Digging into a Soil Health Test

A University Analysis of the Haney System Unearths Some Questions

By Caroline van Schaik

A streak of creativity brightens the landscape when farmers join forces with scientists to investigate "the standard" of what we thought we already knew. Take, for example, the fresh look at how soil functions—collectively called soil health—that has been the talk of Land Stewardship Project workshops and field days the past five years or so. It was farmer curiosity that led to scientific breakthroughs in measuring the ability of soil biology to generate its own fertility. As this new approach gains momentum, one result is that our agricultural world is being rocked (or at least nudged) by new test data that reinforces what some farmers have already noted in their fields: healthier soils require less fertilizer.

At their core, soil health tests quantify the results of soil biology by capturing more plant-available nitrogen than what a standard chemical analysis can measure. This more complete assessment is good news not only for farmers who could save on fertilizer costs, but for any member of the public that's interested in cleaner water—less fertilizer means less contamination of our lakes, streams, rivers and groundwater. In addition, farmers are finding that soil with a higher biological rating absorbs more rainfall and stays put better, two characteristics that bode well for the environment.

Our land grant universities and their extension services should be at the forefront of work that promotes soil health when the results have such far-reaching societal consequences. In fact, the University of Minnesota is at the leading edge of such innovations as perennial wheat and other Forever Green initiatives that provide much-needed year-round coverage of Minnesota soils (*see page 9 for more on Forever Green*).

So I did a double-take when the U of M launched its new Soil Management and Health website (www.extension.umn.edu/agriculture/soils) recently with research that all but dismissed a popular soil health test—and did so with a baffling angle on its data.

Granted, scientists should always show appropriate caution before jumping into something new. And this particular protocol, called the Haney Soil Health Test, is definitely not the status quo. Standard tests focus on the chemical analysis of three key elements needed for plant growth: nitrogen, phosphorus and potassium (NPK). An NPK analysis is a handy tool if one is focused solely on how much fertilizer should be purchased to maximize crop yield.

During a recent field tour, Jeff Gillespie (*right*) inspected soybean nodules in a field bordered by radish, hairy vetch and oats to mitigate compaction from canning pea harvest. Gillespie and other southeastern Minnesota farmers LSP is working with are looking for ways to measure the soil health impacts of their production methods. (*Photo by Caroline van Schaik*)

But this narrow view has its shortcomings; research is making it clear that taking a more holistic view of soil rather than focusing on a few isolated nutrients provides big agronomic and environmental benefits. Furthermore, without the empirical evidence of a test, farmer observations of better functioning soil remain anecdotal, which limits the extent to which certain innovative agronomic techniques gain credibility within the scientific and agricultural communities.

Farmers Seeking Soil Info

The scientist behind the soil test in question is Dr. Rick Haney, a Texas-based USDA researcher whose work was jump-started by farmers puzzled by what they observed in their fields, much of which ran contrary to conventional wisdom. We hear that, too. For example, farmer-presenters at LSP soil health workshops this past winter (*see page 18*) noted significant erosion problems on fields covered in corn residue. This is troubling, given that surface residue is known as a tried and true way to protect soil. The good news is the farmers also reported virtually no soil loss where the roots of cover crops were present. These farmers also noted better soybean yields even after a cover crop took up soil moisture, improved organic matter after years rather than decades of keeping living roots in the soil, and better weed suppression in the wake of growing a non-cash crop like rye. Some of them are getting comfortable pointing to soil biology for an explanation. Scientists such as Haney are striving to quantify this hunch.

Haney's soil health calculation—a mathematical mashing of five independent assessments that include the Solvita carbon dioxide (CO_2) "burst" test and total organic carbon and nitrogen sampling—tells a story of soil as a living organism. Farmers are responsive to this connection: the longer the rotations, the more roots, the less tilling, and the more soil life, the higher the soil health score. We've seen that right here on farms I've sampled.

As a result, biology-friendly practices that happen also to be at the heart of environmental stewardship and farm profitability are on the rise. That includes cover cropping, managed rotational grazing, less or no tillage, and cautious reductions in agrichemical application rates.

Clearly, farmer intrigue in and response to the microbial underworld of their fields turns out to be good for the land and society.

The U of M Analysis

In light of this interest, University of Minnesota researchers set up an experiment comparing the Haney Soil Health Test to the standard chemical method for measuring plant available nitrogen in the soil. They sampled fields under three different tillage systems: moldboard plowing, ripping and strip tillage. Findings were reported as pounds of available nitrogen per acre. (The University's full report on this research, "Should soil health results be used when

Haney Test, *see page 17…*

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…Haney Test, *from page 16*

determining fertilizer needs in Minnesota?," is at www.extension.umn.edu/agriculture/soils/soil-properties/haney-soil-test.)

The data comparing samples taken from the top six inches in the soil profile show that the Haney method measures more plant-available nitrogen in that half-foot of area than the standard test does. This pattern held across the three tillage systems. For example, strip tillage samples showed 78 pounds of available nitrogen in the top six inches using the Haney method as compared to 29 pounds using the standard testing method.

Apples & Oranges

The problem is, the U of M's researchers did not use this "apples-to-apples" comparison of soil depths to reach their ultimate conclusions about the utility of the Haney test. Rather, the final standard test results were based on samples taken from the top *24 inches* of the soil profile. As I mentioned before, the Haney results were based on samples drawn from the top *six inches* of soil. Considering that half-a-foot of soil matter was compared directly to two feet of sample material, the results were predictable. Depending on the tillage method, the Haney data showed overall from 37 to 97 *fewer* pounds of available nitrogen per acre than its standard counterpart.

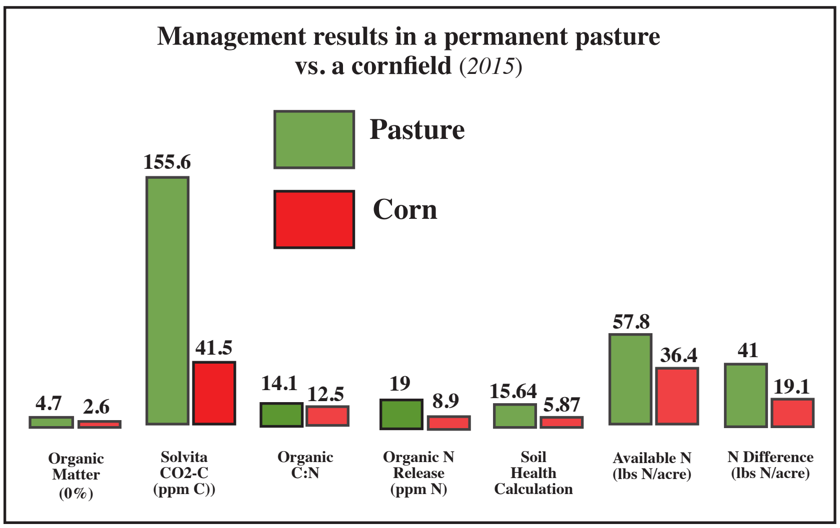
Given the results derived from the wide difference in sampling depths, it's not surprising U of M scientists concluded that the Haney test, "would trigger a higher nitrogen application rate than when using standard testing procedures and U of MN Fertility Guidelines." Their take home message? "Non-standard" soil tests can lead to over-applications of fertilizer, which can cause environmental problems and even result in reduced yields and lower farmer profits. That's about as negative a critique of a methodology as you can get.

Lizabeth Stahl, a U of M Extension educator specializing in crops, led the study. When contacted about the research, Stahl acknowledged that soil sampling depth can greatly impact test values. For example, less mobile nutrients are typically concentrated in the upper depths. But the Haney test is set up to be conducted only in the top six inches of the soil profile.

"Soil labs will tell you if you want to run a Haney test in your field, collect soil from a zero to six-inch depth," Stahl wrote in an e-mail. "So, for an applied, real-world comparison, that is why we followed directions and took samples from zero to six inches for the Haney test."

Stahl also pointed out that the Haney test has not been correlated or calibrated for Minnesota conditions.

"It was developed in Texas, which has a completely different environment, different soil types, different temperatures, different precipitation, different growing season, differences in soil organic matter, cropping system, and so on," she wrote. "That should raise all kinds of red flags as we know these factors influence nutrient availability, mineralization, etc."



This chart, which shows results from two fields sampled in fall 2015 as part of LSP's Haney Soil Test Project, illustrates how a farmer can use the test to compare the impacts of land management practices on various soil health parameters.

Stahl makes some good points, but based on my experience working with farmers in southeastern Minnesota, as well as conversations I've had with soil scientists, there are some serious considerations missing.

While it is standard protocol to split soil samples into surface (zero to six inches) and subsoil depths, comparing different depths of soil to one another is confusing. The only appropriate comparison to Haney results is with six-inch samples since the Haney test is only applied to that depth. Laboratories that offer a "non-standard" test such as the Haney recommend an additional subsoil chemical analysis for serious nitrogen management. These labs make their fertilizer recommendations based on standard tests but specify that soil health test results could influence actual rates. The U of M research team does not go that far: "…it is not recommended to be used to help determine fertilizer needs," they write of the Haney test. It should be noted that Stahl and the other U of M researchers do acknowledge that non-standard soil health tests, "can be used to help demonstrate contrasts in management practices."

The problem is that most people will read this research report on the U of M's main soil health web page and conclude that it is best to stick exclusively with the standard testing methods, even when the actual data conclude otherwise. That's unfortunate, since it threatens to shackle us to some old ways of thinking about soil even as something interesting is unfolding. After all, even 20 years ago we didn't envision building soil organic matter in mere years or measuring what we just called "unavailable" nutrients.

Water, climate, cash flow, erosion, air and habitat issues are all the better when agriculture is defined by growing food *and* soil. Haney results focus the conversation on why this is so and what farmers can change in real time for a higher test score, producing in the bargain better armor in their fields against a barrage of climatic and economic challenges. The bottom line is that standard "NPK" soil tests don't tell farmers what they need to know to adequately address their significant role in environmental and economic resource management.

The Haney test is not above criticism. U of M researchers charge accurately that this particular soil health assessment isn't correlated to Minnesota soils or calibrated for specific fertilizer recommendations. And I believe Dr. Haney needs to publish his on-going correlation work with 30,000 soil samples from around the country, including Minnesota.

It's the mission of our land grant institutions to conduct such science for the public good. Stahl says the U of M continues to evaluate the Haney test through on-farm trials and at some of the school's research and outreach centers, and that the University hopes to have more to report on in the future. Along with the hundreds of farmers who continue to flock to soil health events, I can't wait to see the results. ❒

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