

Soil Health

Introduction

Soil management plays a key role in establishing a consistent crop with the right plant population to maximise yield. An important part of managing soils is understanding if your soil is in good health allowing you to identify if your management is optimising soil performance or if it can be improved. This Factfile will focus on how to assess your soil health. This forms the basis for decisions on cultivation type and timing which is covered in the Tillage fact file.

It is important to undertake soil testing for plant nutrients and pH to ensure good crop health. The tests do not, however, provide a measure of overall soil health. To understand how to measure soil health effectively and efficiently on farm, BBRO worked in collaboration with AHDB on the five-year Soil Biology and Soil Health (SBSH) Partnership (2017-22) which led to the AHDB GREATSoils program.

To understand if we are improving or maintaining soil health BBRO recommends the soil health scorecard approach developed as part of this program.

This section will guide you through soil sampling, analysis and interpreting results using the soil health scorecard approach.

Key Points

- Sugar beet is very sensitive to poor soil health, especially soil structure
- BBRO trials and monitoring of commercial crops consistently identify soil health as one of the most important yield limiting factors
- Improved soil structure and health is clearly linked to improved plant populations and resilience to stress, especially drought
- Production of a good quality and healthy seedbed is key to early and rapid canopy growth
- Decisions on subsoiling, ploughing and reduced tillage should be based on measuring soil health and conditions

Part 1: Sampling strategy and frequency of sampling

The soil health scorecard requires assessment of:

1. Soil structure – using VESS (Visual Evaluation of Soil Structure)
2. pH
3. Extractable nutrients (phosphorus, potassium and magnesium)
4. Earthworms
5. Soil organic matter

The frequency of assessment for these differs as follows:

Annual assessments: VESS and earthworm counts should, ideally, be done annually at the same time of year (usually spring and/or autumn).

Assessments every 3-5 years: chemical tests, for pH and nutrients, should be conducted at least every three to five years.

Assessments less than every 5 years: soil organic matter changes relatively slowly. There is little point in conducting tests for soil organic matter more often than once every five years, potentially only every 10 years, unless significant amounts of organic materials have been applied annually.

Soil health scorecard sampling strategy

For the soil health scorecard, the guidance is to record a centre point for the assessment area and to take samples up to 5m away from it (at random points). For visual assessments of soil structure (VESS) and earthworms, take three samples (illustrated by the orange squares below). How to undertake a VESS is covered in part 2 and earthworm assessments in part 3.

For other indicators, take several samples (illustrated by the blue stars).
Analysing samples for soil nutrients, pH and organic matter is covered in part 4.



Do not sample:

- Within six months of a lime or fertiliser application (except nitrogen)
- When the soil is very dry
- In headland or in the immediate vicinity of hedges, trees or other unusual features

Effective record-keeping

Keep good records, to track changes in soil health over time. Ideally, a file for each field should be kept. Laboratory results, notes on soil profile, soil structure assessments and yield figures are important. Additional information, such as comments on weather, soil conditions and ease of cultivation, is also worth keeping on record.

There is a free to use soil health scorecard spreadsheet on the AHDB soil health scorecard website which is outlined later to support this.

Part 2: Visual Evaluation of Soil Structure (VESS) – orange squares on sampling diagram

How to assess soil structure

Soils should be assessed when they are moist and soil aggregates are easier to break up by hand. Avoid assessing soils during prolonged spells of wet or dry weather. Wait at least one month after cultivations.

Step1: Surface assessment

Assess the cover (grass sward, crop or residue) to identify moderate or poor areas that require further assessment.

Good

- Good cover
- No standing water
- No poaching and/or deep wheelings

Moderate

- Poor cover (or with more weed species in grassland)
- Some standing water
- Some poaching and/or deep wheelings

Poor

- Very poor cover and growth/sward quality
- Standing water and/or surface capping
- Severe poaching and/or deep wheelings

Step 2: Soil block extraction

- Dig out one spade sized block of soil (depth approximately 30cm), cutting down on three sides
- Lever the block out, leaving one side undisturbed
- If the soil block falls apart easily, dig out one block and then a second next to it to assess
- Lay the block on a plastic sheet or tray



Step 3: Soil assessment

Gently open the soil block by hand (like a book) to look for layers.

- If the structure is uniform, assess the block as a whole
- If there are two or more horizontal layers of differing structure, identify the layer with the poorest structure (the limiting layer)
- Record the depth of this limiting layer and carry out the rest of the assessment on this layer

Break up the soil with your hands into smaller structural units or aggregates (soil clumps).

Using one hand, break up larger soil aggregates to assess their strength. Consider their shape, porosity and roots.

Top Tip: Dig in 'good' (eg hedge bottom) and 'bad' (eg gateway) areas to get familiar with soil structure

Step 4: Scoring

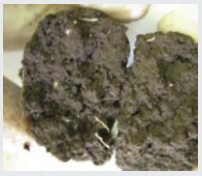
Assign score from table on following page. The information here is based on the VESS method of soil structure assessment:

SRUC Visual Evaluation of Soil Structure

Part 3: Earthworm numbers

Earthworms are a great indicator of soil health so counting the number of earthworms in the block of extracted soil is worthwhile. For detailed information on earthworm assessments refer to the AHDB How to count earthworms guide.

Visual Evaluation of Soil Structure (VESS)

	Score	Soil structure	Soil aggregates	Description	Management options
	Score 1: Good Crumbly (aggregates readily crumble with fingers)			Good soil structure, highly porous. Small, rounded, crumb-like aggregates (<6mm). Numerous, well distributed roots down to spade depth. Sweet earthy smell	No management changes needed, continue routine monitoring.
	Score 2: Good Intact (aggregates easily break apart with one hand)			Good soil structure, mostly porous. Larger, rounded aggregates (2mm-7cm). Numerous, well distributed roots down to spade depth. Sweet earthy smell.	No management changes needed. Re-assess annually on grassland. Continue rotational monitoring on arable land.
	Score 3: Moderate Firm (most aggregates break apart with one hand)			Adequate soil structure, less visible pores. Rounded aggregates, with some angular (2mm-10cm). Fewer roots distributed within soil aggregates. No noticeable smell.	Minimise traffic on wet ground. Infrastructure changes in grassland can help, eg back-fencing, multiple field entrances or tracks. Consider cultivation depth on arable land in autumn.
	Score 4: Poor Compact (effort needed to break apart aggregates with one hand)			Poor soil structure, very few pores. Mostly large angular aggregates (10cm), reduced rooting, clustered in large pores, earthworm channels and cracks between aggregates. Red/orange mottling may be present (sign of poor drainage). May have 'bad egg' smell.	Minimise traffic on wet ground. Check subsoil layers for compaction. Consider targeted cultivations under the right soil conditions. On grassland, consider using a sward slitter or aerator (<10cm depth) and a sward lifter/top-soiler (10-30cm depth). If the sward is poor, consider ploughing or reseeding. On arable land, consider improved drainage and diversifying crop rotations, especially the inclusion of no-till periods (eg ley-arable rotations).
	Score 5: Poor Very compact (aggregates difficult to break apart with two hands)			Poor soil structure, very large pores. Very large angular or platy aggregates (10cm). Few roots, if any, restricted to the surface, down large pores, following earthworm channels or cracks. May be grey/blue in colour, or with orange mottling (sign of poor drainage). Strong 'bad egg' smell.	Minimise traffic on wet ground. Check subsoil layers for compaction. Consider targeted cultivations under the right soil conditions. On grassland, consider using a sward slitter or aerator (<10cm depth) and a sward lifter/top-soiler (10-30cm depth). If the sward is poor, consider ploughing or reseeding. On arable land, consider improved drainage and diversifying crop rotations, especially the inclusion of no-till periods (eg ley-arable rotations).

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Step 5: Management

Consider management options based on the soil structure score and worm count.

Then re-assess:

- After a change in management practice
- After grazing/trafficking on wet ground
- Routinely every two years on grassland
- Routinely after each full crop rotation on arable land

Part 4: Analysing soil for nutrients, pH and organic matter – blue stars on sampling diagram

What can a soil sample show?

Laboratory analysis of a representative soil sample will provide valuable information on the level of:

- Phosphate
- Potash
- Magnesium
- pH
- Soil organic matter
- Micronutrients

How to collect a soil sample for nutrient analysis for the soil health scorecard

In arable and horticultural rotations: at each soil health scorecard assessment location (blue stars on sampling diagram) collect a sample to 15cm depth using a gouge corer or screw auger.

However, if the land is min-tilled, phosphate and potash will tend to accumulate near the soil surface, and a 15cm sample will overestimate nutrient concentrations to normal plough depth. In this case, samples are better taken to about 23cm.

To minimise the impact of local variation (e.g. the presence of old fertiliser granules), mix the samples collected from the sampling areas (blue stars on sampling map) in a clean bag or bucket to form a bulked sample. Send a well-mixed representative subsample to the laboratory for analysis. Use appropriate packaging (normally available from the laboratory) and label samples clearly, providing as much information about the field and crop as possible.

This approach applies to sampling specifically for the soil health scorecard. To analyse soil for crop nutrient management or pH for liming the whole field will need to be sampled in a grid or W pattern.

Part 5: Using the soil health scorecard

Once you have your results you can enter them on the soil health scorecard spreadsheet linked in the introduction or found on the AHDB website.

When your results are entered it will highlight them as follows:
Red – Investigate
Amber – Review
Green – Monitor

Red and amber results can then be explored in more detail with the scorecard providing initial signposting and links to the topic in question. Some of the key factors to consider in relation to the three key pillars of soil health are:

Biological

- Feed the soil regularly, through plants and organic inputs
- Move soil only when necessary
- Diversity of plants in space and time

Physical

- Know soil textures and understand limits to workability and trafficability
- Optimise water balance through drainage if necessary
- Minimise compaction and improve soil structure

Chemical

- Maintain optimum pH
- Apply nutrients at the right amount, right place and at the right time
- Know the impact of soil texture on nutrient dynamics

For guidance on tillage operations to help optimise soil health and crop performance, the Tillage Fact File is a useful reference.

