Evaluating the Cornell Soil Health Assessment

(Interim Report)

Purpose:

Producers have made many changes to their cropping systems to improve productivity and environmental sustainability. Crop rotation, manure applications and residue management are known 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/soil health have been developed, many having 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 in the assessment. 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 faculty 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. The farm samples were taken from a range of soil types and cropping systems including organic crop production from across the province. This year 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 no penetrometer readings were 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 and active carbon analysis. The available water capacity measurements of some samples have been conducted at Agriculture and Agri-Food, Harrow. In year three the sampling will take place on many more grower’s fields and possible at a few more long term research sites.

Results:

The data shows that aggregate stability for no-till can be as much as three times as great as for conventional tillage. Aggregate stability also improves as the crop rotation moves from a single crop to multiple crops 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 had a slightly higher score for no-till versus conventional and a slightly higher score for rye cover crop versus no cover crop. That plot is in a continuous corn rotation. 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 on, 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 from the first two years 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. The individual indicators sometimes differ but that will be fully assessed when we have a more complete data set next year. Generally, less tillage improves the soil health score as does a rotation that includes more that 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:

A more complete analysis of the data set will be done. The various components of the test will be assessed for applicability to Ontario conditions. In 2011 samples will be taken from a wide range of soil types and production practices to further evaluate the test for Ontario. Recommendations for an Ontario soil health assessment will be developed.

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