CASE STUDY

GREATSOILS

British Beet BBRO Research Organisation

AHDB

Soil Biology and Soil Health Partnership Research Case Study

Testing the effect of organic material additions on soil health

Figure 1. Muck spreader (Source: ADAS)

Background

Growing food and fibre crops requires soils to be maintained in a suitable state that provides optimal soil structure, water retention and nutrient availability. The physical, chemical and biological properties of soil interact to deliver these functions. Measuring soil health, therefore, requires an integrated approach that combines the assessment of soil chemical, physical and biological properties. There is a good understanding of the soil chemical and physical constraints to crop and grassland productivity, but the role of soil biology is less clear.

A key aim of the Soil Biology and Soil Health Partnership is to improve our understanding of soil biology and to explore ways that farmers can measure and manage soil health. The Partnership has developed a soil health scorecard, which aims to provide information on key indicators of soil chemical, physical and biological condition, to help guide soil and crop management decisions. This is now being tested at a series of long-term experimental sites exploring the key drivers of soil biology: food source, physical and chemical environment.

Long-term experimentation at Harper Adams University

This long-term experiment investigates the impact of repeated organic material additions (at recommended rates) on soil and crop quality in a predominantly arable rotation (cereals and potatoes), previously studied as part of the WRAP DC-Agri experimental programme investigating the use of digestate and compost in agriculture (**www.wrap.org.uk/dc-agri**).

Established in 1991 on a sandy loam soil ('Wick' Soil Series), treatments include annual applications of cattle farmyard manure (FYM), cattle slurry, green compost, green/food compost and food-based digestate, compared with a control treatment receiving manufactured fertiliser only, thus providing a variety of 'food sources' for the soil biological community. Measurements of topsoil chemical, physical and biological properties were undertaken in October 2017.

Table 1. Organic material treatments*

Treatment	Applications to autumn 2017	Organic matter loading (t/ha)
Control	None	0
Cattle FYM	23 years	129
Cattle slurry	23 years	53
Green compost	13 years	62
Green/food compost	7 years	27
Food-based digestate	9 years	7

*balanced with manufactured fertiliser nitrogen to ensure N supply does not limit crop growth

Soil health scorecard

The scorecard approach brings together information about soil chemical, physical and biological properties. The integrated report uses 'traffic light' coding to identify the properties where further investigation is needed to determine the management steps required to minimise any potential risks to crop productivity. Here, we report initial testing of the scorecard for those soil properties where there is already an established evaluation framework (e.g. soil nutrients, visual soil evaluation of soil structure score – VESS).

Further ongoing research is developing interpretation frameworks for a wider range of soil properties, including biological indicators (e.g. microbial biomass/respiration, nematodes).

Table 2. Example scorecard for Harper Adams University trial site

Attribute*	Control	FYM (23 yrs)	Slurry (23 yrs)	Green compost (13 yrs)	Green/food compost (6 yrs)	Food-based digestate (9 yrs)
SOM (%)**	3.0	4.1	3.6	4.0	3.7	3.4
pH **	6.4	7.0	6.4	7.0	6.2	6.5
Ext. P (mg/l)**	56	73	53	60	59	65
Ext. K (mg/l)**	80	311	194	187	140	167
Ext. Mg (mg/l)**	44	87	75	63	66	48
VESS score	2	2	2	1	2	2
Earthworms (Number/pit)	11	13	9	11	9	13

Investigate

Monitor

No action needed

*SOM: Soil Organic Matter – comparison to 'typical' levels for the soil type and climate; Partnership project 2 **ahdb.org.uk/greatsoils**
Ext. P, K & Mg: Extractable Phosphorus, Potassium and Magnesium; See '*The Nutrient Management Guide - RB209*' for specific crop advice, **ahdb.org.uk/nutrient-management-guide-rb209**
VESS: Visual Evaluation of Soil Structure – limiting layer score; **www.sruc.ac.uk/info/120625/visual_evaluation_of_soil_structure**
Earthworms: total number of adults and juveniles; >8/pit = 'active' population for arable or ley/arable soils; Partnership project 2 **ahdb.org.uk/greatsoils**
**Attributes that showed a statistically significant difference between treatments (P<0.05)

The results show the value of applying organic materials for increasing soil organic matter (SOM) contents on light textured soils, particularly bulky materials such as FYM and green compost. These materials also provide valuable nutrients such as P and K, although in the case of P, the soils at Harper are inherently high in extractable P. The VESS scores indicated 'good' soil structure throughout the top 30 cm of soil, with an 'active' population of earthworms. Additional measures of topsoil bulk density (at 5–10 cm depth) also indicated that the application of bulky organic materials reduced the level of topsoil compaction (from 1.4 g/cm^3 on the control treatment to 1.3 g/cm^3 where FYM or green compost had been applied).

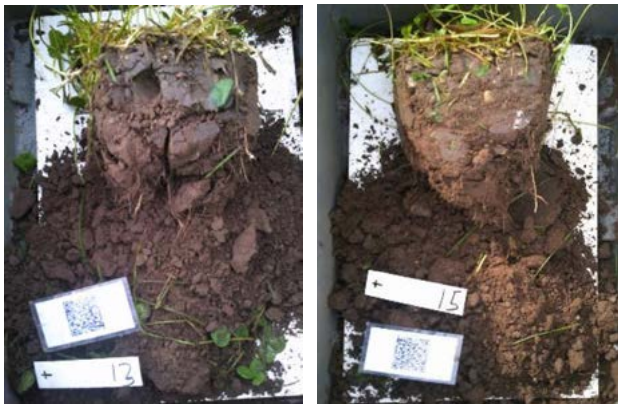

Figure 2. VESS assessment of the long-term FYM (left) and control (right) treatments

Future work

Sampling will be repeated at this site following three further years of arable cropping (winter wheat, potatoes, spring cereal) to evaluate the impact of additional organic material applications on a wider range of soil quality indicators. The scorecard is also being evaluated at other long-term sites to determine the effect of crop rotation, topsoil pH, tillage and drainage status on soil health.

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