



Gen6-2011 - Evaluating the Cornell Soil Health Assessment

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Evaluating the Cornell Soil Health Assessment (Interim Report)

Purpose:

Over the years growers have made many changes to their cropping systems to improve productivity and enhance environmental sustainability. Crop rotation, manure applications and residue management have long been promoted as best management practices for the soil. Many growers ask the questions “Is what I am doing making a difference?” and “Is my soil healthy?” A number of measures of soil quality or soil health have been developed over the years. Many of them have specific sampling methods that are difficult to take in the field and then relate to management practices. Cornell University recently developed the Cornell Soil Health Assessment. It appears to come the closest to meeting the needs of agronomists and farmers. The purpose of this project is to quantify, validate and calibrate the Cornell Soil Health Assessment relevant to Ontario conditions.

Methods:

The Cornell Soil Health Assessment uses a number of indicators. They include: aggregate stability, available water capacity, surface hardness, subsurface hardness, organic matter, active carbon, potentially mineralizable nitrogen, root health, pH, extractable phosphorus, extractable potassium and secondary and micronutrients. Sampling in the field requires the collection of enough soil cores to a 6 inch depth to equal six cups (1.5 litres), usually 30 to 40 cores. Penetrometer readings are also taken at a 0-6” (0-15cm) depth and 6-18” (15-45cm) depth. The samples are taken in May and June.

In 2009 samples were taken from the three long term, field-crop trials that were established over the past four decades by researchers at the University of Guelph: 1) Long Term Rotation trial – Elora Research Station; 2) Long Term Tillage Trial – Elora Research Station; 3) Long Term Rotation Trial – Ridgetown Campus. In 2010 soil health samples were taken from long term research plots at AAFC Delhi, (tillage and cropping, cover crop and tillage), AAFC Ottawa, (rotation and manure, tillage and rotation), 2 cover crop research projects and 78 samples from farms. In 2011 samples were taken from long term research plots at the Agriculture and Agri-Food Canada research station at Woodslee, Ontario. Samples were taken from 4 long term rotation, compost, and tillage plots. Another farm samples were also taken. The farm samples were taken from a range of soil types and cropping systems including organic crop production from across the province. Samples were also taken from undisturbed areas (fencerows, woodlots, edges of lanes) near some of the research plots and beside farm fields. Penetrometer readings were taken at a later date in Ridgetown in 2009 and penetrometer readings were not taken from the other research sites. A lab was set up by the OMAFRA soil management specialists to conduct wet aggregate stability and root health tests. The remainder of the soil was sent to Agri-Food Labs for nutrient, organic matter, potentially mineralizable nitrogen, texture and active carbon analysis. The available water capacity measurements of some samples have been conducted at Agriculture and Agri-Food, Harrow.

Results:

The data shows that aggregate stability for no-till can be up to three times as great as conventional tillage. Aggregate stability also improves as crop rotation increases from a single crop to multiple crops and further to rotations that include perennial crops. Overall soil health scores for the tillage plots at Elora (loam soil) were highest for the no-till treatments and the spring tandem disk and lowest for the moldboard plow treatments. For the rotation plots at Elora (loam soil) overall score for no-till treatments was slightly higher than conventional. The continuous alfalfa scored the highest while the corn-corn-soybean-soybean rotation scored the lowest. At Ridgetown (clay loam soil) the winter wheat-soybean rotation had the highest overall soil health score and the corn-soybean rotation had the lowest score. No-till scored higher than conventional.

At Delhi (sandy loam soil) the tillage and cropping site, conservation tillage scored higher than the conventional tillage treatments and the soybean-wheat rotation scored the highest, tobacco rye intermediate and continuous corn the lowest. The cover crop and tillage site there is in continuous corn. It had a slightly higher score for no-till versus conventional and a slightly higher score for rye cover crop versus no cover crop. The samples taken from the windbreaks and woodlot scored higher than any of the treatments in the plots.

There are two sites at Ottawa. The first, a clay loam to loam soil is a rotation and manure study, the continuous soybeans scored the lowest, continuous corn, corn-clover, corn-soybean, no crop were intermediate and continuous red clover (continuous alfalfa prior to 2009) scored the highest. The manure treatments scored highest followed by the commercial fertilizer treatments with composted manure being the lowest. In the second one, a tillage and rotation study, a loam to sandy loam soil, continuous soybeans scored the lowest and continuous wheat scored the highest, corn-soybeans-wheat and continuous corn were intermediate. There was very little difference in scores between the no-till and conventional. In the first cover crop trial, the mowed and incorporated treatment scored slightly higher than the mowed and left, and the no cover crop treatments. In the second cover crop trial the peas and rye scored the highest, the vetch, oilseed radish and oats scored intermediate and the no cover scored the lowest.

Summary:

The results analyzed so far indicate that the overall soil health assessment scoring is picking up many of the soil health differences we would expect to see in the various cropping and tillage systems. Initial indications are that the aggregate stability indicator seems to correlate well with soil management practices. The surface hardness or soil compaction indicator is really not that useful as it does not give a specific depth of the compaction and the conditions are not always suitable when the samples are taken. The available water capacity is not that suitable as an indicator as it is done with a disturbed core and it requires equipment most labs do not have. The organic matter indicator is fine. The active carbon indicator does not seem to be very responsive to soil management practices. The potentially mineralizable nitrogen indicator is somewhat responsive but may be too expensive to include in the suite of tests for Ontario. The root health assessment is time consuming and most of the scores came back the same. The value of the nutrient indicators is still up in the air.

Generally, less tillage improves the soil health score as does a rotation that includes more than three crops or perennial crops. Manure additions also improve the soil health score. More information on the Cornell Soil Health Assessment can be found at: www.hort.cornell.edu/soilhealth/

Next Steps:

Analysis of the data will be completed in the first half of 2012. The various components of the test will be assessed for their applicability to Ontario conditions. A literature review was done as a side project to try to improve the biological indicators. Samples were taken in the fall of 2011 and will be analyzed and assessed. Recommendations for an Ontario soil health assessment will be developed later in 2012.

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Ridgetown long term rotation and tillage plots.



Sampling the long term rotation plots at Woodslee.



Mega Dripper for aggregate stability testing.