

# TURNOVER OF SOIL ORGANIC MATTER



*Soil organic matter is forever turning over. Carbon lost to the atmosphere needs to be replaced and renewed to maintain levels of soil organic carbon.*

Organic matter contains a range of nutrients and other elements including carbon. Soil organic carbon measures the carbon content of organic materials. Although soil function is influenced by the properties of the organic materials rather than their carbon content, behaviour of soil is normally associated with soil organic carbon content.

## Particulate organic matter

The majority of particulate matter enters the soil as plant residues. Plant root systems can contribute as much carbon as surface residues. Practices that enhance productivity and/ or the return of plant residues to the soil will add more organic matter. Manure, mulch, compost, and biosolids are regularly applied to soil to top up particulate matter. Turnover is rapid hence the particulate pool is the easiest to manipulate to renew soil carbon. However, if not managed properly the carbon will equally return to the atmosphere as carbon dioxide rather than enter more stable pools.

Soil macrofauna –worms, ants, beetles, and mesofauna –springtails and mites, help cut up the fresh surface residues into pieces less than 2mm in size and/or incorporate them deeper into the soil, where they mix with minerals, clay and other soil particles and residues from root systems.

Microorganisms power decomposition and have key roles in the cycling of carbon, nitrogen and phosphorus and breakdown of chemicals, as well as produce substances that binds soil into stable structural units.

Plant residues originating from legumes or which are high in nitrogen decompose rapidly, and are unable to maintain surface cover over extended periods of time.



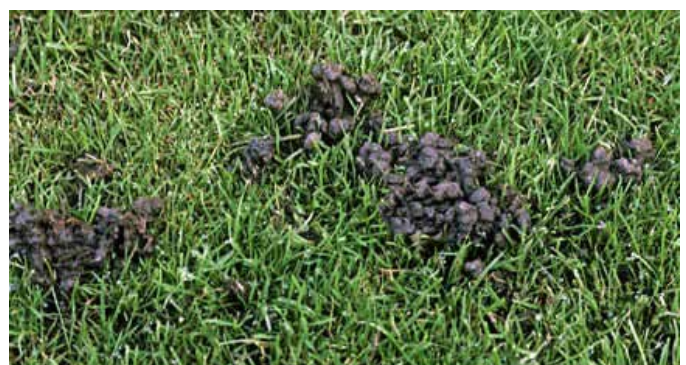
^ Figure 1: Soil Organisms.

Source: <http://4.bp.blogspot.com>; <http://media.web.britannica.com>; <http://insects.tamu.edu>; <http://australianmuseum.net.au>

## Humus

This pool contains well decomposed materials less than 0.05 mm in size, collectively called humus. Humus holds up to 90% of its weight in water and the majority of available soil nitrogen derived from soil organic matter. Humus also contains chemical groups able to buffer soil against change in pH. Humus gives soil its characteristic dark brown to black colour.

Humus is biologically active. Binding of humus by minerals and clay and to other soil particles within aggregates reduces its accessibility to soil organisms responsible for degradation. As a result of this protection, degradation of humus is slow unless exposed through cultivation.



>> Figure 2: Humified worm casts.

Source: [www.online-turf.co.uk](http://www.online-turf.co.uk)

## Charcoal and Residual Materials

Charcoal and other residual organic materials at the final stages of microbial decomposition are no longer biologically active and remain relatively stable in soil. They take hundreds of years to form from the time the labile organic carbon was added to the soil. Residual materials may hold nutrients accessible to soil organisms and plants, and buffer against pH change similar to humus. Biochar produced from manure or bone may also supply plant nutrients.

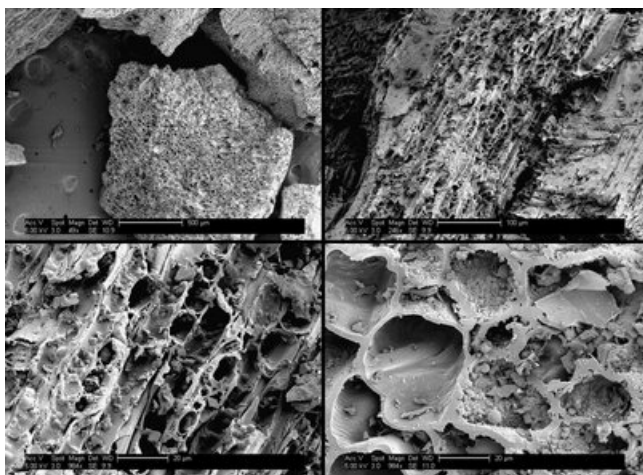


Figure 3: Biochar.

Source: University of Western Australia

## Maximum levels of Soil Organic Carbon

The maximum level of stored organic carbon is determined by clay content, soil depth and soil density. Clay particles are able to readily bind with humus and other degraded organic materials due to their small size, large surface area, and negative charge. The relative importance of clay in retaining SOC is higher in sandy soils, because sand particles are too large to bind with organic materials on their own.

Deeper soils provide more opportunity for plant root systems to explore a higher volume of soil therefore can potentially receive and retain more organic carbon, than shallow soil.

Soil organisms grow through and live in the space between soil particles and rely on oxygen and water distributed via the networks of soil pores. Ideal living conditions are lost when aggregates are broken down and soil compacts. Consequently the maximum potential for storing organic carbon is reduced.

Most soils do not contain the maximum possible level of stored carbon because the ideal combination of factors promoting input of soil carbon over losses is rarely present in natural systems.

There is NO golden rule for setting benchmarks for the ideal level of soil organic carbon. Instead indirect indicators based on soil function are used, as soil in better condition consistently has higher levels of soil organic carbon.

*Many soils do not hold the maximum soil organic matter possible, which provides opportunity to improve current levels of soil organic carbon.*



^ Figure 4: The soil on the left was transformed by regular addition of compost. Source: <http://2.bp.blogspot.com/>



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