Soils in Our Environment, 9e (Miller/Gardiner)

6 Organisms and Their Residues

I. Chapter 6 Introduction

Preview

Soils appear to be inert masses of minerals but, in fact, they teem with organisms and plant roots. Soil organisms mix and aerate soil, fix atmospheric N_2, decompose dead organic substances, oxidize and reduce many elements, and recycle nutrients. Imagine a world with all the plant and animal bodies ever grown laying around on the surface! Truly, two of the most important processes on earth are **decomposition** (recycling elements) and **photosynthesis** (storing energy from the sun into chemical bonds in plants).

Some organisms cause horrendous damage by reducing crop yields and by spreading animal disease. For example, in the United States, parasitic nematodes (small roundworms) in the soil cause an estimated plant loss of about $2 billion annually; soilborne diseases, such as *Phythium* root rot of cereals and *Fusarium* wilts of fruits and vegetables, cause an estimated $1 billion damage annually; and various large larvae (grubs, cutworms, wireworms, root maggots, and sod webworms) destroy several million dollars worth of crops annually.

Although the detrimental soil organisms are many, the beneficial organisms surpass them in importance. **Fungi** and **bacteria** are the most important organic matter decomposers. Decomposers produce **enzymes**, which reduce the **activation energy** necessary to break the bonds of a substance. Hundreds of different enzymes are needed; generally each enzyme breaks only one kind of bond. Other organisms, **algae**, fix atmospheric nitrogen, which then becomes part of the soil organic matter. **Actinomycetes** fix N_2 and help in the decomposition of organic materials. **Protozoa** are also decomposers and prey on bacteria.

The organic matter residue left after the initial stages of decomposition in soil is called **humus**. Soils have varying amounts of humus, mostly in the top 15 cm to 40 cm of depth. The more arid the climate and the less vegetation grown, the less humus there will be in the soil. Even a small amount (0.5 percent to 2 percent of humus) is important. Humus and actively decomposing organic residues comprise the soil's **nitrogen reservoir**; they also furnish large portions of the phosphorus and sulfur that plants use and some of most nutrients. They protect soils against erosion forces, supply the cementing substances to form desirable aggregates, and loosen up the soil to provide better aeration and water movement.

Soil organic matter is constantly undergoing change and must be replenished continually to maintain soil productivity. Soil organic matter can be supplemented by the addition of organic amendments, such as animal manures, municipal sewage sludge, and septage, logging and wood–manufacturing refuse, industrial organic residues, and food–processing residues. In many countries residues are used for purposes other than to improve the soil, such as using straw in mud for building structures and using manure for fuel (Figure 6–1).

Important Facts to Know

1. Several reasons to study soil organisms
2. The beneficial and nonbeneficial role of soil animals such as earthworms
3. The impact of photosynthetic organisms (plants and algae) on the rhizosphere and on the ecosystem as a whole
4. The importance of fungi in soils and the many roles they play, particularly as decomposers, plant pathogens, and mycorrhizae
5. A few important members of the Protista kingdom
6. The importance of bacteria in decomposition, N_2 fixation, plant disease, and energy transformations and the contributions of actinomycetes and cyanobacteria to soil ecology
7. The unique nature of viruses, viroids, and prions, how they damage other organisms, and why they are difficult to control
8. The general conditions favoring the growth of microbes and methods involved in controlling unwanted microbes
9. The nature and typical composition of soil organic matter
10. The role of enzymes in the decomposition of organic material
11. The role of soil organic matter in improving soil chemical and physical properties
12. The values and properties of livestock manures, crop residues, sewage waste, and composts
13. The reasons to pursue low–input sustainable agriculture