Measuring and Managing Soil Properties for Optimum Crop Production

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Have our field management practices created soils that can help our crops through periods of unusual and extreme weather? The short answer is yes, there is evidence of great soil management practices everywhere you look. Anyone driving through farmland in recent years may have seen many examples of improved soil management practices; cover crops are being planted on an increasing number of acres every year leading to more diversified crop rotations, increased organic matter additions to the soil and covering the soil with a growing crop for a longer part of the year. Reduced tillage practices are replacing the moldboard plow and heavy manure spreading equipment is being replaced with draghose systems leading to better soil structure and less soil loss. These improved farming practices help reduce erosion, increase soil organic matter, increase yields, lower input costs, optimize nutrient use, and improve crop resilience during both drought and wet years. The need for continuous improvement is also evident. Unusual weather patterns are the new normal and the role of soil is critical to the success of our future cropping programs.

How can farms further manage their soils for continuous high performance? The general consensus is that increasing soil organic matter (SOM) typically improves a soil's ability to support crops in many situations since SOM improves several critical soil functions. However, cropping practices implemented over many years of a rotation all impact SOM differently and figuring out which practices are increasing SOM and which ones are not can be difficult. Fortunately there are tools available to help us measure organic matter and identify which combinations of farm-specific management practices, including tillage, cover crops, crop residue management, rotations etc are working to improve SOM. Tracking the organic matter reported on your normal soil test is one way to assess how farm-specific management practices are impacting SOM. In addition, two other tests-the Illinois Soil Nitrogen Test (ISNT) and the Cornell Soil Health Test - can be used to track more specific functions of SOM that impact production.

Tracking the organic matter reported on your soil test is a good place to start, additionally tracking the cation exchange capacity (CEC) and nutrient levels reported in a soil test can give a bigger picture of how field management practices are impacting soils. The soil organic matter reported on a soil test is a gross measure for something that has multiple components that all impact the soil functionality differently. When a soil test reports an organic matter value it represents (1) the living organisms in the soil, (2) the fresh organic residue that sits on the surface, (3) an active fraction of organic matter and (4) a stable fraction of organic matter (Figure 1). Tracking these components separately can provide feedback to management to fine-tune field practices to achieve the desired result in SOM. The ISNT analysis mentioned earlier can be used as an indicator of the active fraction of organic matter and the Cornell Soil Health Test measures soil performance as impacted by the stable and active components of the SOM.

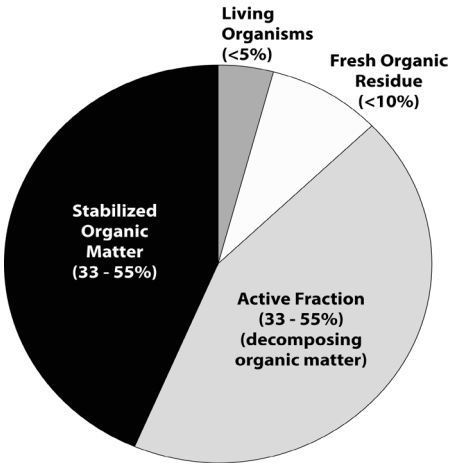

Figure 1: Soil Organic Matter (SOM) is composed of different fractions each with unique functions in the soil.

The Illinois Soil Nitrogen Test (ISNT) is a soil test that measures the amount of nitrogen that could become mineralized from organic matter in the soil if the soil is warm, moist and well-aerated. ISNT results can be used immediately to manage nitrogen in farm fields and also tracked long-term as an indicator of how management practices are impacting the active organic matter fraction.

The active fraction of SOM impacts nearly all nutrient cycling in the soil, however the ISNT results have only been calibrated for managing nitrogen (N) in corn in New York State. When the ISNT has a value above the corn-line (figure 2) the soil can provide enough N for the crop with a small amount of starter N from manure or purchased fertilizer. When the ISNT results fall below the corn-line the soils can only be expected to provide 60-70 lbs of N per acre. The ISNT is helpful in situations like this spring where wet conditions have created areas of nitrogen deficient corn. If the ISNT has previously been shown to be high in these fields we can be more certain that there will be enough available N for the plant once the roots are aerated, N starts to be mineralized and the roots take it up.

For more information on the ISNT refer to Cornell Agronomy Factsheet #36
http://nmsp.cals.cornell.edu/publications/factsheets/factsheet36.pdf

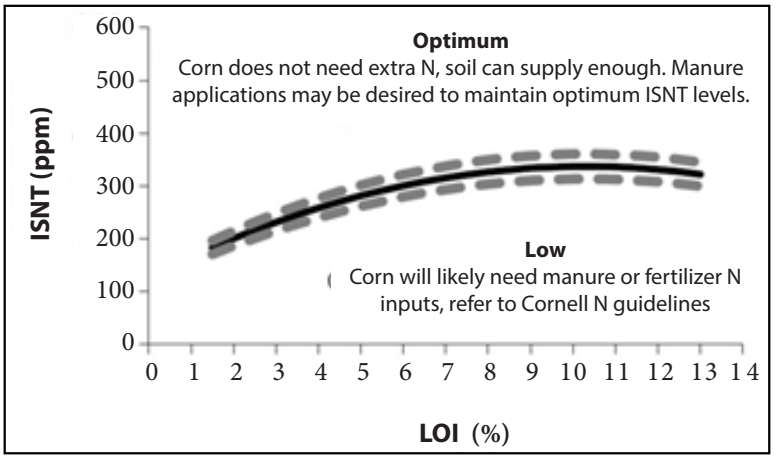

Figure 2: The Illinois Soil Nitrogen Test results can be used immediately for nitrogen management and also for long-term tracking as an indicator of the active fraction of soil organic matter.

Another test that can be used to provide information regarding soil functionality is the Cornell Soil Health Test. This test subjects a soil sample to fifteen different analyses that assess the physical, biological and chemical performance of the soil (Figure 3). The report gives an overall score for the health of the soil and includes assessments that can be used to track both stable and active fractions of SOM.

For more information on the Cornell Soil Health Test refer to the program website at: **http://soilhealth.cals.cornell.edu/**

Soil Health Assessment Indicator	Soil Function Process
Physical Indicators	
Aggregate Stability	aeration, infiltration, shallow rooting, crusting
Available Water Capacity	water retention
Surface Hardness	rooting, water transmission
Subsurface Hardness	rooting at depth
Biological Indicators	
Organic Matter Content	energy/C storage, water and nutrient retention
Active Carbon Content	organic material to support biological functions
Potentially Mineralizable Nitrogen (PMN)	N supply capacity, N leaching potential
Root Health Rating	soil-borne pest pressure
Chemical Indicators	
pH	toxicity, nutrient availability
Extractable Phosphorus	P availability, environmental loss potential
Extractable Potassium	K availability
Minor Element Contents (4)	micronutrient availability, element imbalances

Figure 3: The Cornell Soil Health Test provides a number of indicators that can be tracked long-term to assess changes in the stable and active fractions of SOM.

Tracking SOM values to assess crop management practices requires more frequent soil testing then our usual practice of soil testing every 3 to 5 years. Soil testing more frequently during the rotation can help identify which parts of the rotation are building SOM, which parts are drawing them down, and identifies the final balance over time. All the fields on the farm can be tested more frequently or picking a subset of fields to test every year can save on the cost of sampling while still being an effective management tool. When using soil sample results to track management practices, sample at the same time every year, use the same lab and request the same lab analysis package.

Managing and improving our soils has always been important to the success of our farms. Tools like soil testing, the ISNT and the Cornell Soil Health Test can help us quantitatively measure, assess and manage our cropping systems so that soil organic matter is increased. Testing more frequently is needed to use these tools effectively. Develop a management strategy by identifying indicator fields in which to implement more intensive sampling and get started during fall soil sampling time!

For more information on soil testing, contact the Agro-One Soils Lab in Ithaca, New York at 800-344-2697 or www.dairyone.com

If you would like help with soil management or crop production on your farm contact Agricultural Consulting Services (ACS) at 800-540-8716 or www. acscrops.com.