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It's Alive! Soil Biology and its Pivotal Role in Crop Production

In agriculture, our understanding of crop production is always evolving and more recently has been building upon the work of soil microbiologists. As agriculturalists, we are now in an era in which we stand upon the shoulders of those researchers and practitioners who build our understanding of soil biology.

Previously, traditional crop science saw the soil as a "black box" in which inputs (seed, fertilizer, etc.) went in one side, and crop yield came out the other side.

There have been many advancements in our understanding of what goes on inside the box, focused on the soil chemical processes and physical characteristics of the soil that make it productive for crop production.

With the understanding of soil chemistry and physics, we saw dramatic increases in production. However, our understanding and mere acknowledgement of soil biology was sorely lacking–one can argue that it still is today.

With recent advancements, we are beginning to recognize that soil biology plays an outsized role in these chemical and physical processes. In a previous article (June 2023), we spoke about how soil organic matter was so pivotal to the structure and function of a soil. Yet, this is only half the picture as the real value of soil organic matter is its role in feeding and housing soil microorganisms, which in turn yield outstanding benefits to growing plants.

A handful of soil contains more living organisms than humans on this Earth–billions of bacteria, fungi and other organisms that have dynamic relationships with each other, the crops we grow, and the world around us.

Many of these microorganisms have metabolisms similar to humans as they respire–intaking oxygen and releasing carbon dioxide as they break down carbon-rich substances, like sugars, for energy. These microorganisms seek the complex carbon-rich molecules of dead or dying plant material.

Microorganisms consume these particles for energy and often release other plant nutrients like nitrogen, phosphorus, and sulfur previously trapped in the organic matter, which plants may use for their metabolic processes.

This decay-release process is responsible for a majority of available plant nutrients and represents the necessity of a functioning soil carbon cycle that both deposits and releases carbon and nutrients for effective plant growth.

Most recently, novel work further builds upon these mechanisms of nutrient cycling. Scientists at Rutgers University have found that growing plant roots actively absorb soil microorganisms and strip them of desired plant nutrients only to spit them back out again into the

space surrounding the roots. This wildly interesting phenomenon is termed the rhizophagy ("root-eating") cycle.

The researchers note that this process is pivotal for plant growth and development as the plants obtain necessary nutrients by extracting them from soil bacteria only to return the bacteria to find more nutrients and repeat the process. To help the microorganisms along, the plants supply them with energy rich compounds through root exudates–a gelatinous substance secreted from the roots themselves.

This relationship between plant roots and microbes represent a symbiotic relationship between the two as both greatly benefit from their relationship. The team also suggests that this process occurs in a wide variety of plants–including many cultivated crops.

The field of soil microbiology is at the seat of innovation as findings like these have the potential to revolutionize the manner in which we agriculturalists raise crops.

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