

Life in the soil

“Soil organisms do not constitute the life of the soil; they are the actual organs of a living organism”.



Fact Sheet series for the Small Rural Landholder

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What is a biologically active soil?

A biologically active soil is a healthy living system teeming with microorganisms that:

- recycle and mobilise plant nutrients;
- fix nitrogen from the atmosphere;
- combine soil particles together;
- store air and water; and
- minimise plant disease.

A hectare of healthy fertile soil may contain at least 300 million small invertebrates – mites, millipedes, insects, worms and other micro species

Significant microorganism populations can also occur in a soil sample e.g. a mere 30 grams of soil may contain 1 million single species bacteria, 100,000 yeast cells and 50,000 pieces of fungus mycelium.

Lady Eve Balfour, a noted British agronomist, describes this engine room of activity as ‘The Cycle of Life’.

A biologically active soil will support high levels of agricultural production generating healthy plants and associated livestock products.

Healthy fertile soils are an essential component of highly productive agricultural food and fibre systems.

Maintaining a diverse range of micro and macro organisms within a soil creates an environment where active biological processes contribute significant natural value to support healthy growing plants.

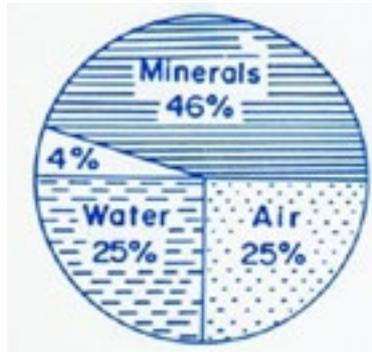
As farmers we walk over it every day of our lives, but how many of us spare a thought for what is actually happening beneath the soil surface?

The top few centimeters of the soil (about 10cm), is the ecosystem for a huge range of macro and micro flora and fauna, many of which still remain to be identified.

Some of the key life forms we should know about are:

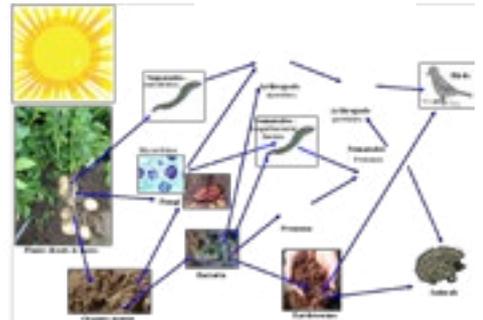
- bacteria,
- fungi,
- actinomycetes,
- protozoa,
- algae,
- mycorrhiza,
- nematodes; and
- earthworms

Soil biology occupies only a very small percentage of the soil volume but in terms of its importance, it cannot be underestimated.



Organic matter & soil biology occupies 4% by volume in an average silty loam soil

The Soil Food Web



It is only recently that science has placed a greater emphasis on the role that a biologically active soil plays in sustainable livestock and crop production.

The term soil food web describes the interaction of organisms present in the soil, which are responsible for nutrient cycling, and the retention of nutrients.

A well-structured soil with good pore space provides an aerobically rich environment where beneficial organisms can function.

As the complexity of the Soil Food Web increases, crop productivity also increases.

In one square meter of soil



Diagram courtesy, Soil Fertility Services

Key management strategies

How to enhance soil biological populations?

Soil organisms that benefit gardeners and farmers require a soil that has:

1. An open pore structure
2. A supply of fresh organic matter to supply carbon and nitrogen
3. A soil pH between 6 - 6.5
4. Moisture sufficient for organisms to flourish

Different organisms break down different forms of organic matter. Increased organic matter in the soil will support higher populations and diversity of organisms.

Organic matter, with a carbon nitrogen ratio of approximately 25 parts Carbon to 1 part Nitrogen, is the basic diet of soil organisms. Carbon from this material is the 'Energy Food' (carbohydrate) for these creatures.

The conversion of organic matter by microorganisms is called mineralisation. This process enables available plant nutrients to be accessed by plant roots.

Foliar sprays of seaweed, fish emulsion, compost teas and other biological preparations may further stimulate soil biological activity.



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Some of the key species in the Soil Food Web

Dung beetles

Dung beetles are important animals in the soil ecosystem. They bury animal manure, stimulate nutrient cycling, aerate the soil, improve water infiltration reducing the habitat of the bush fly.



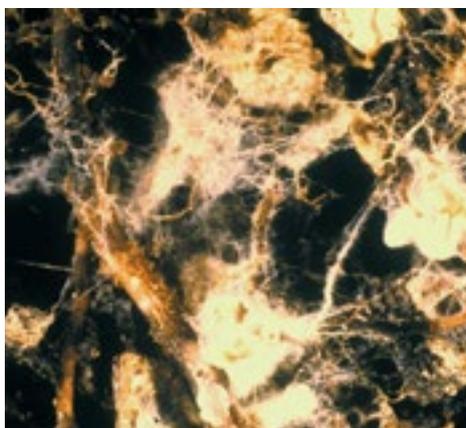
Active Dung beetles

Earthworms

Earthworms are great improvers of soil structure and water infiltration. They mix and aerate the organic matter layer and help increase microbial activity and nutrient availability. Encouraging populations of this macro species is important.

Fungi

Fungi play an important role in the breakdown of organic matter into useful forms, assist in nutrient retention and disease suppression.



Importantly fungal hyphae bind soil particles into macro-aggregates, which increase the soil's ability to absorb and retain water.

Soil fungi

Mycorrhiza fungi develop beneficial relationships with plants by colonising plant roots. They assist plants in the improved uptake of nutrients such as phosphorus and zinc from the soil.

Bacteria

Some of the major activities of soil bacteria include nitrogen fixation, decomposing organic matter into humus and solubilising inorganic mineral elements.



Nitrogen fixing nodules on the roots of a legume

Actinomycetes

Actinomycetes are thread-like organisms that behave similar to bacteria and fungi in breaking down organic matter into humus. They produce antibiotics that play a role in disease mediation and suppression.

Protozoa

Protozoa are single celled organisms that primarily consume bacteria and fungi releasing readily available nutrients. They are key players in nutrient cycling.

Nematodes

Commonly called eelworms, they range in size from 0.5-1.5mm in length. They can consume bacteria or algae, decaying organic matter or other smaller soil animals.

Agricultural practices that inhibit soil biological life

- * Excessive cultivation
- * The use of agricultural chemicals
- * Excessive irrigation/ water logging
- * Passage of heavy equipment over the land

Quoted in Sattler, F. and Wistinghausen, E. 1992

Disclaimer: Western Port Catchment Landcare Network (WPCLN)

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