# MICROBES IN YOUR SOIL

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Soil is more than just something to hold your plants upright. It is a super organism that is home to the most populous community on the seven continents. Ninety percent of all organisms live underground. There can be 10,000 – 50,000 species in less than a teaspoon of soil. There are more microbes in that teaspoon of soil than there are people on the earth. Real soil is active, alive and moving. Critters are everywhere, doing interesting things; many of them (bacteria, fungi, protozoa and nematodes) are invisible to the naked eye.

The common denominator of all soil life is that every organism needs energy to survive. Most organisms need to eat something containing carbon to get the energy they need. Carbon may come from plants, waste products produced by other organisms, or the bodies of other organisms. It is an eat-and-be-eaten world in and on the soil.

Plants take up nutrients through their roots to feed their leaves. The photosynthesis in their leaves is then used to produce chemicals, known as exudate, which they secrete through their roots. Root exudates are in the form of carbohydrates and proteins. Their presence in the soil wakes up, attracts and grows specific beneficial bacteria and fungi that subsist on these exudates and the cellular materials sloughed off as the plant's root tips grow. All this takes place in the zone immediately around the roots. This zone contains bacteria, fungi, nematodes, protozoa and even larger organisms such as earthworms and beetles.

Soil bacteria are like small bags of fertilizer, retaining in their bodies nitrogen and other nutrients they gain from root exudate and other organic matter. The soil protozoa and nematodes act as fertilizer spreaders, releasing the nutrients locked in the bacteria and fungi by eating them. They digest what they need to survive then excrete carbon and other nutrients as waste in the root area of the plant. Soil life provides the nutrients needed for plant life, while plants fuel the cycle by producing exudates. The protozoa and nematodes are in turn eaten by insects, spiders and arthropods (animals with segmented bodies, jointed appendages, and an outer covering called exoskeleton). Soil arthropods also eat each other and are the food of snakes, birds, moles and other animals.

The soil is one big food restaurant. These organisms create soil structure: bacteria produce slime in order to stick to things so they won't wash away; fungal hyphae travel through soil particles, sticking to them and binding them together, thread-like, into aggregates. Worms, insect larvae, moles and other burrowing animals move through the soil in search of food, creating pathways that allow air and water to enter and exit. This soil food web not only provides nutrients to the roots, it also helps create soil structure.

Not all soil organisms are beneficial; a large and diverse soil community controls trouble makers. If the soil food web is a healthy one, the competition keeps the pathogens in check. A healthy soil food web won't allow one set of its members to get so strong as to destroy the web.

Special soil fungi, called mycorrhizal fungi, establish themselves in a symbiotic relationship with Roots, providing them not only with physical protection but with nutrient delivery as well. In return for exudants these fungi provide water, phosphorus, and other necessary plant nutrients. Chemical fertilizers negatively impact the soil food web by killing off entire portions of it. Once the bacteria, fungi, nematodes and protozoa are gone, other members of the food web disappear as well. Earthworms, lacking food and irritated by the synthetic nitrates in soluble nitrogen fertilizer move out. Since they are major shredders of organic material their absence is a great loss.

As soil structure deteriorates, watering can become problematic; pathogens and pests establish themselves and gardening becomes a lot more work. If the salt-based chemical fertilizers don't kill portions of the soil, rototilling will. Rototilling breaks up fungal hyphae, decimates worms, and rips and crushes arthropods. It destroys soil structure and saps the soil of necessary air. Air pollution, pesticides, fungicides, and herbicides also kill off members of the food web community or chase them away. Compaction also destroys the soil food web by compressing the animal habitat and ultimately the habitat of soil microbes and the plant roots they depend on for nourishment.

So what's a gardener to do? Compost can be used to inoculate beneficial microbes and life into the soil around your yard. Some plants (trees, shrubs and perennials) prefer soils dominated by fungi. Coarse, dry, aged brown organic materials support fungi as does mulch laid on the surface. Other plants, such as vegetables, annuals and grasses, prefer bacterially dominated soils and fresh green organic material worked into the soil. Avoid additives that have high NPK numbers, rototilling, or compacting your soils beds by walking on them. These activities destroy or severely damage the soil food web.

For more information see: Acres U.S.A. Vol 40, No.6 Vol 43, No.8 Vol 43, No.10
Teaming With Microbes - A Gardner's Guide to the Soil Food Web
-Jeff Lowenfels and Wayne Lewis