Soil testing that pays

Dustin Sawyer for *Progressive Forage*

AT A GLANCE

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"You cannot manage what you do not measure." It's a phrase that rings true and one that every soil lab knows well. Another common message proclaims: "Soil testing doesn't cost, it pays!" While both of these sayings are true, soil testing relies on underlying assumptions that, if violated, can cause a misunderstanding of the test results and cause both of these upbeat phrases to take a negative turn.

There is no question that soil testing is important and has proven its worth time and again in the agricultural community. The only true criticism one may level against the practice is that it's stale. While it seems that everything else in the modern world is constantly changing, upgrading or updating, soil testing has remained stubbornly unchanged for decades. The industry's craving for something new hasn't gone unnoticed as new types of soil testing and new ways to interpret soil tests seem to show up with each new cropping season. In the ever-evolving environment of agriculture, there's one more cliché that rings true as new methods of evaluating our soil sprout up: "In order to know where we're going, we need to understand where we've been."

Soil is a complex and poorly understood system that combines carbon sources like living and dead microorganisms with weathered rock (sand, silt and clay), water and air. Traditional soil testing, also known as soil fertility testing, tries to determine the amount of essential nutrients in the soil that will be available to the plant through the growing season, then use that information to assess the likelihood of a crop yield response to added fertilizer. If the soil test suggests a fertilizer response is likely, the soil test data are also used to determine how much fertilizer addition is required.

This concept of "plant-available" nutrients is key to soil testing and understanding how soil testing works. Plants are not mere passive observers in the soil environment; the rhizosphere is alive and active, and plants can alter their soil environment both physically and chemically. That means the idea of "plant availability" is dynamic and changes based on the qualities of the soil as well as the physiology of the plant. There has long been debate, and the debate is not over yet, as to how a laboratory can truly mimic a plant to measure these plant-available nutrients. This is why there are several different methods for testing soil fertility and why it's important to know which method is used when conducting a soil test.

To illustrate the breadth of soil testing methods, the Agricultural Laboratory Proficiency (ALP) Program recognizes six different methods for measuring soil pH, eight methods for soil potassium, and 10 methods for soil phosphorus.

Ultimately, soil testing is intended to answer a simple yet fundamental question: What is the probability of seeing a crop response to added fertilizer?

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This is an international organization that provides proficiency testing to the soil-testing community and needs to be well-versed in all aspects of soil testing. In fact, ALP recognizes multiple test methods for nearly every nutrient or soil property that can be measured. Why? Because soil is a complex system.

Which soil test method is best? In general, all methods work equally well. The caveat is that all methods have their limitations and fail in some conditions, so every soil test method needs to be viewed in the context of a complete soil testing system.

As defined by the Soil Science Society of America, a soil test system consists of three parts: correlation, calibration and interpretation. If a researcher wants to evaluate a new extraction technique, he or she must first use the new technique on soils that exhibit the traits of interest. For example, if phosphorus is the nutrient of interest, the researcher will use the method on soils that have a range of phosphorus levels to ensure the new method yields low numbers on soils that grow phosphorus-deficient plants and higher numbers on soils that grow phosphorus-sufficient plants. This is the correlation stage – determining if the method yields values that correlate with the health of the plants grown in the soil.

If a soil test can be correlated to plant growth, research moves on to the next step in the process. At this stage, the values the test produces have no real meaning. A value of five, for example, could be high, optimum or low; nobody really knows. This is where calibration studies come in. The intent of calibration is to define a scale that can be used with the test, effectively assigning meaning to the values so they can be turned into useful terms in a fertilizer equation.

The interpretation of a soil test is where the thresholds of low, optimum and high soil test levels are set and where the probability of crop response is defined. By definition, soil test values that fall into the low category are statistically more likely to see a response to added fertilizer than those in the optimum or high categories. The higher the category, the lower the chances of a response. It is common too that interpretations vary from crop to crop. That is because each type of plant has its own nutrient needs and therefore will have its own probability of a response.

The system of correlation, calibration and interpretation is unique to each soil test and, in some cases, unique to the soil of a specific region. If the system is used in its entirety, the specificity of the soil test system makes it easy to compare soil test results across different methods or different regions. For example, a low soil test that uses the Morgan method will have a similar likelihood of fertilizer response as a low soil test that uses the Bray-1 method. Where a person can get into trouble is when the soil test value is taken out of context and compared across methods. Comparing soil test results across methods without using the interpretation system to provide context simply should not be done.

Ultimately, soil testing is intended to answer a simple yet fundamental question: What is the probability of seeing a crop response to added fertilizer? The question is deceptively simple, and many brilliant minds have been hard at work for more than a century to answer it. Great strides have been made, but there is still a lot of ground to cover. New methods will come along, and some of them may stay around for a long time. Regardless of how new or old a soil test method is, it will always be underpinned by one assumption: Soil test results will be viewed within the context they were designed. To violate that assumption will only yield frustration, not profits.