Technical and Business Information

Soil tests under the microscope in Harper Adams / Agrii project

Simplistic measures of soil health can be extremely misleading. Every one of today's commercially available soil health tests has its limitations. And even if all the most sophisticated and costly one-off biological analyses were to be applied they would provide little or no reliable comparative soil health information. (Tillage & Soils Magazine)

Summary

This is the clear understanding emerging from the latest soil health research by Harper Adams University and Agrii as part of the Horizon 2020-funded Agrocycle project led by University College Dublin; an understanding that presents clear difficulties for farmers wanting to reliably improve soil health, not to mention a Government wishing to incentivise and reward it.

Under the joint EU/China project designed to make the most of agri-food wastes, post-graduate researcher, Ana Natalio has been investigating the best ways of monitoring changes in soil health by measuring biological and physico-chemical parameters.

In pursuit of a practical way for farmers and agronomists to assess the biological status of their soils alongside chemical and physical qualities, she has examined a whole range of bio-indicators from microbial biomass carbon and earthworm ecotypes to springtail groups and nematode communities.

"Soil health improvement has risen rapidly up the agenda for politicians as well as farmers," she pointed out. "At the same time, a wide range of biological tests are being offered and promoted. Unfortunately, though, they all have limitations as useful measures of soil health in agricultural systems.

"Different soil organic matter testing methodologies, for instance, give very different results. Soil organic matter levels change only very slowly. And a favourable balance within the organic matter is as important for soil health and vitality as its absolute level. "While microbes tend to be the dominant group of soil organisms in terms of biomass they respond too rapidly and transiently to changes in management practices and environmental conditions, limiting their practical use.

"Equally, measures of soil respiration tell you nothing about the balance between favourable organisms and damaging ones. Or, indeed, the diversity of their communities which is likely to be crucial for the most resilient soils.

"Earthworms can be a good indicator of soil structure and are important in nutrient cycling. But there are highly productive soils that have very few worms; the balance of earthworm ecotypes is important; and detectable numbers vary widely with soil conditions.

"Springtail populations, which are also good indicators of soil structure and respond more quickly to changes in management than earthworm populations, can vary very widely too, and are difficult and expensive to measure," explained Ms Natalio.

"Of all the bio-indicators we have assessed, nematode populations offer the greatest value in monitoring soil health. They respond distinctively to organic enrichment, environmental disturbance and in their sensitivity to pollutants. In our work we've seen striking differences in nematode communities in response to management changes."

Again, however, nematode analyses to the degree that Ana Natalio has found to be essential as a useful measure of soil health require considerable expertise and are very costly – starting at around seven times a standard soil test. Unfortunately, her research also shows that simple nematode assessments designed to overcome these limitations aren't much use.

"What's important, more than anything else, we've found to be the precise balance of what can be extremely diverse nematode communities," she stressed. "And, even if you know this, you really can't compare measurements from different soils under different rotations and conditions. Instead, you need to establish biological benchmarks for specific sites and monitor them in a consistent and carefully-structured way over time." So, the research shows there is a meaningful way of measuring soil health using biological parameters. Unfortunately, however, it's a way that isn't currently practicable . And, the sheer complexity of soil biology means neither it nor any other test is likely to have any real value on a one-off basis or to make comparisons between fields, let alone farms.

Under these circumstances, how can land managers reliably plan to improve soil health ? Or, indeed, how could they be rewarded for doing so under the new post-Brexit environmental land management system

? After all, as the saying goes, ‘you can’t manage something you can’t measure.’

Well, senior agronomist, Andrew Richards of project partners, Agrii believes there is a way round this apparent impasse for both farmers and Government; a way which involves applying a number of well-understood soil health improvement approaches in carefully-planned and recorded strategies.

“Research confirms that nematodes and other soil fauna and flora are extremely sensitive to one soil parameter we can and do measure easily and regularly – pH,” he noted. “So, maintaining soil pH between 6.5 and 7.5 is obviously essential in any improvement plan; all the more so for its value in ensuring the best-balanced nutrient availability.

“We know too that well-structured soils are vital to soil health in arable regimes, as is the right – which generally means less – tillage, good crop rotations, less bare soil over the winter and organic matter addition. At the same time, we know that all soils and farming systems are different.

“Until we have the reliable soil health benchmark data we need, our improvement efforts really need to be focussed on specific management plans involving things we can actually measure,” he reasoned. “Plans that reflect our particular systems; are geared to what needs to be achieved; and are flexible enough to be adapted to changing seasonal challenges.”

Andrew Richards insists that improving soil health and resilience has to be a key priority for many growers. If they are to achieve this without simply adding extra cost to their farming for what, at present, is likely to be only limited benefit, he sees good science and down-to-earth thinking as essential on the part of all concerned.

“At the moment, soil health testing is a perfect example of just how dangerous a little knowledge can be,” he said. “In exactly the same way we’ve found with cover cropping in so many cases.

“Our Agrocycle project work with Harper Adams is providing a timely injection of scientific reality into soil health measurement, underlining just how biologically complex soil is and how many things about it remain to be fully understood.

“The bio-indicators currently available provide only a very partial idea of soil health. What’s more, as with biological activity in general, they fluctuate throughout the year and are very dependent on weather and environmental conditions well outside the control of any farm management.

“This makes it imperative that soil health improvement efforts and any future agricultural support payments linked to them must be based on the application of ‘defined good practice’ and not on any simple test, however attractive this may appear on the surface.”

Tillage & Soils Magazine

Year of Publication	2019
Author(s) / Editor(s) / Creator(s)	Tillage & Soils Magazine
Source organisation	Food and Farming Futures
Review Status	An item subject to the uploading institution’s process of internal review
Type	Briefing
Language	English
Copyright statement	Tillage & Soils Magazine
Usage Licensing	Available for use or reuse subject to terms and/or attribution - as displayed within the item
Directly Accessible (from OFI)	False

This item is categorised as follows:

Category: Administrative Collection / Featured; Evidence for Farming Initiative Collection / 1. Reducing Emissions through Increasing Productivity / 1.1 Improving soil health; Food and Farming Futures Collection / Information Blog Summaries; Subject Collection / Soils & water / Soil management

Tags