Editor's note: This article was originally published in the March–April 2010 issue of Crops & Soils magazine and remains a valuable resource.

Your soil samples are precious things. When you ship them off to the lab, you expect accurate and precise results. However, human error, methodological variance, or a lack of laboratory certification programs can affect their precision and accuracy. Thankfully, there are ways of lessening this variability and ensuring quality, explained Dirk Holstege, director of the UC Davis Analytical Lab at the University of California–Davis, in a talk delivered at the “Fresh Approaches to Fertilizing Techniques” conference last November in Visalia, CA.

And although quality is possible, it certainly isn’t easy. “We’ve all been raised with Star Trek and CSI, where [you think] ‘oh, I’m going to analyze my sample on the mass spec and two minutes later, there’s a result,’” Holstege acknowledged. “That mass spec takes two hours to calibrate, and it takes another hour to get the results, and then it takes an hour of someone scratching their head to figure out what the results mean. So testing is complicated.”

The complications arise as soon as a lab is chosen. From the minute a sample arrives at a given lab, it will be tested in accordance with that lab’s protocol. And, even though Lab A might be performing the same test offered by Lab B, the results may vary significantly simply due to the way the sample is handled or the way the test is run. “And to further complicate the situation, these methods can be performed differently by different labs,” Holstege explained.

While a variation from lab to lab may not be a surprise, the variance in quality of the testing may be. This may have to do with the fact that there is not a standard for regulation or certification for most labs. “Agricultural labs are not regulated in the same way that a medical lab might be,” he continued. “There’s no agency that comes and audits how your soil test is being performed. The methods are not standard; they vary from lab to lab sometimes. There’s no testing that’s checked, and there are no certification programs for agricultural labs for soil and plant testing.”

Because of this, the client really needs to do some research before settling on a lab. To do so, Holstege stresses the importance of understanding “accuracy” versus “precision” (see Fig. 1, next page). Precision is the repeatabil-
Accuracy is nearness to a target value for measurements, although this can still allow for a loose grouping of results around the target’s center. Bias is simply a propensity to be traditionally high or low; for example, the results of a given test are always about 2% higher than what you know to be truly on the mark.

What’s needed in quality testing, Holstege argued, is a combination of both accuracy and precision—and thus, replicable results along with results that are on target. “To control that accuracy and precision, the labs have to do certain things. They have to use a standard method; they have to verify that they’ve run the method correctly; and they have to get results that are comparable to other labs or to a known sample—they have to be able to run that known sample and get the same results.” To ensure precision and accuracy, labs must implement quality control and assurance procedures. Quality control refers to a daily review of the quality of a lab’s processes. This is accomplished by running samples with known values, running duplicate samples, through instrument calibrations, etc. Quality assurance more broadly looks at the quality of the overall process, including efforts such as producing a quality assurance manual, ongoing training, equipment maintenance, and established procedures for when quality efforts fail. “Does the lab you are using have a quality control manual?” Holstege asked.

Additionally, while soil and plant laboratories are not certified, they can and should be actively participating in a proficiency program such as the Soil Science Society of America’s North American Proficiency Testing Program (see a list of participating NAPT labs on pages 11–14) to assess the quality of their results in comparison to other labs. In such a program, 10 labs might be sent the same sample and asked to run a given test. The goal is to return results that are shared by one or more labs. If six of the labs have results that are in a cluster while the others are scattered, this says something about the quality of the testing being done at those labs that aren’t part of the majority cluster. “There’s no way that they can really know that they’re doing a good job unless they’re participating in a proficiency program and they’re getting comparable results to another lab,” Holstege explained.

Having answers to these types of questions when choosing a lab will lead to more accurate testing, better results, and ultimately better recommendations for your clients. Yet despite these cautions and suggestions to look for repetition and assurance, Holstege does not recommend using multiple labs. Instead, he suggests finding a lab that satisfies the criteria outlined here and sticking with it. “You can’t go from one lab to the next and expect the same results; that’s the take-home message.” While you might conduct a bit of your own quality testing of a handful of labs by sending them each an identical sample, eventually you will want to settle on one in which you have confidence.

“The best thing is to pick one lab and stick with it. It may have a bias high or low. It will probably have pretty good precision, and they’ll be giving you the same number every time. If you’re jumping between labs, you’re going to see a lot of variation. “You’re building a relationship with this lab, and you should understand the quality of the product that you’re going to get.” &.

Proficiency testing

The NAPT (North American Proficiency Testing) Program, a program of the Soil Science Society of America, assists soil, plant, and water-testing laboratories in their performance through inter-laboratory sample exchanges and a statistical evaluation of the analytical data. Laboratories sign up for programs in soil (with or without environmental analytes), plant, and/or water to help them with internal accuracy and precision for a variety of methods. Each quarterly exchange consists of five soils, three plants, and/or three water samples.

NAPT guidelines have been developed by the agricultural laboratory industry and interested parties from the U.S. and Canada. NAPT is operated as an activity of SSSA and overseen by the NAPT oversight committee. Representatives include: Regional soil and plant analysis work groups, scientific organizations, state/provincial agriculture departments, private and public soil and plant analysis labs, and government agencies.

A list of laboratories participating in the 2018 program can be found at: www.naptprogram.org/about/participants.