



GREAT

soils

Resilience,
productivity and life

Soil Health and What to Measure

Resilience, productivity and life

Growing Resilient Efficient And Thriving GREATsoils



AHDB Horticulture Project CP 107b aims to:

- * Inspire growers to develop their ability to assess the health of their soil.
- * Give growers practical solutions to improve soil health.

Funded by AHDB Horticulture. Delivered in partnership by Earthcare Technical, Organic Research Centre and Soil Association.



In partnership with:



Soil Health - What to Measure?

- * Introduction - sampling and rationale
- * What to measure in the field
- * What to measure in the lab
- * Grower evaluation of methods

Soil testing - the rationale

1. Identify an area of land to be managed
2. Obtain a representative sample of soil
3. Obtain some information about the soil in that area of land (field/lab tests)
4. Use that knowledge to inform management practices e.g lime application, green manure
5. Repeat soil assessments/tests and review management practices.

Soil Assessment in the Field



- * Spade test and examination



- * Formal visual assessment



- * In-field measurements e.g. infiltration

Signs of Healthy Soil in the Field

- * Aggregates of particles 1-10 mm dia which remain stable when wet.
- * Earthworm population (standardised method should be used e.g <http://bit.ly/2byJR37>)
- * Assess earthworms in spring or autumn to avoid cold or dry soil.



Lincolnshire Fens

Soil capping
(poor infiltration
of water and
agrochemicals)



Soil compaction
(poor root growth,
water-logging and
lack of oxygen)

Visual Soil Assessment

- * Soil structure
- * Soil porosity
- * Soil colour
- * Soil mottles
- * Earthworm count
- * Tillage pan



Score + Weighting = Ranking

Testing in the field

Infiltration of water

- * Simple infiltrometer
- * Effect of compaction



In coriander bed



In wheeling



British Herbs Field Day
August 2016

Soil Testing in the Lab

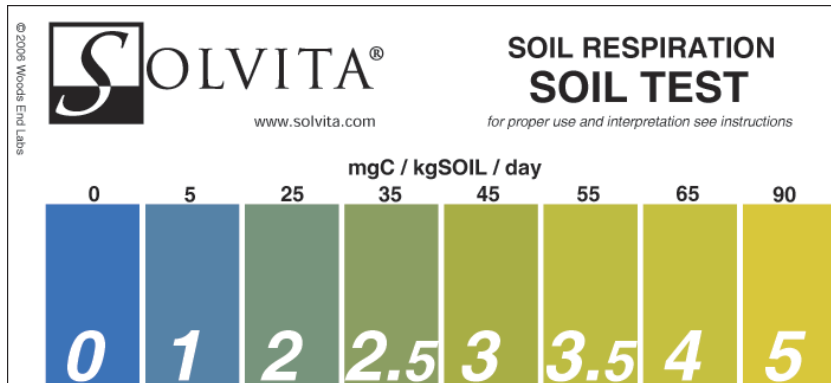
- * Soil pH
- * Soil phosphate
- * Exchangeable cations
- * Micro-nutrients
- * Soil organic matter
- * Soil respiration
- * Soil Health Index



Soil Respiration Measurement

An indicator of biological activity in soil

- * Measure CO₂ release from soil
- * Solvita test (first generation)
- * Standard volume of soil
- * Visual colour chart system



In partnership with:



Soil Respiration Measurement

An estimate of soil microbial biomass

- * Drying and re-wetting of soil
- * Measure burst of CO₂ that follows
- * Digital colour reader for accuracy
- * Estimate of soil microbial biomass
- * Correlated with N, P mineralisation



In partnership with:



Soil Health Index

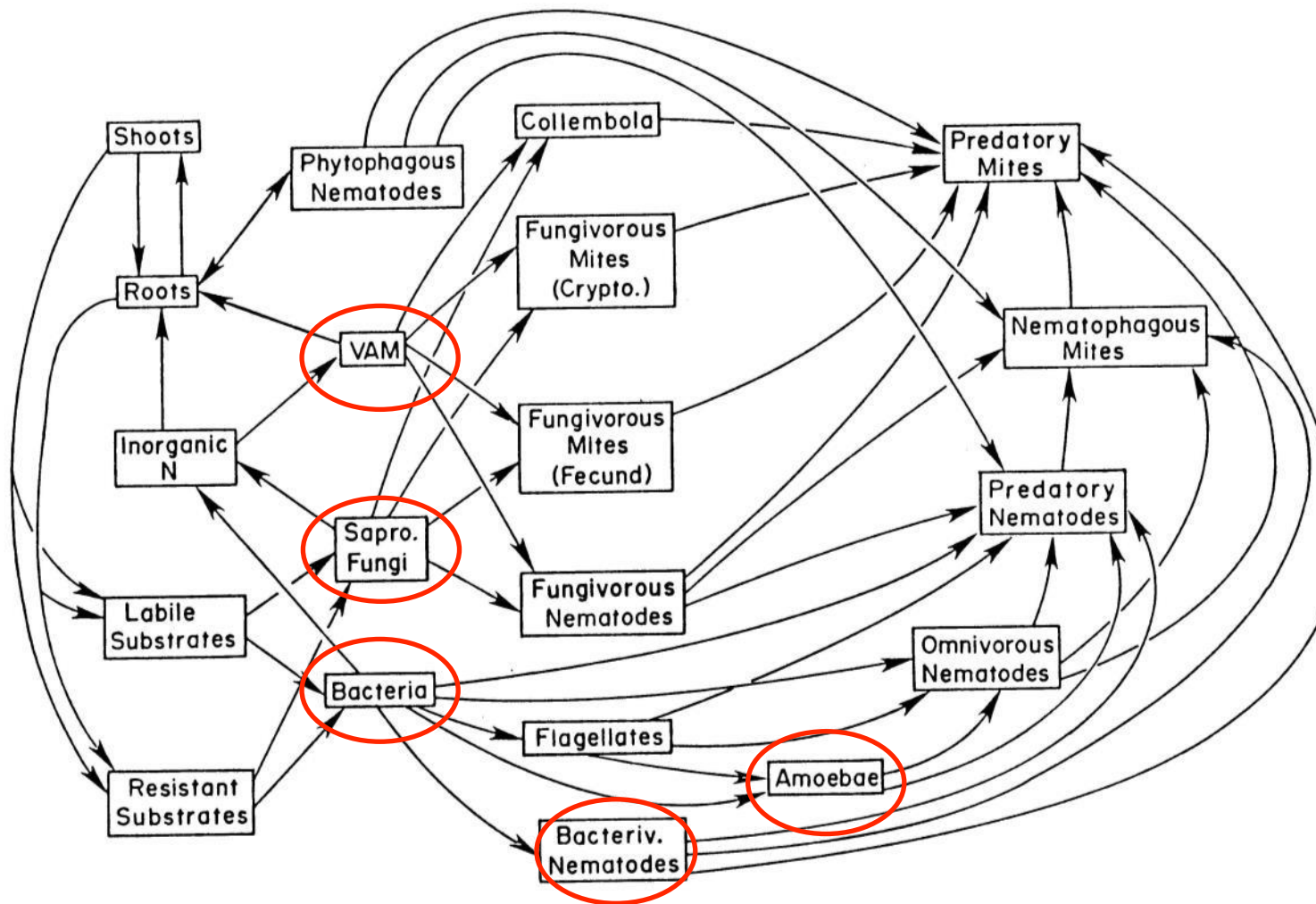
based on lab and field data:

- * pH, P, K, Mg
- * texture, organic matter
- * CO₂ burst test
- * earthworm numbers
- * compaction
- * crop symptoms
- * to give an overall index.

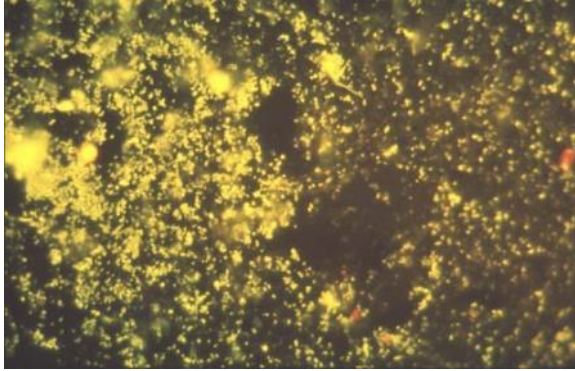


A guide and interpretation
for the NRM Soil Health
Analytical Package

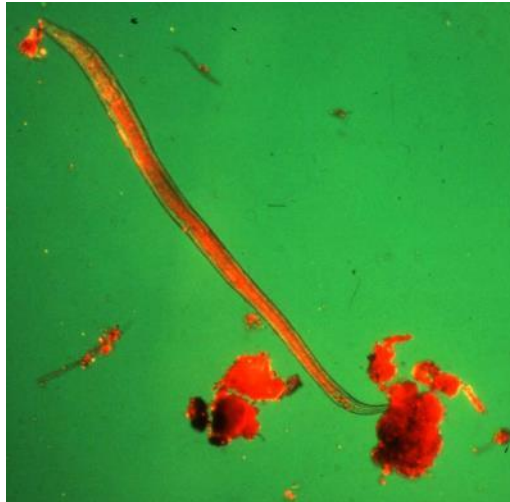
A Soil Food Web



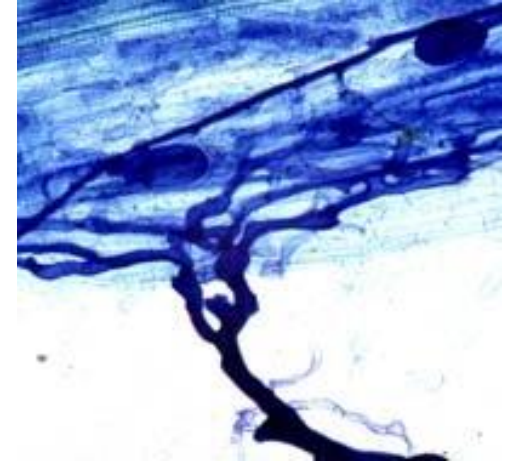
Soil under the Microscope



Total bacteria



Free-living nematodes
(non-pathogenic)



Mycorrhizal fungi
(Vesicular arbuscular)

Beyond Soil Organic Matter

- the light fraction

- * Different fractions based on size and density of the individual particles
- * Particles of low density $<1.7 \text{ g cm}^{-3}$ = the light fraction
- * Includes physical remains of plants and animals, root fragments and fungal hyphae
- * Subject to relatively rapid decomposition.

Grower evaluation of soil assessment methods

- * Plots on grower sites
- * 6 sites in England and Scotland
- * Field veg and protected veg
- * Field salads and protected salads
- * Top fruit
- * Conventional and organic



Grower evaluation of soil assessment methods

- * Earthworm counts
- * Soil respiration
- * Soil food web
- * SOM Light fraction
- * Ongoing 2016-17



Valefresco - Protected Salads

- * Rocket and spinach
- * Sandy loam soil
- * Trialled green manures
- * Buckwheat, Phacelia 6 weeks
- * Soil Respiration
- * Soil Health Index



Soil Health Index

sandy loam, salads

pH	P Index (mg/L)	K Index (mg/L)	Mg Index (mg/L)
6.5	4 (48)	2- (134	3 (104)

Organic matter (%)	CO ₂ burst (mg C/kg)	Texture	Soil Health Index
2.5	35	sandy loam	3 (out of 5)

Further information

AHDB Information Sheet 05
Summer 2016

AHDB GREAT soils
Sustainable
Productivity
Soils

Soil assessment methods

Soil health

Farmers and growers are concerned about the current health of their soils, 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 methods for assessing the health of their soil, beyond the standard pH, phosphorus (P), potassium (K), magnesium (Mg) analysis.

To be of value to farmers and growers, 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 information sheet provides an overview of the various methods currently available.

Latest information	Action
A number of new methods are available that require careful comparison and interpretation.	Develop a soil management plan taking into consideration physical, chemical and biological indicators of soil health.
Assess soil health, beginning with assessment of soil characteristics with (preference) those that are most complex.	Use where possible in 'good' and 'bad' areas of the field, representing different soil types, diverse soil health, and structure.

Assessment methods

During a series of grower consultations in autumn 2015, regional grower groups in Great Britain discussed different approaches to soil assessment, what methods they used and reasons why others are not very commonly used. They were asked to rank a list of categorised soil assessment methods, and the results can be seen in the table.

Indicators of soil health

The functioning of soil depends upon a complex interaction between organisms, plants and animals, chemical reactions in solution and in surface of soil particles, water, a distinct self-sustaining nature processes and modified by soil management.

A comprehensive appreciation of indicators of soil health can therefore be used to measure the effects and sustainability of agricultural practices. The most commonly agreed and used indicators can be categorised into three categories of biological, chemical and physical parameters.

Further information

AHDB Horticulture, Horticulture and Land Use packages can be found at: www.aahdb.co.uk
 AHDB Potatoes, Potatoes and Land Use packages can be found at: www.aahdb.co.uk
 AHDB Cereals & Oilseeds, Cereals and Land Use packages can be found at: www.aahdb.co.uk
 AHDB Horticulture & Land Use and AHDB Dairy Soil Management plans for arable crop production (AHDB HRC)

The information sheet was funded as part of an AHDB Horticulture project CP 1070 and is a collaboration with the Soil Association, The Organic Research Centre and Earthcare Technical. Further information is available in a more detailed Regular review of soil assessment methods, conducted in 2015 by Aron Vetterli at The Organic Research Centre.

Soil Association, GREAT soils, Earthcare Technical

AHDB Information Sheet 05 Soil Assessment Methods
<http://bit.ly/2aqJx5b>

AHDB Information Sheet 06
Summer 2016

AHDB GREAT soils
Sustainable
Productivity
Soils

Project CP 1070 Soils Case Study 1

Compost is good news for soil health

Background

Deciding which type of compost is best for your soil and growing system is not easy. It is well known that many soils and cropping systems are suffering from a lack of organic matter (OM). Farmers and growers often want to add OM to maintain or enhance soil organic matter (SOM) content, but it is difficult to choose the best type of material to achieve this purpose. Recent work has shown that when improved soil health is considered, not all forms of OM are equal. This case study outlines recent findings from the Waste and Resource Action Programme (WRAP) 'Digestion and compost in agriculture: CO2-Agri' project on the soil health advantages and financial benefits of using compost.

There is clear evidence that composts can bring significant benefits to soils, particularly when used repeatedly over several years.

SOM is the organic component of soil, consisting of three main parts: fresh plant residues and small living soil organisms, decomposing organic matter and stable OM (humus). OM is important to soil fertility and crop productivity, building and maintaining it is a vital component of sustainable soil management. The amount of OM in soils depends on soil use, the relative proportions of crops, all and dead, animals, the types and composition of organic materials, the rate at which OM is decomposed, and the type of farming system employed.

Soils used for arable and vegetable production contain typically 1-3% OM (generally higher in Scottish soils). Depleted soils usually contain more capacity when compared with a continuous arable system. In general, for any one cropping system, the natural level of SOM in a soil will be higher than that in a nearby field. It will be almost always good to aim to increase your SOM content, vegetable growers on a sandy soil should not expect to achieve and maintain the same SOM contents as pasture fed livestock producing fields on an heavier soil.

Benefits of increasing SOM

When SOM content increases, farmers and growers report seeing many benefits to soil workability and crop performance. The CO2-Agri project confirmed that increases in SOM following repeated compost additions were associated with improvements in other soil properties. For example:

- Increases in the total weight of microorganisms
- Increases in soil fertility (amounts of crop nutrients present)
- Increases in soil water holding capacity in some of the lighter soils
- Increases in the soil's ability to retain nutrients (as measured by the soil's cation exchange capacity)
- Resilience in soil bulk density (affects the weight of soil per unit volume)

High soil bulk density values do depend on an water on the soil before but are also associated with compaction, poor structure, and a lack of pores and channels to allow air and water movement. Many farmers now report that they require larger machines to cultivate their soils. This reflects increased soil bulk density, which are often associated with reductions in SOM content.



Practical considerations

Using compost costs money. Users have to buy the material itself and then use for storage and application (Figure 1 and 2). The cost effectiveness of compost use in specific situations has to be considered first.

The online WRAP calculator www.organiccalculator.co.uk helps farmers and growers get to grips with compost use finance. The calculator assesses the financial value of compost, based on current fertilizer prices and the compost nutrient content. Users need to know the nutrient content of the composts they wish to apply – report analysis of the actual products to be applied must be used. If available, but if this information is not available then average values that are given in table 1 can be used.

AHDB Information Sheet 06 Case Study 1

Growing Resilient Efficient And Thriving GREATsoils

- * Webinars
- * Publications
- * Workshops

WEBINAR: Managing soil health using organic manures

Date: 7 October 2016

Time: 13:30 PM - 14:30 PM



GREAT
soils

In partnership with:

AHDB
HORTICULTURE

Soil
Association

THE ORGANIC
RESEARCH
CENTRE
ELM FARM

Earthcare
TECHNICAL



GREAT
soils

Resilience,
productivity and life

Get in touch
GREATsoils@soilassociation.org
www.horticulture.ahdb.org.uk/great-soils
@GREATsoils