Compost is good news for soil health

Case Study 1 – Audrey Litterick, Earthcare Technical

Figure 1. PAS 100 compost

Action points

- **Aim 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 increased SOM in half the time of farmyard manure**
- **Check guidelines before using compost. Most UK farm assurance schemes now permit the use of quality PAS 100 composts*, as do most produce buyers, but some have rules governing their use**
- **Determine if adding compost to your soil is cost-effective by comparing the costs of buying, hauling and spreading compost with the financial value of the nutrients compost supplies and the yield benefit**
- **Bear in mind that soil quality and yield benefits can take several years of continued compost use to develop**

*Nearby compost suppliers can be found by entering the holding's postcode at the UK Compost Certification Scheme website qualitycompost.org.uk/producers

Background

Soil Organic Matter (SOM) is the organic component of soil, consisting of three main parts:

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

Organic matter is important for soil fertility and crop productivity; building and maintaining it is a vital component of sustainable soil management. The amount of organic matter in soils depends on soil texture, climate, the input and composition of organic materials, decomposition, and the type of farming system employed.

Soils used for arable and vegetable production typically contain 1–3% organic matter (generally higher in Scottish soils). In general, for any one cropping system, the natural level of SOM in a clay soil will be higher than in a sandy soil, and grassland soils usually contain more relative to a continuous arable rotation. Therefore, whilst it is generally good to increase your SOM content, vegetable growers on a sandy soil should not expect to achieve and maintain the same SOM content as pasture-fed livestock-producing neighbours on a heavier soil.

Many soils are suffering from a lack of organic matter. Farmers and growers often want to maintain or enhance SOM content as this can have a range of benefits for soil health. However, recent work has shown that, where improved soil quality is concerned, not all forms of organic matter are equal. Given that applying bulky organic matter has a financial cost, it is important to understand the merits of different organic materials.

Field experimentation

The Defra/WRAP-funded Digestate and Compost in Agriculture (DC-Agri) project was commissioned in 2010 to provide the evidence base to support the confident use of digestates and composts by farmers and growers as renewable fertilisers. The core experiments ran across three growing seasons, with supplementary research completed in 2015.

Amongst other things, the DC-Agri field experiments evaluated the effects of adding different types of organic material over time to a network of seven sites across the UK (Figure 2). The sites represented a range of soil types, climatic conditions and crop rotations. At each site, 18–21 experimental plots were exposed to a particular treatment (Table 1) using a randomised block design. The treatment was applied each year for three years. Two of the sites had previously received repeated applications of farmyard manure, livestock slurry and green compost over a 6 to 17-year period; these plots therefore received a total of 9 to 20 years of application, providing insight into the longer-term effects of organic matter application. Crops were grown according to best farm practice.

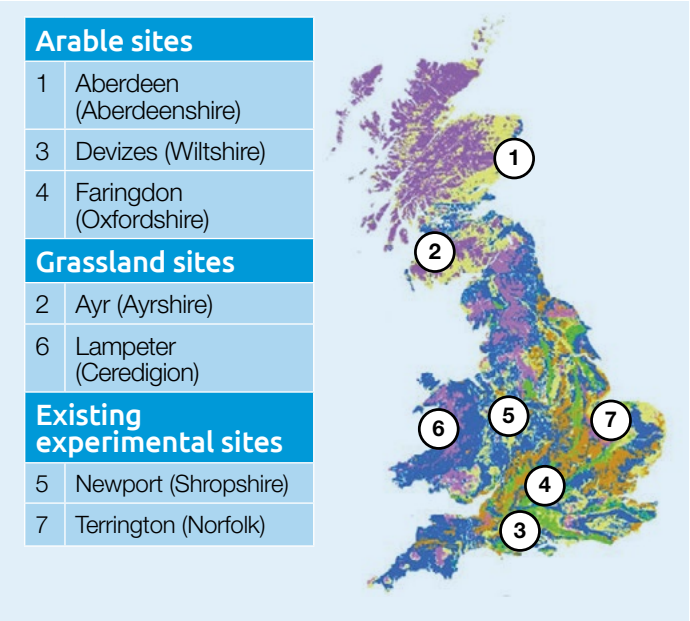

Figure 2. Location of the seven DC-Agri field experimental sites

Table 1. Bulky organic material applications in DC-Agri project

Material	Application rate (tonnes/hectare)
Synthetic fertiliser control (no organic matter)	To address crop need
Quality green compost	16
Farmyard manure (FYM)	16
Quality green/food compost	11
Livestock slurry	8
Food-based digestate	2
Manure-based digestate	3–6 (depending on N content)

WRAP DC-Agri field trials results

Compost builds SOM in half the time

Applying bulky organic materials can increase SOM, but only when applied over several years. Both green compost and farmyard manure (FYM) resulted in >20% increase in SOM relative to the control treatment when applied for 9 and 20 years, respectively; however, no significant changes in SOM were seen in any of the 3-year treatments (Figure 3).

Nine years of green compost application resulted in similar increases in SOM to 20 years of FYM application, even though similar amounts of organic material were applied each year in both treatments. This suggests that compost builds SOM more quickly than FYM; however, there is no information about the effect of FYM after 9 years, so it is not certain that FYM is less effective.

Retention of the organic matter supplied from the green compost was almost double that of FYM, which might be because a lot of the organic matter in compost has already been decomposed into stable humus material such as lignin. This is supported by analysis that showed about 70% of the organic matter present in green compost is made up of lignin, compared to 55% in FYM.

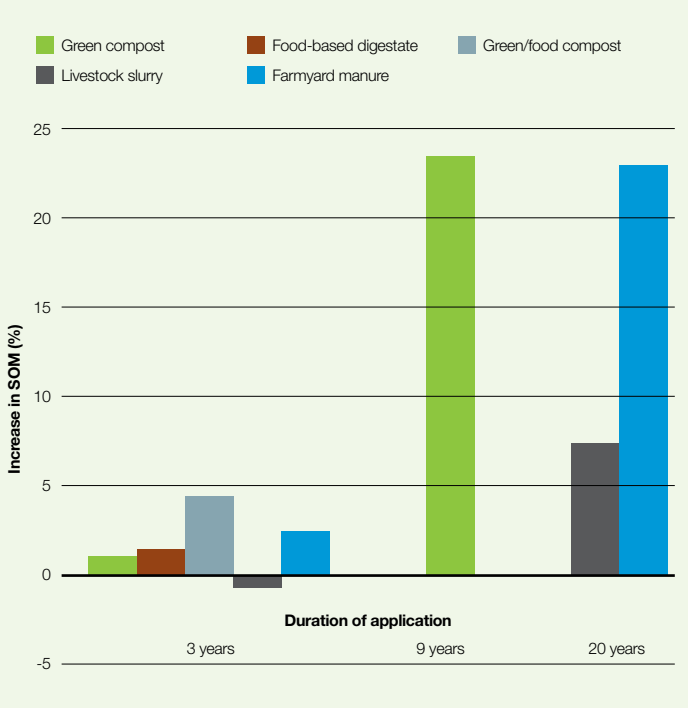

Figure 3. Increases in soil organic matter following continuous application of different organic materials for 3, 9 and 20 years (relative to an untreated control)

Figure 4. Compost being loaded into a modern rear-discharge spreader

Figure 5. Compost being spread onto stubble prior to being cultivated in Fife, Scotland

Soil microbes like compost

Applying green compost for 9 years increased soil microbial biomass. Soil microbes influence a soil's ability to store and recycle nutrients and are also important in the development of good soil structure. However, 20 years of FYM application provided greater increases, which is probably because FYM contains more readily decomposable organic material.

Earthworms can also increase soil quality and their populations were higher in plots treated with FYM and, to a lesser extent, those treated with compost.

Compost decreases soil bulk density

In the 9-year green compost and 20-year FYM treatments, there was a decrease in soil bulk density. Decreased soil bulk density can increase water and gas infiltration rates, soil biological activity and root penetration. A less dense soil may also require less force to till, which can reduce fuel costs and machinery wear. On the contrary, where digestate and livestock slurry had been applied for three years, there was some evidence of increased bulk density, although these changes were not statistically significant.

Compost confers resilience

The AHDB Cereals & Oilseeds Project 'Improvement of soil structure and crop yield by adding organic matter to soil' findings suggest that adding organic material to soil can confer an element of resilience to crop yields and income. Benefits were greatest in years when yields from un-amended plots were poor (impacted by drought, for example). These results suggest that adding organic material to soil can confer an element of resilience to crop yields and income.

Is compost use cost-effective?

Using composts costs money. Users have to buy the material itself and then pay for haulage and application (Figures 4 and 5), meaning that compost application is not always the most cost-effective option.

The MANNER-NPK tool **www.planet4farmers.co.uk/manner** can provide a quick estimate of crop available nitrogen, phosphate and potash from applications of organic manure. The financial value of this nutrient supply can be estimated using the online WRAP Compost Calculator **wrap.org.uk/content/compost-calculator**, which provides estimates of nutrient values based on the current market price of inorganic fertilisers. After calculating the financial value of the compost, farmers and growers can prepare a partial budget to see if using compost is likely to be cost effective. An example is given in Table 2.

Experience has shown that money is rarely saved in the first few years of use because many of the soil quality and yield benefits from compost application can take several years to show. The results of the DC-Agri field experiments suggest that noticeable improvements can be seen after 9 years, but that 3 years is insufficient.

Table 2. Partial budget: use of 17t/ha green compost compared with inorganic fertilisers on spring barley

Losses £/ha/yr	The extra costs	Gains £/ha/yr	Costs saved
Compost – 17t @ £1.50/t	£25.50	Phosphate (54kg/ha @ 59p/kg)	£31.86
Haulage – 17t @ £3.00/t	£51.00	Potash (65kg/ha @ 44p/kg)	£28.60
Spreading – 17t @ £2/t	£34.00		
The revenue foregone	nil	The extra revenue (£82 x 0.4t extra yield)	£32.80
Subtotal A	**£110.50**	**Subtotal B**	**£93.26**
		Change in profit = B - A	**-£17.24**

Monitoring SOM improvement

Building SOM takes time and money. Many are frustrated when they find very little change in their SOM levels after multiple years of trying to increase it. This is made worse by how difficult it is to pick up small changes in SOM using the 'loss on ignition method' commonly offered by soils laboratories. However, there is increasing interest in measuring a particular fraction of the total SOM known as the 'light fraction organic matter' (LFOM). This is the active fraction of organic matter that can be much more responsive to changes in soil management practices over short periods. Evidence suggests that LFOM is a very good indicator of whether management practices being implemented on the farm are likely to result in long-term benefits to SOM content if continued over time.

AHDB Horticulture are not aware of any laboratories currently offering LFOM testing, at the point of writing (June 2017).

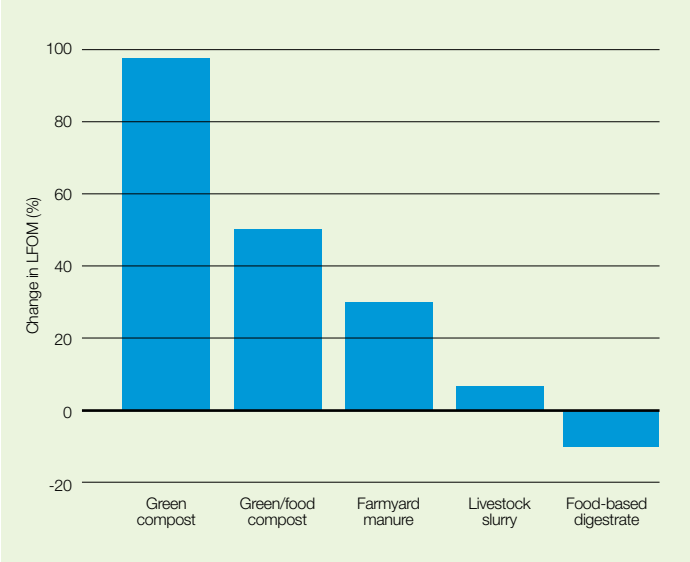

Figure 6. The change in LFOM following repeated additions of organic materials for 3 years at the arable sites in the DC-Agri project. The amount of 'active' organic matter within the soil was significantly increased by compost, as indicated by the LFOM

Other resources

A wealth of practical information on the benefits of compost and how to use it, along with information on digestates is available at the DC-Agri website: **wrap.org.uk/dc-agri**

In addition, a range of resources to help you with soil management is available on the AHDB GREATsoils website: **horticulture.ahdb.org.uk/great-soils**

Acknowledgements

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