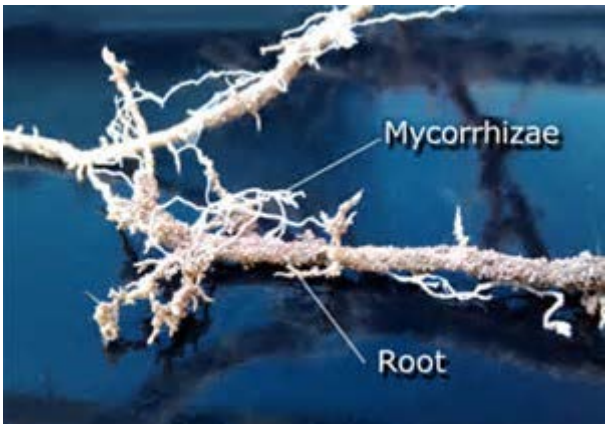
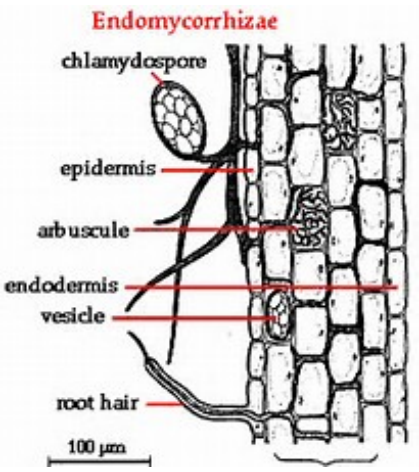
Mycorrhiza: The Hidden Plant Support Network

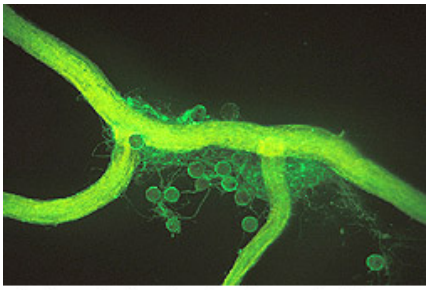


Within the last 20 or 30 years, there has been a growing awareness that most vascular plants could not grow and reproduce successfully without the assistance provided by networks of fungi in the soil. This association between plant and fungus is called mycorrhiza (plural: mycorrhizae). In most instances, the relationship is mutualistic (symbiotic). The plant provides sugars and carbohydrates to the fungus and in return the fungus uses its branched, threadlike hyphae (mycelium) to gather water, minerals, and nutrients for the plant. Mycorrhizal fungi greatly expand the reach of the plant's root systems and are especially important in helping them gather non-mobile nutrients such as phosphorus. These fungi have also been found to serve a protective role for their associated plants; they can reduce plant uptake of heavy metals and salts that may be present in the soil. Many also help protect plants from certain diseases and insects. Scientists believe that it was mycorrhizal fungi that allowed ancient vascular plants to populate the land. Of the current plant families, 95% include species that either associate beneficially with or are absolutely dependent on mycorrhizal fungi for their survival.

Mycorrhizal fungi are commonly divided into two types: ectomycorrhiza and endomycorrhiza. The hyphae of ectomycorrhizal fungi form a lattice around cells in the plant root, whereas the hyphae of endomycorrhizal fungi actually penetrate the walls of cells in the root cortex. Ectomycorrhizal fungi are mainly associated with woody plant species. There are four different kinds of endomycorrhizae that are specifically associated with plants in the Orchid and Heath Families (Orchidaceae and Ericaceae). Interestingly, orchid seeds do not contain food and they require their fungal symbiont to provide the carbon that they need for germination and seedling growth. However, the vast majority of endomycorrhizae fall into the category known as **arbuscular mycorrhiza** (see illustration at left). When the hyphae of an arbuscular mycorrhizal fungus enters the wall of a root cell, they form a finely branched structure called an arbuscule. The arbuscule is the site where the metabolic exchanges between the fungus and the host plant take place. About 80% of vascular plant families associate with arbuscular mycorrhizae. Corn, wheat, and soybean are examples of arbuscular mycorrhizal crops.



In 1996, Sara Wright, a researcher with the USDA Agricultural Research Service, discovered that arbuscular mycorrhizal fungi are responsible for providing much more than just nutrients to plants. She found that a sticky glycoprotein produced on the hyphae and spores of these fungi acts as the glue that holds soil particles together to form aggregates. This glycoprotein is named glomalin, from Glomales, the taxonomic order that includes these arbuscular mycorrhizal fungi. Glomalin is a major component of soil organic matter and it helps the soil to resist erosive forces and prevent surface crusting.



A microscopic view of an arbuscular mycorrhizal fungus growing on a corn root. The round bodies are spores, and the threadlike filaments are hyphae. The substance coating them is glomalin, revealed by a green dye tagged to an antibody against glomalin. (K9968-1)

Not all plants form mycorrhizal associations. Some groups of non-mycorrhizal plants include carnivorous and parasitic plants, several aquatic species, and some plants that inhabit extremely harsh habitats, such as deserts or arctic and alpine sites. A more commonplace group of non-mycorrhizal plants are members of the Mustard Family (Brassicaceae), which are often referred to as brassicas. In addition to not associating with mycorrhizal fungi, the roots of brassicas contain chemicals that are potentially toxic to soil fungi. More research is needed to determine the effect of growing brassica crops, both agronomic and cover crops, on populations of mycorrhizal fungi in the soil.

Because we cannot easily see mycorrhizal fungi, we tend to overlook their significance. Their presence in the soil is vitally important to the growth of most plants on our planet. They also perform a critical function in building soil structure and sequestering carbon. Therefore, we need to begin thinking about how what we do to the soil, for example tillage, affects these almost imperceptible fungal systems.

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