Soil Biology

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Soil Biology is the study of the living component of soils – the bacteria, fungi, and soil animals which all have particular soil processing roles. It is linked to the processes involved in Soil Chemistry (nutrient processes) and Soil Physics (soil structure, texture, stability, water movement in soil).

What are soil organisms?

There are four levels of organisms: microflora, microfauna, mesofauna and macrofauna. The microflora, bacteria and fungi, make up 75-90% of the soil living biomass and are the primary decomposers of organic matter. They transform organic molecules into mineral nutrients (eg nitrate, ammonium, phosphate) that are then available for uptake by plants. The microfauna, single cell animals such as protozoa and nematodes (simple worms), prey on the microbes. The mesofauna group of collembola (springtails) and mites also prey on bacteria and fungi. The larger organisms or macrofauna include earthworms, beetles, ants and termites.

Where are the organisms located in soil?

Most organisms are found in the top layers of soil, usually the top 2-3 centimetres, since this is typically where most of the organic matter is. Organisms do occur to depths of several kilometres below the soil surface, but the types of organisms that occur this far down are not the same as those close to the surface. The organisms in soil are often commonly found close to root surfaces in the rhizosphere (the area of soil that immediately surrounds and is affected by a plant's roots), within living and dead roots, on soil particles, or amongst aggregates of soil particles.

Earthworms and other soil animals are able to move through most of the top layers of soil. Fungi can form a mat of hyphae (a part of the vegetative portion of a fungus that resembles threads), which can extend centimetres or even metres through the soil. They can also form a network of hyphae inside soil aggregates. Bacteria tend to accumulate inside soil aggregates because they are less likely to be eaten by soil animals such as protozoa and mites in this environment. Bacteria can be carried down further into the soil in water that is passing through downwards, but generally they do not move far.

Soils that are clayey often have more bacteria than sandy soils because the clay creates lots of small pores (spaces) which offer protection for bacteria. Sandy soils with fewer aggregates and small pores are less suitable habitats for bacteria and fungi unless a large amount of organic matter is added to the soil.

Why is soil biology important?

The activities of the wide range of organisms in soil play a crucial role in both natural and managed ecosystems. Their processes of organic matter breakdown contribute to the soil's health.

Soil biological, physical and chemical processes are interrelated and all contribute to plant productivity. The level of soil biological activity is therefore affected by the soil type, but it also depends on the management practices used, particularly the management of organic matter, especially carbon. Changes that are made to the chemical and physical environment in soil will therefore influence the biological processes and subsequently the contribution they make to the soil's fertility overall.

Soil Biology Quick Facts

- A single spade full of rich garden soil contains more species of organisms than can be found above ground in the entire Amazon rain forest.
- Although the soil surface appears solid, air moves freely in and out of it. The air in the upper 8 inches of a well drained soil is completely renewed about every hour.
- The plants growing in a 2-acre wheat field can have more than 30,000 miles of roots, greater than the circumference of the Earth.
- The wonderful "earthy" smell of newly ploughed ground is believed to result from chemicals produced by micro-organisms. One of these chemicals called geosmin is an organism that have some properties of both bacteria and fungi.
- One cup of soil may hold as many bacteria as there are people on Earth.
- It takes about 4,000 to 6,000 pounds of crop residue per year to maintain the content of organic matter in a soil.
- Of the carbon returned to the soil as plant residue, about 5 to 15 percent become tied up in the bodies of organisms and 60 to 75 percent is respired as carbon dioxide back to the atmosphere. Only 10 to 25 percent is converted to humus in the soil.
- The weight of all the bacteria in one acre of soil can equal the weight of a cow or two.
- Earthworms move from lower strata up to the surface and move organic matter from the soil surface to lower layers. Where earthworms are active, they can turn over the top 6 inches of soil in 10 to 20 years.
- One cup of soil may hold as many bacteria as there are people on Earth.
- The tips of small plant roots move through the soil with a twisting screw-like motion. Mature trees can have as many as 5 million active root tips.