IPNI Stewardship SPECIFICS

Does Fertilizer Harm Soil Microbes?

No. 16

Microbes in the soil are important to the nourishment of plants. Soil microbes facilitate many of the chemical conversions needed to make nutrients available for plants. Some people claim that soil microbes should supply all the nutrients needed by plants. Some also claim that applying soluble forms of plant nutrients harms the soil biology and reduces its productivity. Let's look at the evidence.

Both plants and microbes use nutrients in the soluble form. Most fertilizers supply nutrients in this soluble form and are extremely beneficial when present in the proper amount. However if soluble fertilizers are added in large amounts, the dissolved fertilizer can temporarily inhibit microbial growth. But considering that a teaspoon of soil can contain between 100 million to 1 billion individual bacteria, this temporary suppression is not significant.

Tillage and crop residues have a larger effect on soil biology than fertilizer practices. The widespread adoption of conservation and no-till agriculture leads to less disturbance of the soil and generally enhances microbial activity compared with frequent soil tillage. Likewise, returning organic matter (such as crop residues and animal wastes) provides a valuable food source for many soil organisms. Growing high-yielding crops that return plenty of plant residue is beneficial for many reasons.

Microbes play an important role in crop nutrition. Here are just two examples of this complicated interaction.

- **The microbes that supply nitrogen (N) are from two categories—symbiotic and free-living.** The symbiotic types are mainly rhizobial bacteria that infect the roots of legumes, such as alfalfa and soybeans. These bacteria supply the bulk of the N needs of legumes. However, after decades of research, scientists have not yet been successful in coaxing the non-legume crops—corn, wheat, canola, potatoes, and many others—to fix N. Most crops depend on N applications in the form of fertilizer, manure, or organic materials.
- Some specialized fungi help supply phosphorus (P) by forming an association with plant roots called "mycorrhizae". This term means "fungus-root." Mycorrhizal fungi explore the soil better than roots, because their hyphae are more slender and longer, allowing them to acquire nutrients from further in the soil than a root.

Mycorrhizal fungi depend on the plant for energy in the form of sugar. It is well known that they are more active when P is deficient. But the plant sugar used to feed the mycorrhizal fungi is sugar taken away from grain yield. For example, in a recent field experiment in Quebec, Canada, corn depending on mycorrhizae yielded 14% less than when fertilized with P. The fertilizer—even though it was applied at twice the recommended rate—reduced the density of fungal hyphae by 24%, but certainly did not eliminate it. When soil test levels are low, P additions can actually increase mycorrhizal development.

http://500m2.wordpress.com; Inset photo: J. Dean, Penn State.

These soybean root nodules contain N-fixing bacteria. Phosphorus encourages root growth and N fixation in legumes such as alfalfa, soybeans, and other crops.

Scientists have recently discovered that mycorrhizae produce a unique substance called glomalin. It may form as much as 30% of the organic matter in soil, and it seems to help maintain soil structure. Dr. Sara Wright, a noted expert on glomalin, stated that the best field-scale management for the production of glomalin is to "use minimal disturbance, add no more P than is required for crop production, and use cover crops."

Soil microbes depend on plants for their nourishment. Fertilizers that nourish plants also nourish the biology of the soil.

FOR FURTHER READING:

Biederbeck et al. 1996. Canadian Journal of Soil Science 76: 7-14.

Drinkwater, L.E., P. Wagner, and M. Sarrantonio. 1998. Nature 396: 262-265.

Ellis, J.R. 1995. Better Crops with Plant Food 79(1): 10-11.

Eno, C.F. and W.G. Blue. 1954. *In* Soil Science Society Proceedings p. 178-181.

Wright, S.F. and R.L. Anderson. 2000. Biology and Fertility of Soils 31: 249-253.

Wright, S.F. 2003. *In* Proceedings of Northcentral Extension-Industry Soil Fertility Conference. 19: 93-98.

IPNI INTERNATIONAL PLANT NUTRITION INSTITUTE

3500 Parkway Lane, Suite 550
Peachtree Corners, Georgia 30092-2844 USA
Phone (770) 447-0335
www.ipni.net

This *Stewardship Specifics* is one of a series of condensed summaries of issues impacted by nutrient stewardship written by scientific staff of the International Plant Nutrition Institute (IPNI). This series is available as PDF files at www.ipni.net/publications.

Ref #13066