Department of Primary Industries

FACTSHEET

Key soil carbon messages

Climate in Primary Industries Unit, Agricultural Resources Branch

Soil organic carbon is a vital component of productive agriculture, but there are many myths and misconceptions about it. Below are the key messages from NSW DPI about soil carbon.

1. **Soil is a significant carbon sink.**

   Sequestration of carbon in agricultural soils through appropriate management actions has been recognised as an important tool to mitigate climate change. Carbon is the main element present in soil organic matter, on average making up 58% by weight.

2. **Increasing soil organic matter can improve productivity by improving soil structure, increasing nutrient cycling and encouraging diversity of soil organisms.**

   Increasing soil organic matter benefits agricultural production through improved soil function and greater resilience to a more variable and changeable climate.

3. **Farm productivity is closely linked to soil functions that depend on decomposition of organic matter.**

   When soil organisms decompose organic matter they make some of the nutrients available for plants, and secrete glue-like substances that bind soil particles together which improves soil structure. The improved structure allows root growth and movement of air and water through the soil.

4. **To increase the amount of carbon stored in soil, carbon-based inputs need to be greater than the losses. If the balance isn't right then the amount of carbon in soil is depleted.**

   Soil carbon increases through increased biomass production and retention and application of carbon-rich amendments. The main losses of carbon from the soil are through organic matter decomposition by micro-organisms, soil erosion, biomass burning, and product removal in food and fibre. When there is a net gain in the mass of carbon in soil, the soil is said to be sequestering carbon.

5. **There are different types of organic matter in soil; some decompose more quickly than others.**

   Organic matter is a diverse group of organic materials of differing composition and at different stages of decomposition. In soil, organic matter comprises partially decomposed organic residues, microscopic organisms, well-decomposed humus, and burnt residues such as charcoal. Each of these broad groups serves diverse and overlapping soil functions. It is important to have all these components to sustain the soil functions that support plant productivity and carbon sequestration over various timescales.

6. **The mass and forms of carbon in soil depend on soil type, climate, vegetation and land management**

   Soils can 'protect' organic matter from natural decay by forming soil aggregates and mineral-organic matter complexes. This 'protection' of organic matter from decomposition has implications for carbon sequestration. Clay particles are more effective than sand and silt particles in protecting soil organic matter. Different forms of clay particles vary in their capacity to retain organic matter in soil. Climate influences the rate of decomposition. For example, in warm humid environments organic matter decomposes more quickly than in both dry/cold and dry/hot environments. Some organic materials decompose faster than others. Legume residues, for example, break down more quickly than low-nitrogen materials such as cereal stubble or woody forest residues.

7. **There are land management options to increase the mass of carbon in soil.**

   Practices that generally increase the amount of organic carbon in soil include stubble retention, pasture phases in crop rotations, maintaining ground cover on grazing land, and improving plant production through nutrient management and overcoming soil constraints such as acidity.

8. **The mass of carbon in soil is closely related to the amount of nitrogen, phosphorus and sulphur in soil.**

   The transformation of organic residues into humus (or "humification") by soil organisms requires nitrogen, phosphorus and sulphur (and other elements in smaller quantities). These elements are constituents of organic matter and must be present in organic residues or added to the soil for humification to occur.

9. **Many Australian soils have the potential to store a large mass of carbon.**

   Most agricultural soils have much less soil organic matter today than in their pre-settlement native vegetation state. This means there is a known capacity for these soils to store more carbon, but achieving this potential may be difficult under some agricultural management systems. The best option is to manage land to maximise biomass production and biomass return in the most profitable and sustainable manner.

10. **The current convention for calculating the stock of carbon in soil is in tonnes per hectare, to a depth of 30cm.**

    To calculate the carbon stock contained in the soil, you need to know the density (g/cm^3) of the soil as well as the total organic carbon concentration (g/100g). To calculate the soil carbon stock (tonnes of carbon per hectare), you multiply the carbon concentration (g/100g) by the bulk density (g/cm^3) by the depth of soil (cm).

    That is;

    Carbon stock (T/C/ha) =

    Carbon concentration (g/100g) x bulk density (g/cm^3) x depth (cm)

    To convert this to tonnes of carbon dioxide equivalents (CO_2e), multiply the carbon stock (T/C/ha) by 3.67 (based on the atomic weight of carbon and oxygen).

    That is;

    Carbon dioxide equivalents (CO_2e) =

    Carbon stock (T/C/ha) x 3.67

For more information

www.dpi.nsw.gov.au/agriculture

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