

UNLOCKING SOIL HEALTH

GREATSOILS AHDB

Kick-started by AHDB Horticulture in 2015, the GREATsoils programme helps farmers and growers to unlock soil health. Audrey Litterick, Earthcare Technical Ltd, explains what soil health is and the ways in which it can be measured and managed.



Audrey Litterick

The land is the beating heart of the crop production system. When it's in good health, the life it supports (including the crops) thrives. The trouble is, it's not always easy to measure the health of the soil directly and, all too often, reliance is placed on the 'indirect' measures – e.g. the hard-to-work soil, the slow-to-drain patch and the low-yielding crop areas.

As soil health has a clear impact on profit margins, it's essential to get a better handle on measuring it. Many growers have become aware that their soils have suffered following years of intensive cultivations with little or no organic matter returns. There is now an increasing desire to 'fix' the problems of the past by adopting more sustainable practices.

When a change in practice is made on the farm (such as a using new piece of cultivation equipment), however, it's important the impact of the change is assessed. But where do you start? Well, the key is to have a firm understanding of health of the soil prior to making the change. Only armed with good 'baseline data' can the impact of management changes be evaluated effectively.

The first three years of the GREATsoil programme was led by the Soil Association and involved Earthcare Technical Ltd and the Organic Research Centre. Focused on fruit, vegetable and salad production, the work looked at how growers could assess the health of their soils and take practical action to improve management.

SOIL HEALTH DEFINED

Before we go any further, it's important to take a look at a definition of 'soil health':

"The capacity of soil to function as a vital living system, to sustain plant and animal productivity, maintain or enhance water and air quality, and promote plant and animal health"

To manipulate this living system, you need to be aware of the three key components of soil – physical, chemical and biological – all of which can be measured in various ways.

- Physical components include soil structure and the degree to which water infiltrates down through the soil profile

- Chemical components include soil pH, crop nutrient indices and soil organic matter content
- Biological parameters include earthworm numbers, soil respiration and the degree of diversity in microorganism populations

The results obtained when soil health is measured are affected strongly by the ways in which soils are managed. Of course, some aspects of soil cannot be changed – e.g. soil depth and the relative percentages of sand, silt and clay – but it is worth being aware of these properties too, since they can impact strongly on the way in which soils behave under different management strategies.

SOIL HEALTH MEASURED

Soil health is complex. It cannot be assessed adequately by looking at a single measure, such as soil pH, soil compaction or earthworm activity. Although some parameters are arguably more useful than others, it is recognised that several parameters need to

be measured in order to give a useful indication of soil health. These parameters should:

- Be easy (and ideally relatively inexpensive) to measure
- Indicate changes in soil functions (eg nutrient cycling)
- Encompass chemical, physical and biological properties
- Be accessible to all users
- Be applicable across a wide range of soil types and UK climate areas
- Be sensitive to changes in management

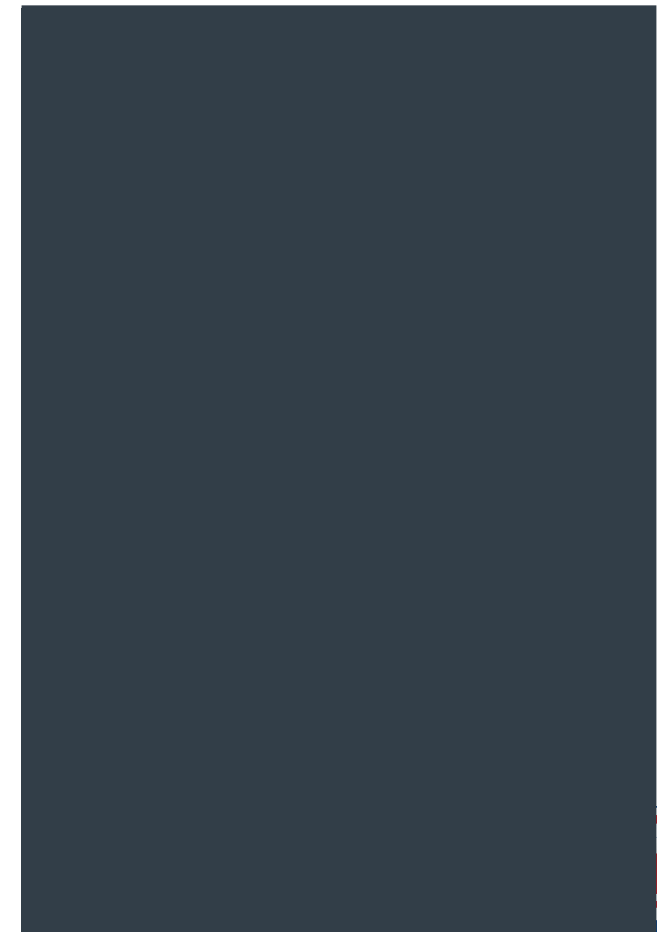
There is a wide variety of soil assessment methods and techniques available. An important element of initial work in the GREATsoils project was to work with growers to identify the best methods for use in UK soils, to evaluate them and then test them in the field with eight grower groups. The key evaluation methods are listed in Table 1.

Table 1. The main physical, chemical and biological soil health assessment methods

Technique or test	Skill needed by grower	Time input	Cost	Of practical use to farmers and growers?
PHYSICAL				
Soil compaction test	Low	Small	Low	Very useful
Infiltration test	Low	Moderate	Low	Useful
Visual evaluation of soil structure	Moderate	Moderate	Low	Very useful
Full soil profile investigation	High	Moderate	High (if paid help needed)	Very useful
CHEMICAL				
Soil pH	None (test done by lab)	Small	Low	Vitally important
Extractable P, K, Mg	As above	Small	Low	Vitally important
Base cation/saturation ratio	As above	Can be high	High	Some growers like it but scientific evidence, at present, is limited
Soil trace elements	As above	Small	Moderate	Often useful, particularly with fruit and vegetable crops
Soil organic matter (Loss-on-ignition)	As above	Small	Low	Vitally important
BIOLOGICAL				
Earthworm counts	Low	High	Low	Useful
Soil respiration	None or low	Small	Moderate	Moderately useful and interesting but difficult, at present, to relate results to the potential to improve crop quality and yield
Soil foodweb	None (test done by lab)	Small	High	Interesting for those interested in soil life but difficult, at present, to relate results to the potential to improve crop quality and yield



Audrey Litterick describing methods for soil structure evaluation



UNEARTH A WEALTH OF INFORMATION ON SOIL MANAGEMENT AT AHDB

AHDB provides information on a range of soil assessment methods, as well as guidance on actions to take. Factsheets, case studies, videos, webinars, grower blogs and research reports are available at ahdb.org.uk/greatsoils

The AHDB GREATsoils programme continues, with new projects involving farmers and growers to improve soil knowledge and develop innovative techniques.



ORGANIC MATTER IN A HIGH-VALUE ROTATION

David Aglen is Farms Manager at Balbirnie Home Farms, a 1200ha mixed farming enterprise in rural Fife, 35 miles north of Edinburgh. His soil is a moderately varying sandy loam with a sandy subsoil. This allows a varied rotation which includes carrots, potatoes, cabbages and cauliflower, as well as combinable crops, grass and forage crops for the cattle enterprise.



David said: "Nurturing the fragile structure of these soils, while growing mechanically intensive crops, is becoming a major driver of the rotation. An absolute minimum level of cultivation is used for the establishment of the combinable crops, along with a vegetable and root crops only being grown one year in four across the 900 ha of cropped land."

David is keen to maintain or increase soil organic matter levels on the cropped fields and, to that end, chose to look at the impact of using chopped straw and green compost on soil health as part of the GREATsoils project.

David chose a 10ha field with a sandy loam topsoil, which he felt was in need of some organic matter, and set up a trial. The field was in a high-value arable/vegetable rotation, with carrots and potatoes, each being grown roughly one year in six, and cereals and cover crops being grown in the intervening years.

TRIAL FACTS

- After carrot harvest in April 2017, the field was divided into four treatment areas. The eastern half of the field had chopped straw applied at

approximately 50t/ha and the western half no straw. The northern half of the field had compost applied at 20t/ha and the southern half had no compost.

- Soil physical, chemical and biological assessments were made prior to the 2016/17 carrot crop, during carrot growth, at barley growth stage 31 in 2017 and after barley harvest in October 2017.

TRIAL FINDINGS

- Bulky organic materials can have multiple benefits to soil health including:
 - Liming value (in some cases)
 - Nutrient value (P, K, Mg, S and trace elements)
- Organic matter – which can improve soil water holding capacity, soil structure, nutrient retention and the activity of soil organisms (including microorganisms and larger soil fauna such as earthworms).
- Regular inspections of soil structure, through frequent test digs and allocation of structure scores (e.g. Visual Evaluation of Soil Structure – VESS)

can give quick, useful indications of the physical aspects of soil health but can have limited value where intensive cultivations are regularly carried out.

- Earthworm counts are a useful indicator of soil biology but to count them properly is time consuming. Quick test digs (removal of a spadeful of soil) can also give an indication of earthworm numbers but care should be taken when interpreting such 'quick looks', since it is very easy to miss small earthworms and reliable, representative data can only be gained by averaging the number of earthworms found over at least four pits in a field (taken regularly at similar times of the year, every year).
- Soil respiration measurements are a relatively new method for estimating the biological life in soil on farms. Further results must be gathered on different farms, soil types and growing systems in order to learn how to interpret the data gained and take actions based upon it.



David Aglen hosting one of several farmer meetings held during the GREAT soils field trial at Balbirnie Home Farms

DAVID'S VIEW

While there are well-established laboratory methods for soil chemical analysis and a range of practical methods for measuring soil physical properties, we are now seeing methods emerge for soil biological analysis. David feels some of these tools have started to provide him with the reassurance that the innovations he's introducing to his mechanically intensive vegetable production system are having a positive impact on the health of his fragile soil.