



AHDB GREATsoils Programme

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AHDB is a statutory levy board, funded by farmers, growers and others in the supply chain to help the industry succeed in a rapidly changing world















What we do at AHDB



Research & knowledge exchange



Market intelligence



Exports



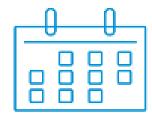
Marketing



Education



The environment



Events



Skills programme



No-till farming

Quantifying soil improvement

Effect of chemistry on soil biology

Cover crops

Micronutrients and bio-stimulants

Straw utilisation and soil carbon reduction

Soil indices and thresholds of soil health

Strategies to build organic matter levels

Which cultivation systems have the best impact on each soil type

How to make nutrients and nitrogen more available to crops

Benefits of including livestock in arable rotations

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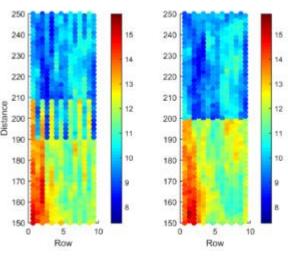
Integrated programme of research and knowledge exchange



NFLTRATION TEST

- Rotations
- Cultivations
- Compaction
- Organic matter
 - Soil nutrients
 - Cover crops
 - Soil biology
 - Soil health
- Precision farming





GREATSOILS **AHDB** Field drainage guide
Principles, installations and maintenance



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Street A & ALDE Healthy grassland soils Four quick steps to assess soil structure

Step one: Surface assessment Look at the quality of the oward to rearrish potentially duringed areas that require further assessment. Where the sward is moderate or poor, this may indicate that further investigation of the soil quality is required.



 Sweet intent No pouching Few wheelings

 Surface nourner Whoolings in place More weed species · Surface cyconics

 Soli exposed Save a nevening

· Poor sward quality

Step two: Soil extraction

Dig out one spude-sized block of soil (depth upprax, 30cm). Cut down on three sides and then lever the block out, leaving one side undisturbe

problem (eg a geteway) and get familiar with signs of soil seucoure damage. Remember: Sumple when the topsoil is most - if the soil is too dry or too wel, it is difficult to distribution again of poor soil tracture.



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Soil pH - how to measure and manage it based on an understanding of soil texture As dray Storick, Participe Seriestral





Applied policits for farmers and growers Kindowskia tearriera and rygos of dodes on your holestee.

That you need get regarding (at least cook somey train yours and cooking cooks divery time points it you are a high nature as up grown over a light soft and and integer if the reas to be seen only to your own soft

care farm and be prepared to speed manay on more samples, where you fled cyclomus that call. pur costo de impacting de criso jueix or where you suspecting determinate in soil pri witten bess Lie aware trut some organic huserues appear to angrove somewith (e.g. composts, organizate)

most, while the same goes from I to 14 paths a hazard pit expension for T iff most applications across better pH visited. If Indicates R R and T R. The pH week to began the state in a find to a period K is, the firms presented to the an added K. The serious priof also is determined by as chemical composition, but enot agreedure note with resout per return of the their to the process scient over time and require spondstone of sime mis per needed to indiman dos bill at taken if guren

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Compost is good news for soil health

Case Study 1 - Audrey Litterick, Earthcare Technical





Alm to increase your Soil Organic Matter (SOM) levels, as this can have multiple benefits for soil health. Adding compost to your soil is an effective way of increasing SOM. In trials, compost increase SOM in half the time of farmyard manure.

Soil Organic Matter (SOM) is the organic component of soil. onsisting of three main parts

. Fresh plant residues and small living soil organisms . Decomposing (active) organic matter and

. Stable organic matter (humus).

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Soil structure and infiltration

Although average annual rainfall for England and Wales

hasn't changed significantly since records began in 1776.

all regions of the UK have experienced an increase in heavy rainfall events in winter. These events are not restricted to winter: the spring of 2012 saw exceptionally

wet weather which affected all of England, Wales and

of erosion. Improved infiltration also retains more water

within the soil rooting zone for use by gropp and reduced

There are peveral ways to appear the rate of infiltration of

water into soil (the hydraulic conductivity), with the more

sophisticated methods giving more detailed information. For example, a Mini Diak Infiltrometer (Figure 1) not only

This factaheet outlines a simple method for measuring infiltration in the field. It also explains how adding organic matter to soil can improve soil structure and

Action points

- Improve soil atructure to increase the ability of soil to absorb and retain water
- The use of organic materials such as compost could lead to an increase in soil erosion and the associated loss of nutrients such as phosphate to drains and rivers. Managing soil health, in particula and green manures can improve infiltration and the ability of soil to absorb increasingly intense naintaining good soil structure, is an essential part of the strategy to improving resilience to changing rainfall intensity. Improving the ability of soil to absorb water during intense rainfall events (infiltration) reduces the risk. Use the drainpipe test as a cheep and simple
- way to measure the infiltration of water into soil. When combined with the spade test, the causes of reduced infiltration (eg compaction at depth) can be quickly identified
- soil erosion and the loss of nutrients from land

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How to count earthworms

Earthworms improve plant productivity, are principally esponsible for engineering the soil environment and are an important food source for native birds such as the song thrush. There are up to 10 common earthworm species in agricultural soils and these can be grouped into three ecological types: epigeic, endogeic and anecic earthworms each group having a unique and important function.
 Earthworms are an indicator of soil health, being impacted try pH, waterlogging, compaction, fillage, rotation and

organic matter management How to identify earthworms

- . Small (c6cm) in size, typically about the length of a matchstick . Often fast-moving (most likely to escape from the worm pot);
- Sensitive to: Tillage (defrimental) and organic matter management such as manure applications (beneficial).

- · Pale-coloured and green worms incl redi-
- . Small to medium size
- . Often curl up when handled, and green worms may emit a yellow fit.
- . The most common earthworm group found in arable fields. Sensitive to: Organic matter management (beneficial)

Roles: Soil aggregation and nutrient mobilisation for plants

. Dark red or black-headed worms

- or midden residue piles
- from ploughed fields and where there is no surface litter such as manum applications and strow return (beneficial) Rolles: Deep burrows that improve aeration, water infiltration and root development.



Soil assessment methods

New methods of assessing soils are available,

Assess soils beginning with methods which you understand, before progressing to those

Appear and texture and structure in several locations representing 'good' and 'bad' areas within a field and compare results with those of

Develop a soil management plan which takes into account physical, chemical and biological indicators of soil health

but they require careful consideration and interpretation

that are more complex

un-cropped field margins.

Action points

 A good presence of earthworms across a field means the benefits are likely to be widespread High numbers of earthworms indicate the potential for significant benefits to plant

The presence of each ecological group

indicates the potential for specific earthwo benefits, such as carbon cycling, nutrient mobilisation and/or water infiltration

Epigaic (litter-dwelling earthworms)

. Dark red-headed worms

Boles: Carbon cycling and prey for native birds

Anecic (deep burrowing earthworms)

- . Large size č-8cmi, typically smilar size to a pencil
- . Make deep vertical tunnels, up to 2m
- . Often found below surface earthworm cast:
- . Feed at night, foraging the soil surface. . Commonly found in grassland but often absent.
- Sensitive to: Titiage (detrimental) and organic matter management

Many farmers and growers are concerned about the health of their soils. They understand the importance of soil health for the productivity, austainability 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 soils 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 they should also provide information that can be used to inform decision making in relation to soil management. his factsheet provides an overview of the various nethods of soil testing that are 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; all within a structure determined by natural processes and modified by soil management.

A broad range of appropriate indicators of soil health are therefore needed to evaluate the effects and austainable 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:

During a series of regional consultation meetings in autumn 2015, horticultural growers in Great Britain discussed different approaches to soil assessment. methods they found useful and reasons why others were not commonly used. Growers rated the methods and the results are given overleaf.

Further information

This factsheet is an output of the AHDS Horticulture GREATsoils project CP 107b.

More information on soils and soil management is available on the AHDB website at ahdb.org.uk/greatsoils

Testing soil health



- Develop a five-year soil health testing action plan for your farm
- Be clear on the reasons for testing soil health Prioritise fields for soil health testing.
- especially where money and time are limited · Compare the best performing field areas with
- Choose soil physical, chemical and biological tests based on the main priorities and concerns
- Keep good records to track changes in soil
- Collect additional weather data and information on crop yields, quality, health and ease of cultivation

What is soil health?

Soil health is the ability of a soil to sustain, in the long term, its most important functions. A healthy soil will be able to sustain crop and livestock productivity and maintain or enhance environmental benefits. It requires a good balance of physical, chemical and biological soil properties, many of which can be tealed:

Why test soil health?

A field's soil health can often be improved and many farmers and growers consider adopting new approaches to achieve these improvements.

When planning major changes to a production system leg a move to reduced tillage systems, an increased use of composts, green manures and cover crops reintroduction of livestock or incorporation of crop residues), it is particularly important to gather good

By testing a range of soil physical, chemical and biological properties, a good overall picture of how they affect the productivity of the land will be obtained. Over time, baseline information can be used to make management decisions that meet your objectives and help you menture ruccens

The following flow chart summarises the main considerations when planning and managing the

health of your soil.

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Soil management information system



- Developed by Cranfield University and PGRO with funding from AHDB
- Cloud-based software package
 - draws together data on soil management from growers (anonymously), research projects and literature
 - presents information that helps farmers and growers make decisions on soil management
- Software and user manuals will be published by AHDB in 2019
- AHDB is looking to develop the software in partnership with other organisations





GREATsoils Partnerships

Research and Knowledge Exchange



Rotations Partnership





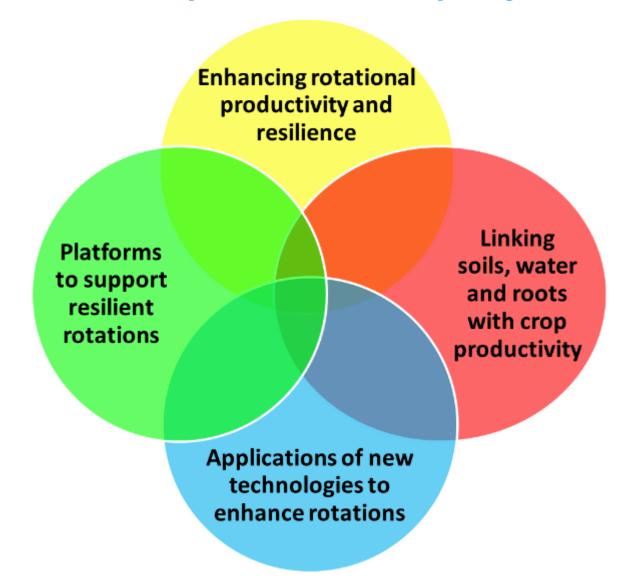








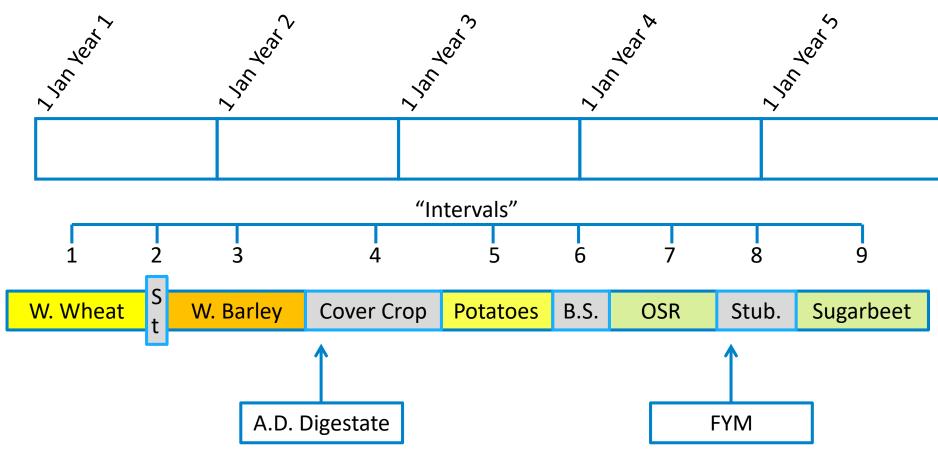
Rotations partnership: research projects





Grower survey

Objective is to understand how soils are utilised for the whole rotation



An "Interval" is a distinct period of land use = is one sheet of an excel file An "Interval" of less than seven days can be ignored



Various trials and experiments

- Cultivations
- Wheel track experiment
- Cover crops
- Organic matter inputs
 - Compost
 - Poultry manure
 - Duck manure
 - Farm yard manure

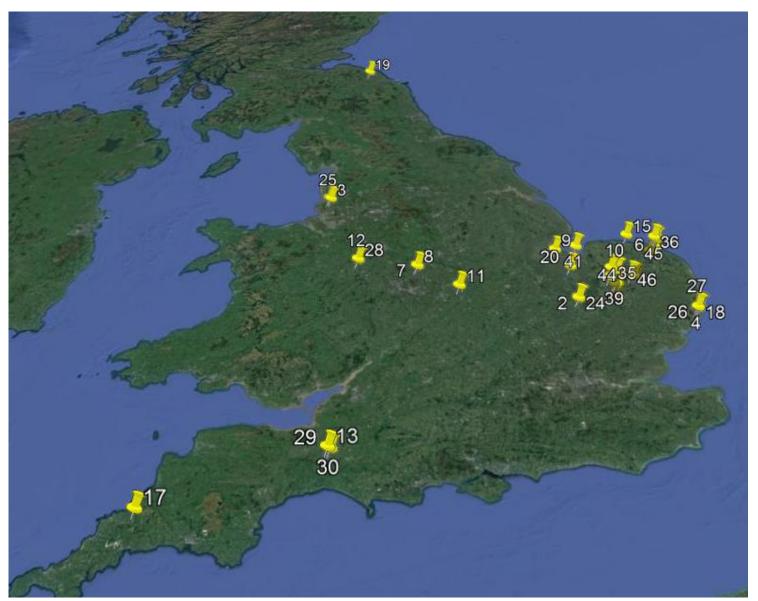








Location of trial sites – 2016-2018



| No | Location | Туре | Test Crop | |
|---------|---------------------------|--------------------------------|---------------|--|
| 2018-23 | Broom's Barn Brome Pin | FYM (in 2016) | Spring barley | |
| 2018-24 | NIAB F24 | Compost (in 2017) | Spring barley | |
| 2018-25 | Webster | Cover Crop | Potatoes | |
| 2018-26 | Greenwell Middle Walk | Pig FYM | Potatoes | |
| 2018-27 | Greenwell Orford | Compost/ Duck manure | Potatoes | |
| 2018-28 | Tern Farm | Cover crop | Potatoes | |
| 2018-29 | SPot SW Dillington Meads | Cover Crop | Potatoes | |
| 2018-30 | SPot SW Dillington 9 Acre | Digestate | Potatoes | |
| 2018-31 | NIAB F29 | Compost/Water/Compaction | Potatoes | |
| 2018-32 | NIAB F29 | Cover Crop | Potatoes | |
| 2018-33 | WO PO Jolly Abbey Shed | Compost/ Poultry Manure | Potatoes | |
| 2018-34 | WO PO Jolly 1SE | Compost/ Poultry Manure | Potatoes | |
| 2018-36 | EG Harrison Hungry Hill | Cover Crop | Potatoes | |
| 2018-37 | B&C Oxnead 2 | Compost | Potatoes | |
| 2018-38 | Elveden Self Sets | Compost | Potatoes | |
| 2018-39 | Elveden Four-Score | Compost | Potatoes | |
| 2018-40 | Greenwell Farms Orford | Compost and traffic management | Potatoes | |
| 2018-41 | Stevensons Missen | Wheel-track | Potatoes | |
| 2018-42 | Hiams BR 6 (VCS) | Cover Crop | Sugar beet | |
| 2018-43 | Hiams BR32 (VCS) | Cover Crop | Onions | |
| 2018-44 | Hiams BR15 (VCS) | Cover Crop | Parsnips | |
| 2018-45 | EG Harrison South Reps | Cover Crop | Cereal TBC | |
| 2018-46 | Wrentham (VCS) | Cover Crop /Compost | TBC | |





Summary of amendment comparisons in 2017 & 2018 –

potato yields

| Expt | No amendment | With amendment |
|--------------|--------------|----------------|
| Expt 1-2017 | 69.6 | 75.3 |
| Expt 2-2017 | 58.8 | 62.6 |
| Expt 4-2017 | 55.9 | 55.7 |
| Expt 8-2017 | 66.5 | 72.5 |
| Expt 10-2017 | 28.5 | 29.9 |
| Expt 14-2017 | 72.0 | 77.7 |
| Expt 16-2017 | 31.8 | 52.7 |
| Mean 2017 | 54.7 | 60.9 |
| Expt 26-2018 | 49.3 | 42.5 |
| Expt 27-2018 | 35.2 | 32.0 |
| Expt 30-2018 | 53.1 | 62.4 |
| Expt 31-2018 | 44.9 | 48.7 |
| Expt 34-2018 | 71.2 | 62.6 |
| Expt 35-2018 | 45.7 | 56.0 |
| Expt 37-2018 | 75.0 | 70.5 |
| Expt 39-2018 | 71.4 | 69.6 |
| Mean 2018 | 55.7 | 55.5 |
| Mean 2017-18 | <i>55.</i> 3 | 58.0 |



Summary of cover crop comparisons in 2017 & 2018 –

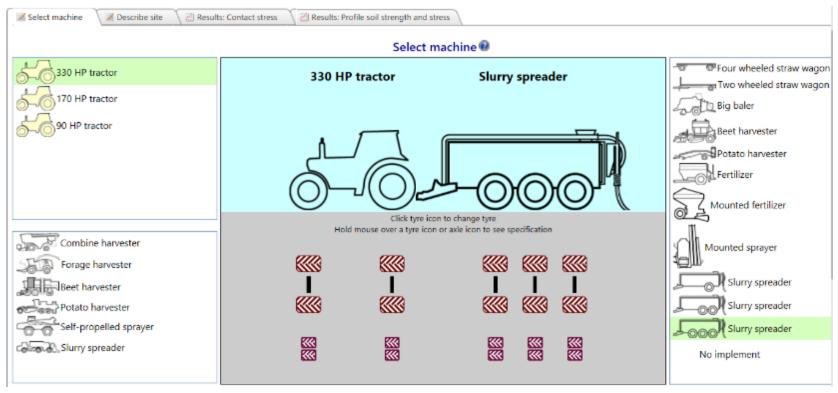
potato yields

| Expt | No cover crop | With cover crop |
|--------------|---------------|-----------------|
| Expt 3-2017 | 55.7 | 56.4 |
| Expt 4-2017 | 55.9 | 55.1 |
| Expt 9-2017 | 71.6 | 69.8 |
| Expt 11-2017 | 67.0 | 68.9 |
| Expt 12-2017 | 44.3 | 41.6 |
| Expt 13-2017 | 57.5 | 59.5 |
| Expt 15-2017 | 43.5 | 46.2 |
| Mean 2017 | 56.5 | 56.8 |
| Expt 25-2018 | 46.3 | 57.2 |
| Expt 28-2018 | 52.8 | 62.6 |
| Expt 29-2018 | 58.9 | 65.7 |
| Expt 32-2018 | 55.7 | 55.9 |
| Mean 2018 | 53.4 | 60.4 |
| Mean 2017-18 | 55.4 | 58.1 |





https://terranimo.dk/





Soil Biology and Soil Health Partnership





























Soil Biology and Soil Health Partnership

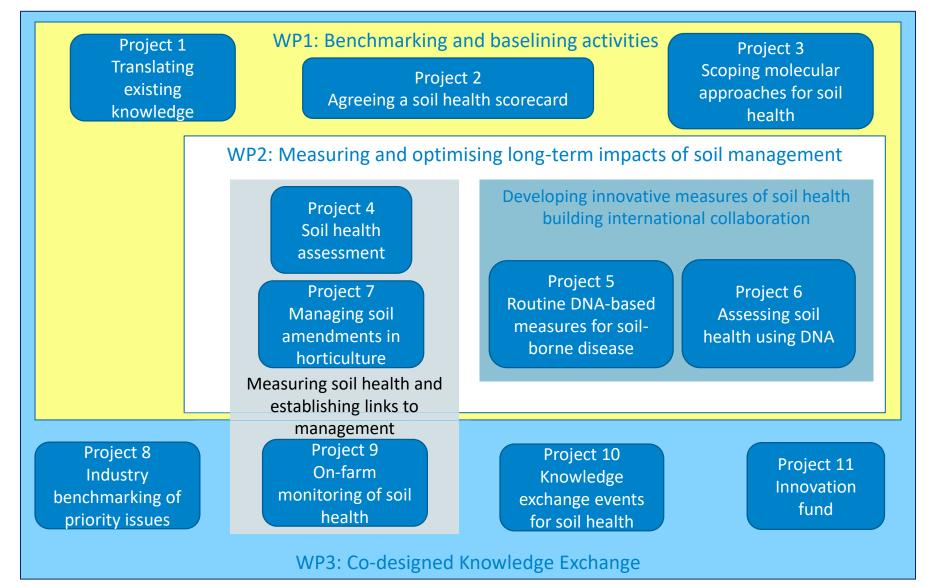
- Five years to deliver linked knowledge exchange and research on soil biology and soil health
- Building on work already carried out

Aims to:

- Improve on-farm understanding of soil health by sharing current academic and industry knowledge in usable formats
- Develop and validate indicators of soil biology and soil health in research trials and on-farm

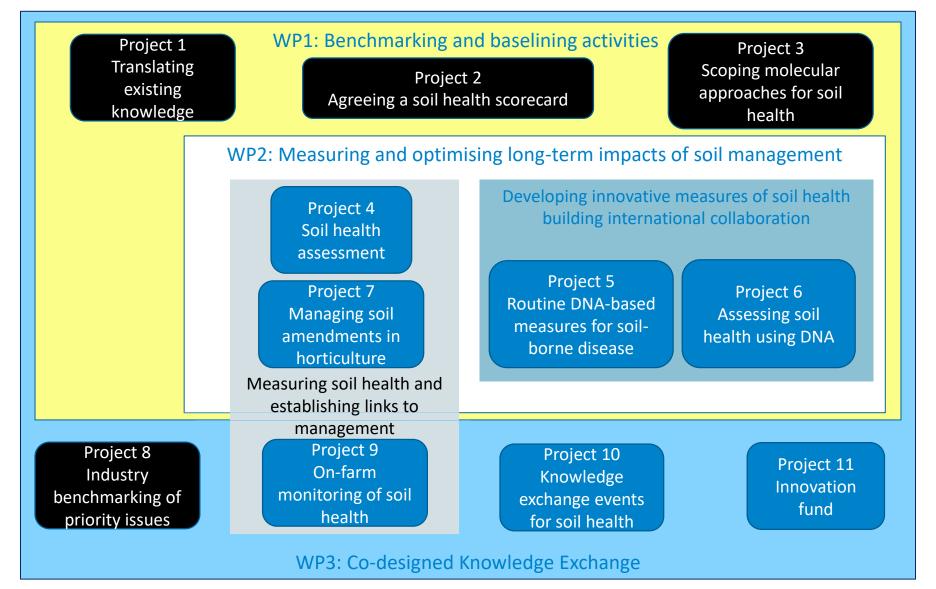


Soil Biology and Soil Health Partnership projects





Soil Biology and Soil Health Partnership projects



Soil health assessment sites: Arable and ley/arable rotations

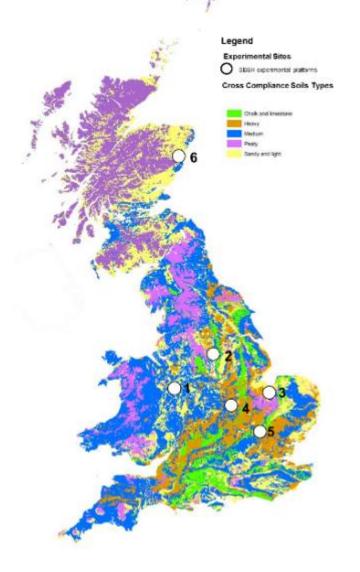
10-20 years of

repeated organic

material additions

- 1. Harper Adams
- 2. Gleadthorpe
- 3. Terrington
- 4. Loddington Tillage
- 5. Boxworth Drainage
- 6. Craibstone
 - a. Crop rotation x fertiliser; 90+yrs
 - b. Crop rotation x pH; 60+yrs.





Soil health assessments

- Timing: post harvest/pre-cultivation
- Bulk soil sample for:
 - Physics: VESS, Bulk density, penetrometer resistance
 - Chemistry: NRM soil health index; SOC and total N; potentially mineralisable N
 - Biology: earthworms, microfauna, nematodes; microbial biomass/respiration
 - DNA/eDNA
 - Archive sample
- Establish relations with:
 - Yield and crop quality
 - Disease and weeds





Testing and developing measures of soil quality: what is on the scorecard?



Traffic light benchmarks?

✓ partial

X

| Existing indicators included |
|------------------------------|
|------------------------------|

Less common indicators evaluated and framework for interpretation developed

New indicators developed and tested

| pH | \checkmark |
|---|-----------------------------|
| Routine nutrients | \checkmark |
| Bulk Density | \checkmark |
| Penetrometer resistance | \checkmark |
| Visual assessment of soil structure (VESS) | ✓ |
| Soil organic matter / loss on ignition (LOI) | ✓ |
| Respiration: Solvita test | \checkmark |
| Earthworms | ✓ |
| Total N Microbial biomass carbon (MBC) Potentially mineralisable nitrogen | X ✓ partial ✓ partial |
| (PMN) DNA measures of pathogens and | X |
| DIVA measures or parmogens and | ^ |

soil health

Nematodes

Microarthropods

Initial 'scorecard' results



Samples taken October 2017 in 2 year G/C ley before spraying & cultivation for WW in 2018

| Attribute | Control | FYM (23yrs) | Slurry (23 yrs) | Green compost (13 yrs) | Green/food compost (6 yrs) | Food- based digestate (9 yrs) | P |
|-----------------------------------|---------|----------------|--------------------|------------------------------|----------------------------------|--|--------|
| рН | 6.4 | 7.0 | 6.4 | 7.0 | 6.2 | 6.5 | <0.001 |
| Ext. P (mg/l) | 56 | 73 | 53 | 60 | 59 | 65 | <0.05 |
| Ext. K (mg/l) | 80 | 311 | 194 | 187 | 140 | 167 | <0.001 |
| Ext. Mg (mg/l) | 44 | 87 | 75 | 63 | 66 | 48 | <0.001 |
| LOI (%) | 3.0 | 4.1 | 3.6 | 4.0 | 3.7 | 3.4 | <0.01 |
| Bulk density (g/cm ³) | 1.40 | 1.34 | 1.43 | 1.29 | 1.46 | 1.43 | NS |
| VESS score | 1.2 | 1.4 | 1.3 | 1.1 | 1.3 | 1.5 | NS |
| PMN (mg/kg) | 22.9 | 90.2 | 23.8 | 43.1 | 37.7 | 42.5 | <0.01 |





On-farm soil health assessment

| Where | Main farming systems |
|----------------|---|
| York | Arable – mixed with root crops |
| East Anglia | Arable – sugar beet – veg – pigs |
| Leicestershire | Arable – mixed |
| North East | Arable - mixed |
| Shropshire | Lowland livestock, arable, field veg |
| Appleby | Grazing systems |
| Inverurie | Arable, with some veg (carrots) integrated, mixed |
| Wiltshire / SW | Dairy |

Valuing and working with farmer innovation developing locally adapted practices





Managing soil amendments in horticulture

Soil-grown raspberries

- PAS110 crop-based fibre digestate
- Biofungicide

Narcissus

- PAS100 green waste compost
- Mycorrhizae
- FYM

Onions

- PAS100 green waste compost
- Cover crop



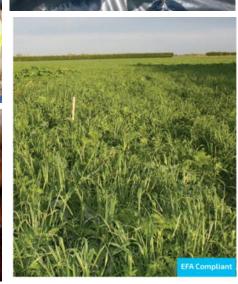














Using the sites above ... assessing soil health using DNA

- Can we replace many of the biological assays with analysis of a single DNA sample?
- Issues being addressed initially representative sample size, cost and interpretation
- Sample size and cost being evaluated in a comparative experiment
- Interpretation by analysing the same samples as the 'traditional' assays.







Watch out for your opportunity to interact in the mid-term consultation events in 2019

www.ahdb.org.uk/greatsoils

