005 Soil Health Tests: Are They Worth It?

A review of the current tests, what the science says about them,
and how to go about implementing soil health testing on your land.

Written by Scott Gillespie
www.plantsdigsoil.com

Knowing the status of your health is important. It identifies areas that are lacking and helps guide future treatments. Just like your own health, a proper assessment of the health of your soil can help you learn limitations today, track progress as you make changes, and allow you to pass on a healthy resource for future generations. In this episode, I'm going to review the current soil health tests available, look into the scientific evaluations of these tests, and suggest ways to approach monitoring your soil.

Background

Chemical analysis of the soil developed over the twentieth century as a way to help farmers apply the proper amounts of nutrients from the newly created chemical-based fertilizers. For example, let's take a look at the development of the phosphorus test. It took 40 years for researchers in the different regions of the United States to develop tests that accurately predicted phosphorus release over a growing season.[1] In my own region, Western Canada, the existing tests from the United States were modified further until a test was developed that worked best in our particular soils.[2]

Just as chemical analysis was a response to chemically based agricultural systems, soil health testing is a response as farmers focus on practices that correct, maintain, or improve the health of their soil. The goals of soil health testing are similar to the goals of our traditional soil testing programs. The focus is on finding indicators that best represent what is going on in the soil. A good indicator will have as many of these attributes as possible:

1. Be easy to measure
2. Share the same sample or be sampled at the same time as other indicators
3. Should not be time-consuming
4. Be accessible to as many people as possible
5. Be repeatable by another person not involved in the first sampling
6. Be cost-effective
7. Be comparable across similar geographies, and possibly between regions

As an example, let's work through testing for phosphorus:

- The measurement is easy, but it takes having a lab nearby that can do the measurement. If there are no labs, then samples can be cooled to near freezing and shipped to a lab.
- The same sample can be used to measure many other nutrients, and they share a similar time for sampling. Gathering the sample can be quick with a truck, or ATV mounted sampler. Hand sampling is time-consuming but it does make it accessible to nearly anyone.

- Repeatability is a challenge when doing random sampling across a field, but with GPS systems so accessible today, marking points and going back to the same points in the following years can be achieved fairly easily.
- Costs will vary, but most soil tests are 1-2% of the cost of the nutrients applied, so even a small savings in product applied or gain in yield from applying the proper amount will be worth it.
- If the appropriate test is used for the region, it can be compared to other fields in the region. While the number can't be compared across geographies, the relative test can be. For example, regions could be compared at a broad scale by comparing the percentage of farms that have low, mid, and high amounts of soil test phosphorus.

Are soil health tests worth doing?

The simple answer is: No. Most of the standard tests we do right now do as good of a job, or a better job, in giving us indicators of the health of the soil. If a new test is correlated to an existing test, why change? It must provide new information that is not captured in an existing test to be worthwhile.

The complex answer is: Maybe. There are some soil health tests that use visual indicators. These may provide a way to standardize our observations and allow better comparisons year over year and between regions. Additionally, some tests of the lab and field-based tests show promise for long term monitoring. Baseline data now may help you compare practices in the years and decades to come. However, there is limited usefulness for evaluating practices right now.

To go deeper into this, let's first look at what tests are available. There are two broad categories of tests: (1) those that must be done in a lab and (2) those that must be done in the field.

Lab tests

Tests that fit into this category will be similar to what we are familiar with in traditional soil testing. Any of these tests require a small sample of soil taken from the field and brought to a lab. For most of the tests, the same soil sample that is used for the chemical analysis can be used for biological analysis. The advantage of these tests is that they are relatively easy to do (if you have a lab nearby), don't take a long time to sample, and are repeatable if sample points are GPS marked and the same lab is used year over year.

Examples of tests that fit in this category are:

- Solvita[3]
    - Respiration test
    - Solvita labile amino N (SLAN)
- The Haney Soil Test[4]
    - Solvita respiration test
    - Water Extractable Organic Nitrogen (WEON) & WEO Carbon (WEOC)
- Components of the Cornel Comprehensive Assessment of Soil Health (CASH)[5]
    - Available Water Capacity (AWC)

    - Aggregate Stability
    - Soil Protein
    - Active Carbon
    - Soil Respiration
- Soil Food Web[6]
    - Microbial communities

Field Evaluations

Tests in this category are generally ones that can only be measured in the field, or are ones where instruments and products have been developed to bring the lab to the field. The advantage to these tests is that a lab is not required near the field, and results are known nearly instantly. The need for specialized test equipment can be a barrier to access; however, not all tests require special equipment, making those tests accessible to anyone.

Examples of tests that fit in this category are:

- Components of the United States Department of Agriculture (USDA) Soil Quality Test Kit[7]
    - Soil Respiration
    - Bulk Density
    - Aggregate Stability
    - Slaking
    - Water Infiltration Test
    - Earthworm Counts
- Components of the Cornel Comprehensive Assessment of Soil Health (CASH)
    - Surface & sub-surface compaction readings
- Components of the Visual Soil Assessment system[8]
    - Soil structure consistence
    - Soil porosity
    - Soil colour & degree of mottling
    - Soil clod development
    - Earthworm counts
    - Tillage pan development
    - Wind & water erosion events, which is more of an observation
    - Degree of surface ponding after rain events
    - Crop establishment
    - Observing the rooting depth & health of crop roots

Scientific reviews of the soil health tests

One of the most rigorous evaluations of the common soil health tests available in the United States was recently completed by Purdue University in Indiana[9]. They evaluated the lab tests previously mentioned in this episode over a four-year period at multiple locations, both on-farm and on their own research plots. There were no “smoking guns” that consistently pointed to healthy soil. Variations in test results year over year indicated that the best use of the test is long-

term monitoring. They advise that the best way to achieve this is to be consistent: pick the same time of year, the same location in the field, and be in, or following, the same crop.

The conclusion that soil health tests are more suitable for long-term monitoring rather than detecting short term changes is backed up by an evaluation of newly established soil health practices on a demonstration farm in North Dakota.[10] There were no detectable differences in the plots after one year of no-till with cover crops. Although the newer soil health lab tests did not show any difference, aggregate stability did improve in just one year. It will be interesting to see if this continues to be the case over the next few years and if some of the lab tests show promise in detecting changes.

A study in Ontario, Canada, demonstrates that long-term effects can start to show in soil health tests[11]. In the study, they evaluated the Haney Soil Test on a long term (>20yr) corn, soybean, wheat rotation. Within the rotation some crops were grown continuously, some were excluded, and some rotations had a cover crop included. They found significant differences in the test number regardless of the phase of the crop rotation. In other words, the tests seemed to be picking up long term effects on the soil.

Something they did not address was whether the numbers had agronomic significance. For example, continuous corn had the same numbers as corn, soybean, and wheat rotations that had a red clover cover crop between wheat harvest and corn planting. Strictly by the numbers, continuous corn appears to be a good option, but agronomically we know that a diverse crop rotation along with diverse plant covers leads to healthy soil.

Where do we go from here?

Soil health tests are not at the point where you can add them on to your traditional tests and get new information. At best, they may give insights as you make long term changes to your land. They will not be able to tell you the change that you made in one year is making a difference.

Indicators need to be calibrated to local areas in the same way that chemical tests of today have been. In a recent Ph.D. thesis, the author developed a Weighted Soil Quality Index (WSQI)[12]. She did this by doing multiple soil health tests on different plots of land that had known long-term rotation effects. Statistical procedures were used to find the indicators that were best correlated with known values. Formal evaluations, such as in this study, may help regions develop the best tests for farmers. Informal evaluations by farmers and agronomists will help tailor a testing program for individual farms.

The best way to start is to ask what it is you want to achieve. For example, you might decide:

- I want to capture more water in my soil for my crop to use.
- I want my soil to stay in place in the fall and spring winds.
- I want my soil to provide most of the nutrients to my crops.
- I want my cropping system to manage pests without me intervening.

From there, think of the indicator that will best measure this. It may be from the suite of soil health tests, it may be from the testing program you already do, or it may be from field

observations. If you have irrigation, capturing more water may mean less water use. If you don't have irrigation, seeing your crop last longer in a drought may be the best indicator. Tracking fertilizer and pesticide inputs may be the best indicator for a soil that provides more nutrients and a system that controls more pests.

Conclusion

Evaluating the health of your soil is not a simple process. There are no tests now that give easy to use information like what we have in our traditional chemical analysis of the soil. Instead of simply adding on these tests, first, ask what you want to accomplish and then look at the best way to monitor it.

This podcast was originally published at:
https://www.scottcgillespie.com/posts/2019/9/25/soil-health-tests-are-they-worth-it

It has since been moved to:
https://www.plantsdigsoil.com/podcast/005-soil-health-tests-are-they-worth-it

---

[1] Selection of an Appropriate Phosphorus Test for Soils. Last accessed Sep 24/19. https://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/research/guide/?cid=nrcs142p2_054264

[2] Determining plant available phosphorus. Last accessed Sep 24/19. https://www.topcropmanager.com/determining-plant-available-phosphorus-18567/

[3] Solvita Soil Health Tests. Last accessed Sep 24/19 https://solvita.com/soil/

[4] Haney/Soil Test Information Rev 1.0 Last accessed Sep 24/19 https://www.wardlab.com/haney-info.php

[5] Comprehensive Assessment of Soil Health, The Cornell Framework, 3rd Edition, 2016. Last downloaded Sept 24/19. http://soilhealth.cals.cornell.edu/training-manual/

[6] Soil Food Web. Last accessed Sep 24/19 https://www.soilfoodweb.com/about

[7] USDA Soil Quality Test Kit. Last accessed Sep 24/19. https://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/health/assessment/?cid=nrcs142p2_053873

[8] Visual Soil Assessment. Last accessed Sep 24/19. https://www.bioagrinomics.com/visual-soil-assessment

[9] How to Understand and Interpret Soil Health Tests. Last downloaded Sept 24/19 https://www.extension.purdue.edu/extmedia/AY/AY-366-W.pdf

[10] Soil Health Minute: Evaluating soils when building soil health. Last accessed Sept 24/19. https://www.agweek.com/opinion/columns/4579808-soil-health-minute-evaluating-soils-when-building-soil-health

[11] Correlations of two commercial biological indicators of soil health in a long-term tillage system and crop rotation experiment in Ontario, Canada. Last accessed Sep 24/19. https://scisoc.confex.com/scisoc/2019sssa/meetingapp.cgi/Paper/115971

[12] Impact of cover crops and crop residue removal on soil quality, N dynamics, and processing tomato (Solanum lycopersicum L.) yield and quality. Last accessed Sep 24/19. https://atrium.lib.uoguelph.ca/xmlui/handle/10214/16100