A holistic approach to assessing soil health

openaccessgovernment.org

9 November 2022

In this Q&A, Dr Christine Sprunger, Assistant Professor of Soil Health in the Department of Plant, Soil, and Microbial Sciences explores the importance of a complete and well-rounded approach to assessing soil

With her research focusing on the intersection of agriculture and the environment, Dr Sprunger provided this factsheet for farmers interested in soil assessment.

1. What is soil health, and why is it important?

The Natural Resources Conservation Service, a branch of the United States Department of Agriculture, defines soil health as “the continued capacity of soil to function as a vital living ecosystem that sustains plants, animals, and humans”. Soil health has gained heightened attention from both farmers and scientists because of its association with agronomic performance and environmental sustainability.

2. How do you conduct these assessments?

Our lab generally seeks to measure a combination of chemical, physical, and biological processes when we perform soil health assessments. We feel that this approach gives us a more holistic to understanding the health of soil within a given farm. The biological indicators that we focus on include indicators that reflect microbial activity and indicators that directly measure soil biota.

For indicators that reflect biological activity, we like to assess **soil respiration**, which measures a burst of CO2 following soil re-wetting. This reflects a pool of carbon that is most accessible to microbes but can also reflect the amount of soil organic matter present in a given system. This is one of our favorite methods to test on farmer fields because it is susceptible to recent changes in management and can help farmers assess how different management practices might influence soil carbon dynamics.

Next, we like to measure ‘**active carbon**’, also known as permanganate oxidizable carbon (POXC). Active carbon also reflects a more labile pool of carbon, but over time, we’ve started to realize that it reflects a slightly more processed pool of carbon. All this means, is that this carbon is slightly more protected from microbial activity and could serve as an early indicator of soil carbon sequestration. Nevertheless, active carbon is still more sensitive to recent changes compared to per cent soil organic matter.

Lastly, we test **soil protein**, which is a newer indicator that reflects the labile pool of soil organic nitrogen. Soil protein provides an important source of readily available nitrogen. Moreover, it is highly correlated with soil organic matter and has proven to be a strong

predictor of crop yield.

Nematode

Regarding indicators that directly measure soil biota, we like to quantify **beneficial free-living nematodes**. Nematodes are microscopic non-segmented worms that are heavily involved in decomposing organic matter. These free-living nematodes are different from the soybean cyst nematodes that are extremely harmful pests across the United States. These beneficial nematodes are an effective biological indicator to monitor due to their sensitivity to management practices, abundance in soil, their function in multiple trophic levels, and their universal appearance across all soil environments. Nematodes are specialists, meaning that certain nematodes solely feed on bacteria, some only feed on fungi, plant parasitic nematodes feed on plant rooms, predatory nematodes feed on each other, and omnivores, nematodes that change feeding preferences based on the environment and resource availability. Calculating the proportion of these various types of nematodes can tell scientists much about how healthy a given soil is.

Our lab also complements these soil health tests with routine nutrient analyses that are important for assessing soil fertility and cover the chemical aspects of soil health as well as indicators of soil physical health, including aggregate stability and soil texture.

3. What is the link between soil health and ecosystem services?

We are beginning to understand that improvements in soil health are associated with soil carbon sequestration and carbon stability. This is critical as the conversation around soil carbon credits (i.e. paying farmers for sequestering carbon) continues to expand across the globe. Our lab is working on a new project to understand which soil health indicators most accurately predict soil carbon sequestration in long-term agroecosystem trials across the United States.

4. How does climate change influence soil health?

We are only just beginning to understand the impacts the climate extremes have on soil health. A recent study from our lab showed that drought led to reductions in several key soil health indicators, which suggests that extended periods of drought reduces the

overall health of the soil. However, soil health indicators seem to recover once the drought is alleviated, especially in systems dominated by perennials.

5. What is the future of soil health research?

We strongly believe that future soil health assessments need to expand beyond university experimental stations to on-farm trials. Conducting large regional assessments of soil health on-farm is especially important for scientists to understand how soil health changes across different soil types, vast arrays of crop types, and under various management decisions. We also believe that soil health assessments should be more strongly linked with edge-of-field studies to understand how soil health is linked to water quality efforts across the Midwest, USA.

Please Note: This is a Commercial Profile