EvoAktiv

What does EvoHerba work on plants?

An explanation from Dr. Arthur C. Groves III, October 2014

Various species of bacteria thrive on different food sources and in different microenvironments. In general, bacteria are more competitive when labile (easy-to-metabolize) substrates are present. This includes fresh, young plant residue and the compounds found near living roots. Bacteria are especially concentrated in the rhizosphere, the narrow region next to and in the root. There is evidence that plants produce certain types of root exudates to encourage the growth of protective bacteria.

Bacteria alter the soil environment to the extent that the soil environment will favor certain plant communities over others. Before plants can become established on fresh sediments, the bacterial community must establish first, starting with photosynthetic bacteria. These fix atmospheric nitrogen and carbon, produce organic matter, and immobilize enough nitrogen and other nutrients to initiate nitrogen cycling processes in the young soil. Then, early successional plant species can grow. As the plant community is established, different types of organic matter enter the soil and change the type of food available to bacteria. In turn, the altered bacterial community changes soil structure and the environment for plants. Some researchers think it may be possible to control the plant species in a place by managing the soil bacteria community.

Certain strains of the soil bacteria Pseudomonas fluorescens have anti-fungal activity that inhibits some plant pathogens. P. fluorescens and other Pseudomonas and Xanthomonas species can increase plant growth in several ways. They may produce a compound that inhibits the growth of pathogens or reduces invasion of the plant by a pathogen. They may also produce compounds (growth factors) that directly increase plant growth.

These plant growth-enhancing bacteria occur naturally in soils, but not always in high enough numbers to have a dramatic effect. In the future, farmers may be able to inoculate seeds with anti-fungal bacteria, such as P. fluorescens, to ensure that the bacteria reduce pathogens around the seed and root of the crop.

Mutualists – the mycorrhizal fungi – colonize plant roots. In exchange for carbon from the plant, mycorrhizal fungi help solubilize phosphorus and bring soil nutrients (phosphorus, nitrogen, micronutrients, and perhaps water) to the plant. One major group of mycorrhizae, the *ectomycorrhizae*, grow on the surface layers of the roots and are commonly associated with trees. The second major group of mycorrhizae are the *endomycorrhizae* that grow within the root cells and are commonly associated with grasses, row crops, vegetables, and shrubs. Arbuscular mycorrhizal (AM) fungi are a type of endomycorrhizal fungi. Ericoid mycorrhizal fungi can by either ecto- or endomycorrhizal.

Mycorrhiza is a symbiotic association between fungi and plant roots and is unlike either fungi or roots alone. Most trees and agricultural crops depend on or benefit substantially from mycorrhizae. The exceptions are many members of the Cruciferae family (e.g., broccoli, mustard), and the Chenopodiaceae family (e.g. lambsquarters, spinach, beets), which do not form mycorrhizal associations. The level of dependency on mycorrhizae varies greatly among varieties of some crops, including wheat and corn.

Land management practices affect the formation of mycorrhizae. The number of mycorrhizal fungi in soil will decline in fallowed fields or in those planted to crops that do not form mycorrhizae. Frequent tillage may reduce mycorrhizal associations, and broad spectrum fungicides are toxic to mycorrhizal fungi. Very high levels of nitrogen or phosphorus fertilizer may reduce inoculation of roots. Some inoculums of mycorrhizal fungi are commercially available and can be added to the soil at planting time.

Protozoa are single-celled animals that feed primarily on bacteria, but also eat other protozoa, soluble organic matter, and sometimes fungi. They are several times larger than bacteria – ranging from 1/5000 to 1/50 of an inch (5 to 500 µm) in diameter. As they eat bacteria, protozoa release excess nitrogen that can then be used by plants and other members of the food web.

Protozoa are classified into three groups based on their shape: *Ciliates* are the largest and move by means of hair-like cilia. They eat the other two types of protozoa, as well as bacteria. *Amoebae* also can be quite large and move by means of a temporary foot or "pseudopod." Amoebae are further divided into *testate amoebae* (which make a shell-like covering) and *naked amoebae* (without a covering). *Flagellates* are the smallest of the protozoa and use a few whip-like flagella to move.

Protozoa play an important role in mineralizing nutrients, making them available for use by plants and other soil organisms. Protozoa (and nematodes) have a lower concentration of nitrogen in their cells than the bacteria they eat. (The ratio of carbon to nitrogen for protozoa is 10:1 or much more and 3:1 to 10:1 for bacteria.) Bacteria eaten by protozoa contain too much nitrogen for the amount of carbon protozoa need. They release the excess nitrogen in the form of ammonium (NH_4^+). This usually occurs near the root system of a plant. Bacteria and other organisms rapidly take up most of the ammonium, but some is used by the plant.

Another role that protozoa play is in regulating bacteria populations. When they graze on bacteria, protozoa stimulate growth of the bacterial population (and, in turn, decomposition rates and soil aggregation.) Exactly why this happens is under some debate, but grazing can be thought of like pruning a tree – a small amount enhances growth, too much reduces growth or will modify the mix of species in the bacterial community.

Protozoa are also an important food source for other soil organisms and help to suppress disease by competing with or feeding on pathogens. Protozoa and bacterial-feeding nematodes compete for their common food resource: bacteria. Some soils have high numbers of either nematodes or protozoa, but not both. The significance of this difference to plants is not known. Both groups consume bacteria and release NH_4^+.

Products like EvoHerba stimulate the growth or reproduction of aerobic organisms which strengthens the symbiotic relationship between the plant, bacteria and fungi to produce stronger more disease resistant plants and crops.

By Dr.Arthur C. Groves III October 2014