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Gardening In An Ecosystem I
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The yellow crocuses in our front yard started to bloom yesterday. Spring will soon be here and time to plant a garden. I grew my first garden when I was in the sixth or seventh grade. And most years since then I have had a garden, for more than 50 years on the same plot of ground. But as I think a little more clearly about what I do when I garden, I realize that I have never grown a garden. I am a facilitator and a harvester from an ecosystem composed of many species of microorganisms, plants and animals that live within and above the soil. In this essay I want to discuss the garden soil. Soil is not just dirt, but rather a living ecosystem that is the basic resource for a gardener.

Amy Stewart (2004) has described some of the components of this soil ecosystem: "If bacteria can be pictured as teeming black ants under the microscope, imagine fungi as gossamer spider webs. These organisms form long threads called hyphae that stretch between plant roots. Some form into even larger masses called mycelium that can span an entire backyard." Paul Stamets (2005) points out, "There are more species of fungi, bacteria and protozoa in a single scoop of soil than there are plants and vertebrate animals in all of North America." He goes on to describe soil fungi, "I believe that mycelium is the neurological network of nature. Interlacing mosaics of mycelium infuse habitats with information-sharing membranes. . . .The mycelium stays in constant molecular communication with its environment, devising diverse enzymatic and chemical responses to complex challenges."

Many kinds of animals also live in the soil - earthworms, nematodes or roundworms, isopods ("roly-polies"), springtails and other small primitive insects, larger insects and insect larvae, mites, and burrowing vertebrates such as moles. All of these organisms relate to one another in a system of checks and balances. Some of the nematodes may feed on fungi, bacteria and protozoa while some fungi entrap and kill nematodes. Other nematodes may prey on insects or feed on plant roots. Earthworms are important keystone species in many soils and their importance was first recognized by Charles Darwin in the nineteenth century. A large amount of soil passes through their intestines, where it is modified in nutrient content and bacterial composition and deposited at the surface as worm castings, estimated at 1 to 100 tons per acre per year. In burrowing through the soil they leave small channels lined with sticky secretions that allow water and air to more easily infiltrate into the soil.

Plant roots are also a part of this soil ecosystem. The soil, water, air, and associated organisms immediately surrounding a root is known as the rhizosphere. The rhizosphere contains gelatinous secretions from the root and is rich in bacteria and protozoa that are attracted to it. Most of these microorganisms are beneficial to the plant (making nutrients more available, producing antibiotics, etc.) or neutral, but a few can cause plant diseases. There are also fungi called mycorrhizae that live on the surface of or inside roots and increase the efficiency of the roots in absorbing water and nutrients. Most plants grow better in association with these symbiotic fungi. The soil ecosystem is built upon a multitude of interrelationships – mutualism, competition, predation, parasitism – among all these living organisms.

The first principle of good gardening is to consider the effects on the whole ecosystem when deciding on management practices. Although we do not know what many of these effects will be, it is better to be cautious about very disruptive practices and to learn from small experiments. How does this affect the management of my garden?

1) **Soil fertility -** In my garden, I try to take advantage of natural fertility cycles. Kitchen scraps go to the chickens or goats (the manure then goes to the compost heap), the

basement worm bed or the compost heap along with all other waste organic material. I feed the microorganisms that feed the plants. I add materials from which nutrients are slowly released to enrich the soil in my garden, such as compost, bone meal, blood meal, legume cover crops, etc. In the last 50 years of gardening, I have not used commercial highly soluble fertilizers that release nutrients immediately. These immediately available nutrients have important effects on life in the soil and are often subject to leaching and runoff causing groundwater and surface water pollution.

Also organic sources of nutrients add organic material to the soil. Organic material or humus is a key component in the soil. I add mulches, cover crops and other organic matter to maintain the humus content. Magdoff and van Es (2000), in a book on managing soils, state, "However, as organic matter decreases, it becomes increasingly difficult to grow plants, because problems with fertility, water availability, compaction, erosion, parasites, diseases and insects become more common. Ever higher levels of inputs – fertilizers, irrigation water, pesticides, and machinery – are required to maintain yields in the face of organic matter depletion." Organic matter is key to having a soil that is rich in fungi, bacteria and other organisms needed for a healthy soil.

2) **Tillage** – In college, I read Edward Faulkner's book, *Plowman's Folly,* but was not convinced enough to incorporate his ideas into gardening. For many years I would plow or rototill or do both when preparing for a new planting. However, over the years I have become convinced that tillage should be minimized. Now I often plant without rototilling and only till the soil when I want to incorporate organic matter from a cover crop or mulch or when I need to destroy a crop of weeds. And when I rototill, I usually keep it rather shallow. I often use mulches to control weeds rather than cultivation. Tillage destroys soil structure, affects soil life such as fungal mycelia and increases organic matter breakdown resulting in lower soil organic matter and the release of more carbon dioxide, a greenhouse gas, into the atmosphere.

3) **Cover crops and green manure –** I try to keep a vegetative cover on the soil summer and winter, as much of the year as possible. When I have harvested a plot for the year, I plant it to a winter cover crop of rye or wheat or oats with a legume, hairy vetch or clover. I have also sometimes grown a cover crop between the rows of summer crops, such as sweet corn, and I often use mulches as a cover between the rows of crops. Cover crops prevent erosion and preserve soil structure or tilth, add organic matter when incorporated into the soil, add nutrients for succeeding crops, minimize nutrient leaching over the winter, suppress weeds and break pest cycles, help maintain high populations of mycorrhizal fungi and provide habitat for the maintenance of spiders and insect predators.

The goal of these and other practices in my garden is to maintain a diversity of life in the soil ecosystem. I do not grow perfect gardens. I sometimes have crop failures. But failures are part of gardening. And I usually learn more from failures than from successes. Next month I will discuss how I manage the ecosystem above the soil.

References

Darwin, Charles. 1897. The Formation of Vegetable Mould Through the Action of Worms, With Observations on Their Habits. New York: D. Appleton & Co.

Magdoff, Fred and Harold van Es. 2000. Building Soils for Better Crops (2nd edition). Burlington, VT: Sustainable Agriculture Network, x + 230 pp.

Stamets, Paul. 2005. Mycelium Running, How Mushrooms Can Help Save the World. Berkeley, CA: Ten Speed Press, xii + 339 pp.

Stewart, Amy. 2004. The Earth Moved, On the Remarkable Achievements of Earthworms. Chapel Hill, NC: Algonquin Books, xv + 223 pp.