GREATsoils AHDB Horticulture project CP 107b

Which tests to use to assess the health of your soil?

Farmers and growers are concerned about the current health of their soils (compared to 30 or 40 years ago), and some of these concerns are supported by soil analysis data collected over the same period. Most farmers and growers understand the importance of soil health for the productivity, sustainability and profitability of their business, but many face significant challenges when interpreting results from laboratory analysis or when choosing suitable tools or methods for assessing the health of their soils beyond the standard pH, P, K, Mg analysis. To be of value to growers and farmers, methods for soil assessment should not only measure soil health, but should also provide information that can be used to inform decision making in relation to soil management. This review aims to provide an informative overview of the various tools and methods currently available.

The functioning of soil depends upon a complex interaction between organisms large and small, chemical reactions in solution and on surfaces of clay particles, within a structure determined by natural processes and modified by soil management. A broad range of appropriate indicators of soil health is therefore needed to evaluate the effects and sustainability of agricultural practices. The most commonly agreed and used indicators can be grouped in the three categories of (1) biological, (2) chemical and (3) physical parameters.

A list of the most commonly used indicators for soil health:

Biological indicators	Chemical indicators	Physical indicators
Soil organic matter (SOM)	Nitrogen (N): mineralised N (N-min), ammonium (NH4+), nitrate (NO3-)	Soil structure (e.g. aggregate stability)
Number and diversity of macro- and microorganisms	Macro-nutrients: phosphorus (P), potassium (K), magnesium (Mg)	Compaction
Number and diversity of Mycorrhiza (AMF), and root colonisation	Micro-nutrients: e.g. iron (Fe), copper (Cu), boron (B), manganese (Mn), etc.	Erosion
Number and diversity of earthworm populations	pH	Water-logging
Respiration rates	Electrical conductivity (EC)	
Enzymatic activity	Cation exchange capacity	
Microbial profiling	Salinity	

During a series of grower consultations in autumn 2015, regional grower groups in the UK discussed different approaches to soil assessment; what methods they find useful and reasons why others are not very commonly used. They were asked to rate a list of categorised soil assessment methods, and the results can be seen on the reverse. Links to the various methods are listed at the bottom of the page.

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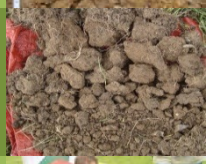
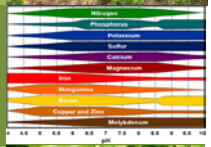
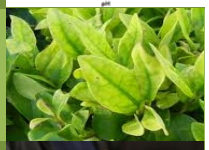
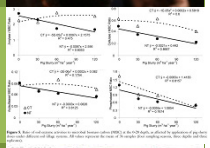
Soil assessment methods evaluated and rated by growers

1 = low; 5 = high rated by growers	Skill required	Time input	Cost input	Suitable for	Not suitable for	Comments from growers	
Spade diagnosis (depth 30cm)	1	1	1	Easy, quick, good indication of soil health, fast general impression of the soil status	Subsoil assessment, quantitative nutrient levels	Most commonly used method, very easy and informative; 'spade is always with me'	
Soil pit/profile (depth range 30-150cm)	3	3	1	Subsoil assessment, horizons and exact location/depth of compacted layers	No quick results, is a rather destructive method, location of sampling important	Very useful results if done properly, good for structure assessment	
Visual evaluation of soil structure (e.g. SRUC VESS tool)	2	2	1	Soil structure and compaction detection	Quantitative assessment of nutrients	Some specific knowledge required	
Visual soil assessment tools (e.g. Eblex-DairyCo. Tool)	1	2	1	Good overview of a wide range of soil health indicators (roots, worms, soil structure, colour…)	Quantitative assessment of nutrients	Assessment speed comes with experience, easy to learn, need the tool only at first	
Earthworm counts	2	3	1	Good indicator for soil structure and health, soil life and activity, soil biodiversity	Quantitative assessment of nutrients, subsoil assessment	Seasonal fluctuations, some skill required for species identification	
Plant health monitoring (current and previous crop, weeds)	1	1	1	Early signs of nutrient deficiencies or compaction	Specific or quantitative information	Seasonal, need some experience and additional tests for details	
Standard Lab test (macro nutrients and pH)	1	2	2	Soil nutrient content P, K, Mg and pH	E.g. soil life, structure, compacted layers, root development	Regularly done, directly informs fertiliser strategy	
Micronutrient test	2	2	3	Trace elements/ micronutrient levels in the soil	E.g. soil life, structure, evaluation of compacted layers	Done only if deficiencies suspected in plants	
Total soil organic matter (SOM) (usually in %)	1	1	1	Total soil organic matter (labile, stable and inert fractions of SOM)	Monitoring labile SOM (providing/ releasing energy and nutrients)	No need to do annually, need specific sampling technique!	
Soil life suites (e.g. Food Web Tests, enzymatic activity, basal respiration etc.)	5	2	5	Bacteria and fungi, number, species and diversity (no standards yet!)	E.g. soil structure, compaction evaluation	Skill required for adequate sampling and high skills for interpretation!	
Soil Health Test (NRM)	3	2	3	Measures pH, avail. P, K, Mg, texture, total SOM and respiration rate	In-depth evaluation and meaningful results/conclusions	Skill required for interpretation of overall results, e.g. respiration rates!	
OM balance modelling tool	5	5	2	Input/output estimation of SOM levels on field or farm level	Beginners in SOM assessment, basic day-to-day assessment	Not commonly used in UK yet, but might be promising planning tool	

Useful links and references	
Visual evaluation of soil structure	e.g. SRUC VESS Tool http://www.sruc.ac.uk/info/120062/crop_and_soils_systems/412/visual_evaluation_of_soil_structure
Visual soil assessment tools	e.g. Eblex-DairyCo.Tool http://dairy.ahdb.org.uk/resources-library/technical-information/grass-management/healthy-grassland-soils-pocketbook
Earthworm counts	www.opalexplorenature.org/earthwormguide www.opalexplorenature.org/sites/default/files/7/file/soil-survey-field-guide-2014.pdf
Soil life suites	Food-web tests, enzymatic activity, basal respiration etc. e.g. www.laverstokepark.co.uk/soil-foodweb-tests.aspx
Soil Health Test	NRM www.nrm.uk.com/services.php?service=soil-health
OM balance modelling tool	Publication on the tool: orgprints.org/12077/1/Brock_12077_ed.doc
Photos from:	ORC, www.scielo.br, www.nrm.uk.com, www.graincrops.blogspot.co.uk, documents.crinet.com