Soil organic carbon (SOC)

'Pools' (or types) of soil organic carbon

In total, soils contain about twice more carbon than the atmosphere and two and a half times more than all living things. This carbon comes in two forms:

- organic - mainly resulting from the decay of organic sources such as plants, animals and microbes
- inorganic - such as that contained in calcium carbonate (lime).

These different types of soil organic carbon (SOC) has varying degrees of resistance to breakdown

Organic carbon pool	Size	Stability	Turnover time	Key functions
(1) Crop residues Shoot and root residues on and in the soil	> 2mm	Labile (readily available)	Days	Provide energy and nutrients to biological processes; readily broken down providing soil conditions that favour soil biology
(2) Particulate organic matter (POM) Smaller plant debris	0.05-2mm	↕	↕	These are broken down relatively quickly in suitable conditions but more slowly than crop residues. Important for soil structure, provision of energy for biological processes and nutrients.
(3) Humus Decomposed material dominated by molecules stuck to soil minerals	< 0.05mm			This plays a role in all key soil functions, but is particularly important in the retention and provision of nutrients (e.g. the majority of available N is found in the humus fraction).
(4) Recalcitrant organic matter Biologically stable, dominated by pieces of charcoal	variable	Very stable / relatively inert	Hundreds of years	Decomposes very slowly and if present in large enough quantities can contribute to cation exchange capacity as well as controlling soil temperature.

Broos K and Baldock J 2008, 'Building soil carbon for productivity and implications for carbon accounting', in *2008 South Australian GRDC Grains Research Update*

SOC levels are largely determined by three factors:

- the amount of biomass grown – rainfall, soil fertility and crop type determines the amount of plant biomass and hence the amount of organic material that can be potentially returned to the soils
- management – tillage of the soil reduces SOC by exposing it to organisms breaking down organic materials. Grazing or burning of residues also reduces the amount of organic material returned to the soils. Typically, pasture systems tend to have higher SOC levels than cropping systems.
- soil texture – clay provides protection from decomposition by microbes. The higher the clay content, the higher the potential for soils to store organic carbon.

SOC is essentially in a constant state of flux, responding to changes in organic material inputs and loss through microbial decomposition which results in organic carbon being mineralized and lost as carbon dioxide to the atmosphere. The speed of decomposition depends on the nature of organic material, soil factors (e.g. amount of clay) and climate factors.

There are many production and environmental benefits associated with increasing SOC. These include

- improved soil structure
- increased soil fertility
- increased water holding capacity
- increased water use efficiency
- increased biological activity
- increased plant growth and yields
- increased resilience to dry periods
- reduced erosion risk.