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Where improved soil quality is concerned, not all organic matter is equal

The UN has designated 2015 as the International Year of Soils *"to raise awareness of the importance of sustainable soil management"*, which is vital for food, fuel and fibre production, as well as ecosystem function and adaptation to climate change. Results from WRAP's *DC-Agri* field experiments have a key role to play in this.

The experiments, comparing the ability of a range of organic materials to build soil organic matter levels over time, have shown that not all organic matter is equal and that compost builds levels much more quickly than other organic materials. They also show that repeated applications of compost are a valuable means by which farmers can improve soil quality.

Soil organic matter (SOM) is the organic component of soil, consisting of three primary parts: fresh plant residues and small living soil organisms, decomposing (active) organic matter (OM), and stable OM (humus). OM is important to soil fertility and crop productivity, and building and maintaining it is vital for sustainable soil management. The amount of OM in soils depends on soil texture, climate, the inputs and composition of organic materials, the rate at which organic matter is decomposed, and the type of farming system employed.

Arable soils contain typically 1-3% OM (generally higher in Scottish soils), whilst grassland soils usually contain more. In general, for any one cropping system, the natural level of SOM in a clay soil will be higher than that in a sandy soil and this level will be higher under permanent grassland when compared with a continuous arable rotation.

DC-Agri field experiments

WRAP's *DC-Agri* field experiments have assessed the effects of different types of organic material additions over time to a network of seven experimental sites across the UK. Located at Aberdeen, Devizes in Wiltshire, Faringdon in Oxfordshire, Newport (Harper Adams University) in Shropshire, and Terrington in Norfolk, which were in arable cultivation and Ayr and Lampeter in Ceredigion, which were grassland sites. The sites were selected to represent a range of soil types, climatic conditions and crop rotations. At each site 18-21 experimental plots were laid out in a randomised block design (6 or 7 treatments, with 3 replicates of each). Crops were grown according to best farm practice.

Over the three-year period of the experimental programme, the following amounts of OM were supplied by each material applied:

- green compost and farmyard manure (FYM) c.16 t/ha
- green/food compost c.11 t/ha
- livestock slurry c.8 t/ha
- food-based digestate c.2 t/ha
- manure-based digestate 3-6 t/ha (only applied at Aberdeen and Ayr in Scotland).

The sites at Harper Adams and Terrington were existing experimental platforms that had previously received FYM, livestock slurry and green compost over a 6 to 17-year period, increasing the range of additions to c.80-105 t/ha of OM from FYM and c.50t/ha of OM from green compost. There was also an untreated control treatment at each site which received recommended rates of manufactured fertiliser, but no organic materials.

Compost builds SOM in half the time

The wealth of information from these longer term experiments has shown us that not all OM is equal. Compost has produced the same level of change in OM levels within experimental site soils as FYM, but in half the time and with half the OM loading.

Although the 9 years of green compost applications applied only half the OM that had been supplied by almost 20 years of FYM, it produced a comparable increase in soil organic matter levels. Retention of the OM supplied from the green compost (20-24%) was almost double the retention of OM from FYM (12%). This suggests the green compost is more resistant to decomposition, which is further supported by the lignin content analysed within both materials with c.70% of the green compost OM in the form of lignin compared to c.55% for FYM.

In the shorter term, 3-year experiments the amount of 'active' OM within the soil was significantly increased by compost, as indicated by the measurement of Light Fraction Organic Matter (LFOM).

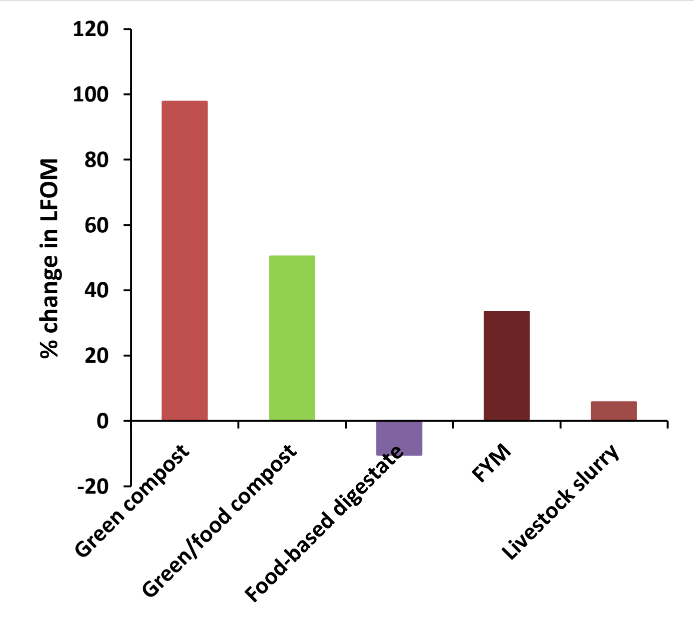

Figure 1 *Change in light fraction organic matter (LFOM) following the repeated addition of organic materials for three years at the arable sites.* Results are expressed as a percentage difference from the untreated control treatment.

Increases in SOM following repeated compost additions were associated with increases in microbial biomass and nutrient supply (both the overall topsoil nutrient status of nitrogen, phosphorus, potassium, magnesium and sulphur, as well as cation exchange capacity and potentially mineralisable N), and decreases in soil bulk density. Although compost increased SOM levels more rapidly than FYM, these associated benefits were greater with the higher FYM OM loading; confirming again that not all OM is equal in terms of its impact on soil properties.

The *DC-Agri* results clearly demonstrate that repeated applications of compost are a valuable means by which farmers can improve soil quality, ultimately leading to increases in crop yields due to improved rooting, nutrient and water acquisition, and improved farm economies from greater yields, less reliance on manufactured fertiliser and reduced energy costs through easier cultivation.

Repeated applications of both food and manure-based digestate had a limited impact on levels of SOM (and hence soil biological and physical functioning) due to the low organic matter loading associated with these materials. Soil nutrient status did improve however.

Sustainable use

There was no effect from repeated compost or digestate additions on soil total metal and organic compound contaminant concentrations or crop metal concentrations. This is an important finding and supports the safe use of these materials on crops grown for food production.

Using compost within an arable rotation is therefore a sustainable way to satisfy the requirement to maintain organic matter levels as part of Good Agricultural and Environmental Condition of soils for Cross Compliance.

Further news

The results from WRAP's *DC-Agri* field experiments show clearly the value of medium and longer-term use of organic materials, and compost in particular, in improving the quality and fertility of soils. Comprehensive results from the field experiments will be presented at a series of winter and spring events throughout the UK.

A short video explaining the second major part of *DC-Agri* experiments on digestate nitrogen supply and environmental emissions, can now be viewed at:

www.wrap.org.uk/digestatevideo

Copies of this and previous bulletins can be downloaded from the project website at: www.wrap.org.uk/dc-agri

Dates for your diary

Comprehensive results from *DC-Agri* will be published and presented over the coming months. Meanwhile, here are some opportunities to catch up with the project team:

- *13 January 2016 – AICC Conference, Towcester*
- *23-24 February 2016 - CPNB 2016: The Dundee Conference: Environmental Management & Crop Protection*
- *AHDB "Agronomy 2016" events. A series of interactive technical seminars providing growers and agronomists with research-based solutions to current on-farm issues. Download further information from:* cereals.ahdb.org.uk/agronomy16
    - *Carfraemill 12 January 2016*
    - *Perth 14 January 2016*
    - *Inverurie 19 January 2016*
    - *Inverness 21 January 2016*

    - *Cheshire 10 February 2016*
    - *Lincoln 23 February 2016*
    - *Somerset 23 February 2016*

- *tbc February 2016 – Biogen UK Ltd will kindly host two events at their Waen, St Asaph and Bryn Pica, Aberdare Welsh AD sites with WRAP Cymru.*

If you would like details of these and future events please contact: enquiries@earthcaretechnical.co.uk

Project partners:

www.wrap.org.uk/dc-agri

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