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

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WHAT IS GOING ON UNDERGROUND?

We spend a lot of time and money to get crops the nutrition they need for maximizing growth and yield. When planning for the next season, don't forget about the part of the plant hidden beneath the soil surface. There are two obvious functions for roots that come to mind; anchoring the plant to keep it upright and getting the water and nutrients needed to support growth, but there are many other things too.

Roots release a large number of organic compounds that aid the plant in its growth. As much as one-third of the carbon fixed through photosynthesis can be pumped out of the roots into the soil, assisting the plant in numerous ways. The organic compounds released from roots are grouped into high molecular weight compounds such as carbohydrates and enzymes, and low-molecular weight compounds such as sugars and organic acids.

The zone surrounding the root is called the rhizosphere, typically extending a few millimeters in to the soil (about the thickness of a nickel). A jelly-like substance is excreted at the root tip that reduces friction and physically protects the delicate cells at the root tip, aggregates soil particles, maintains a pathway for water and nutrient uptake, and influences the growth and development of surrounding plants and microorganisms. These root exudates play a vital role in providing a constant nutrient supply for plants. Some of them regulate microbial growth surrounding the roots. Specific bacteria can be triggered to form nodules in legumes when signaled by the proper root exudates. Other compounds induce spores of mycorrhizal fungi to germinate and assist the plant with P and micronutrient uptake.

Many exudates can directly improve nutrient availability. For example, organic acids released from roots can solubilize P compounds in the soil. Enzymes originating in the root can speed the release of P from soil organic compounds to a form that can be used for nutrition. Specialized root compounds, called phytosiderophores, will chelate iron (Fe) in the soil and enhance plant nutrition and growth.

Roots have the ability to modify the soil pH in the rhizosphere. Plants that receive nitrate as the primary source of N nutrition generally have an elevated pH in the rhizosphere. However, plants that have an abundance of ammonium often cause their rhizosphere to become more acidic.

The physical properties of roots are also important. For example, the root length and the degree of branching are important for exploring soil resources. A root system with a large surface area has greater opportunity for nutrient uptake. The presence of abundant root hairs is beneficial for water and nutrient uptake. It is estimated that up to three-quarters of the total root surface area of many cultivated crops is provided by root hairs

Healthy root systems are often unappreciated, but essential for vigorous plant growth and high yields. Even after the crop is harvested, the decaying root system continues to provide benefits to the soil and to the following crop. Providing an environment where nutritional, chemical, physical, and biological barriers are eliminated allows the crop to reach its full potential. Don't overlook what you can't see.

– RLM –

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Abbreviation: N = nitrogen; P = phosphorus.