How to encourage soil organisms

Soil organisms range from bacteria (0.000001 mm) to giant tunnelling earthworms (1 m). They all play an essential role in decomposing organic matter, cycling nutrients and fertilising the soil.

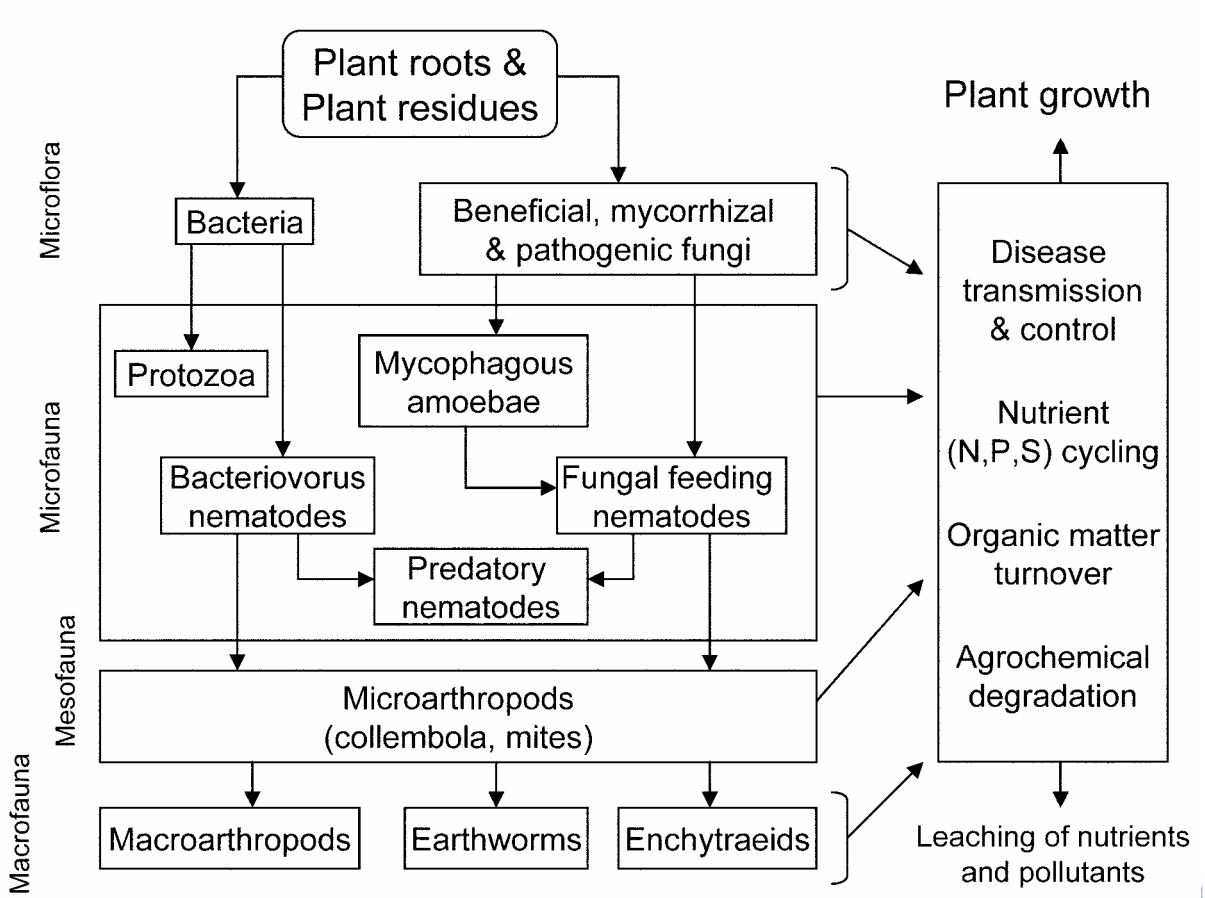
What are soil organisms?

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.

What do soil organisms need?

Almost all soil organisms (except some bacteria) need the same things we need to live – food, water and oxygen. They eat a carbon-based food source which provides all their nutrients, including nitrogen and phosphorus. They require a moist habitat, with access to oxygen in the air spaces in soil. These reasons explain why 75% of the soil organisms are found in the top 5cm of soil. There are other factors that determine whether species can survive and grow, including pH, temperature, salt content, type of carbon and heavy metals.

Below: This diagram shows the organisms in the soil, what they feed on, and their impact on plant growth. From Gupta VVSR & Sivasithampram K (2004) in *Soil biological fertility* (eds LK Abbott & DV Murphy) pp 163-185, Kluwer Academic Publishers. *With kind permission of Springer Science and Business Media.*



What you can do to encourage soil organisms

Maintain ground cover

Bare ground is prone to moisture loss, high temperatures and lacks a supply of organic material to feed soil organisms. Keeping the soil covered with mulch, straw or leaf litter is the first step in promoting soil biota. A living ground cover of plants is even better. Plants devote considerable energy to encouraging soil organisms by secreting sugars, vitamins and other organic compounds into the soil.

Minimise physical disturbance

Use reduced tillage or no-tillage to minimise destruction of soil organisms and habitat, and reduce the rate of organic matter breakdown. Reduce compaction by machinery and animals so that there is space in the soil for air and water to move. Minimise bare surface abrasion by animals and machinery as this leads to microbial damage and possible removal by soil erosion.

Build soil organic matter with green manure crops, mulch or pasture

A diversity of carbon sources will provide food for a wide range of soil organisms. A diverse soil biota has been linked to disease-suppressive soils (see the leaflet 'Fumigation, inoculation and disease suppression'). Adding mulch or compost is particularly useful when these materials can be concentrated rather than spread thinly. The carbon:nitrogen ratio determines the rate of breakdown and therefore the release of nutrients into the soil. Include grazing animals if appropriate.

Maintain adequate moisture

Shelter belts, ground cover and soil organic matter all help to retain soil moisture.

Rotate crops or have mixed species planting

Soil organisms need different root types to maintain a diverse community. They are then better able to resist disease organisms, decompose residues, cycle nutrients and maintain their activity throughout the seasons. Consider introducing a legume species with its associated rhizobia bacteria in the root nodules to convert atmospheric nitrogen to soil bound nitrogen.

Reduce the use of chemicals

Insecticides and fungicides applied to plants also affect insects and microbes in the soil. Some species may be eliminated with frequent use. Some chemicals leave long term residues. Copper from some fungicides can accumulate in soil and affect other organisms such as earthworms.

Apply fertiliser in smaller doses

Applying fertiliser in small doses when the plants need it rather than in large doses when it is convenient will also reduce the amount of excess nutrients that may end up below the root zone or in waterways.

Use organic fertilisers (eg manures)

Organic fertilisers provide microorganisms with a stable food source which then provides long term slow release nutrients to the plants. Organic fertilisers have less adverse impact on soil populations but they should not be considered a substitute for mulching or ground cover.

Check the pH and modify it if necessary

The ideal range for most organisms is pH (water) of 5-8. Strongly acidic soil discourages important organisms such as nitrogen-fixing bacteria and earthworms.

Improve poor drainage by building good soil structure

Waterlogging encourages anaerobic bacteria that can damage plant roots.

Consider your soil as part of a complete agro-ecological system

A healthy, diverse soil food web actively decomposes organic matter and cycles nutrients, ensuring soil and plant health.

More information

Soil biology basics is an information series describing basic concepts in soil biology. For more detailed information we recommend the Australian book *Soil biological fertility:A key to sustainable land use in agriculture* (2003), edited by Lyn Abbott & Daniel Murphy. NSWDPI also has a soil biology website at https://www.dpi.nsw.gov.au/agriculture/soils/biology

Also see:

- Lavelle P & Spain AV (2001) *Soil ecology*. Kluwer, The Netherlands.
- US Department of Agriculture, Soil Biology Unit. Jan 2004. *Soil biology and land management* https://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/nrcs142p2_052489.pdf

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