IPNI Plant Nutrition TODAY
Better Crops, Better Environment...through Science

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INTERNATIONAL YEAR OF SOILS: NUTRIENTS AND SOIL BIOLOGY

It is a tendency of some people to only think of plant nutrition in terms of how much fertilizer to add. This simplification may be understandable since a healthy crop reveals only the above ground plant; the roots that support the visible plant are seldom seen without further exploration.

Plant roots grow in an incredibly complex soil environment, teeming with billions of organisms, particularly bacteria and fungi, which play a crucial role maintaining an adequate supply of plant nutrients for crop growth.

There is still much to learn about the complex interaction between microorganisms and plant nutrition, but the importance of these relationships is clearly recognized. Living organisms have a crucial role in controlling the transformations of plant nutrients. In most soils, nitrogen (N), phosphorus (P) and sulfur (S) are mainly present in various organic compounds that are unavailable for plant uptake. Understanding the role of microorganisms in regulating the conversion of these organic pools into plant-available forms has received considerable attention from soil scientists and agronomists.

The microbial conversions of nutrients into soluble forms take place through numerous mechanisms. Extracellular enzymes and organic compounds are excreted to solubilize nutrients from soil organic matter, crop residues, or manures. Organic acids released by microbes can dissolve precipitated nutrients on soil minerals and speed mineral weathering. Some nutrients become more soluble as microbes derive energy from oxidation and reduction reactions.

Mycorrhizal fungi are found in symbiotic association with the roots of most plants. These soil fungi can increase the supply of various nutrients to plants in exchange for plant carbon. The boost in P uptake provided by mycorrhizal fungi is especially important for crops with high P requirements or growing in soil with low concentrations of soluble P. Mycorrhizal fungi release various enzymes to solubilize organic P and they can extract soluble P from the soil at lower concentrations than plant roots are able to do alone.

Biological N fixation is another essential contribution of microbes to plant nutrition. Specialized symbiotic bacteria living in root nodules can fix atmospheric N into ammonium-based compounds for plant nutrition. The most important of these organisms for agricultural plants are from the species Rhizobium and Bradyrhizobium. There are symbiotic N_2-fixing bacteria that infect woody shrubs, and asymbiotic bacteria, such as Azospirillum, that provide N to the roots of grasses such as sugarcane.

An often-overlooked contribution of soil microorganisms to plant nutrition is their benefit to improving soil physical properties. Good soil structure enhances plant root growth, resulting in greater water and nutrient extraction. Individual soil particles are bound into aggregates by various organic compounds such as polysaccharides and glomalin. The small hyphal strands of mycorrhizal fungi also contribute to improved soil aggregation by binding small particles together.

A better understanding of the essential link between soil microbes and plant nutrition allows more informed management decisions to be made for proper stewardship of soil resources and for sustaining crop productivity

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