.51).

A number of trends were observed at the **Gates Farm long-term soil health research site** in Geneva, NY in 2007. This 14-acre trial was established in 2002 to evaluate the effect of three tillage (conventional till, no-till and strip-till), three cover crop (vetch, rye grain, and no cover) and two crop rotations (continuous vegetable and vegetable with soil building crops) arranged in a split-split plot design. Crop rotation had a significant effect on aggregate stability and potentially mineralizable nitrogen (PMN) with the higher levels or rates occurring in the soil building rotation versus the continuous vegetable rotation. Aggregate stability was also significantly higher in the zone- and no-till plots compared to the conventionally plowed plots. However, aggregate stability scored low (red) across the entire trial according to the Cornell Soil Health Test Report indicating that it is potentially a major soil constraint. Not surprisingly, surface hardness was lower in the plow and strip-till plots compared to the no-till plots especially in the soil building rotation which has been under continuous no-till since the plots were established. The effect of the different cover crops on PMN that was observed last year (higher PMN vetch > rye > no cover lower PMN) was unexpectedly not observed this year. Currently, we are also struggling to understand the unexpected lack of change in soil active carbon and organic matter at this site under the various treatment combinations.

In anticipation of all the plots at Gates Farm being planted to snap bean in 2007 to make yield comparisons, the nitrogen fertility was adjusted to account for the inputs from the different cover crops. Less nitrogen was added to the vetch cover crop plots compared to the no cover and rye cover crop plots. In general 'we' have a good handle on fertilizer and soil fertility management and as result most of the Cornell Soil Health Test Reports including those from this trial score the rating of the chemical indicators as good (green). Due to the unusually dry conditions in 2007, it was not possible to make accurate yield comparisons at the Gates Farm soil health site.

A cover crop trial at Wye Research and Experimental Center, MD compared radish/rye mix to no cover crop in conventional tillage system. While there were significant differences in some soil health indicators (e.g. bulk density, surface hardness), there was no significant difference in the yield of field corn between the cover crop and no cover crop treatments.

- **The use on Visible Near Infra-red (VNIR) Spectroscopy for soil health assessment.** Preliminary results indicate that some soil indicators are well predicted by VNIR method, while others are not. Organic matter and active carbon showed high predictability ($r=0.89$). Some soil physical (e.g. surface and subsurface hardness) and biological properties (e.g. potentially mineralizable N) were poorly predicted. Several other properties showed reasonable predictability, probably due to correlation with better predicted indicators such as organic matter content. We will continue to analyze and refine the data collected using VNIR to finalize the soil health indicators that can be measured through this technique
- **Documenting the number of growers that have benefited from the project and the number that have implemented long-term soil management strategies (project target is 100+).**
A voluntary survey was conducted in the spring of 2006 which will serve as the baseline for this project to capture growers' perception and understanding of soil health. Another survey will take place at the end of this project targeted towards the same previously interviewed growers, to assess how much they have benefited from the project and how many are implementing better soil health management practices. Surveys have also been used as a tool to improve field day and workshop organization and content to better address the needs and interests of the participants and gain perspective on soil health issues and the current methods they are using in their production systems.

Outcomes

In 2007, we analyzed 289 fields from New York, Vermont Pennsylvania and Maryland using the new Cornell Soil Health Test. The generated Cornell Soil Health Test Reports were provided to participating growers and their respective extension educator and/or private consultant together with general guidelines to address identified soil health constraints. A Soil Health Assessment Training Manual (<http://soilhealth.cals.cornell.edu>) was also released as an educational tool and a resource describing the general aspects of soil health management and the new Cornell Soil Health Test. Yield information is being linked with the measured soil health indicators at the IPM systems comparison and Gates Farm soil health sites. The use of visible near infra-red spectroscopy is being evaluated for use as an additional soil health assessment tool and preliminary results had indicated a high level of predictability with some of the measured soil health indicators. Currently, we are analyzing our database of soil measurements and developing appropriate software interface to provide web accessible information services for growers in the Northeast.