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MYCORRHIZAE FUNGI AND HOW THEY ASSIST MANY CROPS TO ABSORB NUTRIENTS

There is a lot more than just plants that live and grow in soil. Soil inhabiting organisms include a diversity of types and sizes. There are small burrowing mammals, insects, amphibians, and worms that can be seen with our eyes, and also a large diversity of tiny and microscopic biota including nematodes, bacteria, fungi and actinomycetes. All of these organisms work to breakup, disperse, incorporate into the ground and decompose plant residues. They also in many instances help to weather soil mineral components and less soluble precipitated compounds. All this activity results in the release of plant nutrients in mineral forms that plants can use to grow. The whole process of nutrients being used by plants, and then plant residues being decomposed in soil is a vital part of nutrient cycling in the environment.

The majority of the nutrients in soil, at any one time, are stored in forms that are unavailable to plants. At first this sounds less effective, but is in fact a necessary feature of soils so that nutrients are stored and released in a timely and adequate manner, but not so soluble that they would be easily leached out of soils. Plant roots exude chemicals that help to dissolve some of these more complex and less soluble compounds that contain plant nutrients. However, plants are not able to do this all on their own, and this is where other soil-inhabiting organisms, noted above, help out. One especially effective and beneficial group of microbes is a genus of fungi called Mycorrhizae (*M*). These fungi have the ability to grow into the roots of many plant species, while their fungal hyphae or branches grow into the soil matrix.

***M* fungi are beneficial to many important agronomic crop species in a couple of ways.** They live symbiotically with the crops by accessing and supplying needed plant nutrients from the soil to their plant partner. The plant in turn shares photosynthetically produced sugars to the fungi as an energy source. The *M* fungi make nutrients accessible to crop plants by first effectively increasing the extent of the plant root system in soil by exploring portions of the soil that the roots would not grow into and touch. Secondly, they have the ability to dissolve low solubility compounds containing plant nutrients, that crop roots are less effective at doing. Because many plant nutrients have low mobility in soil, they diffuse slowly and for only a short distance, for example a few millimeters in a growing season, from an area of higher concentration to an area of lower concentration. It is very helpful to have the *M* hyphae assist in finding and acquiring needed nutrients. In these two ways they help supply nutrients to crops, especially less mobile phosphorus, potassium, and most micronutrients.

Management of cropping systems by choosing certain crop rotations and reduced tillage systems can help *M* fungi to be more effective. Even though in the original natural state many of the grassland soils of the Northern Great Plains contained a diverse group of *M* fungi species the use of intense tillage, summer fallowing, and predominately growing wheat, has drastically reduced the number of *M* fungi species surviving. The remaining species cannot supply needed plant nutrients as well compared to if more species would be present. However, by using conservation or no-till cropping, and a more diverse crop rotation including pulse crops such as lentils and field pea in rotation along with small grain cereal crops, it is possible to create soil conditions suitable to re-establish many beneficial *M* fungi species.

There is on-going research in the Northern Great Plains on how to bring back the beneficial influence of missing *M* fungi for growing crops. Research is being led by Dr. Chantal Hamel, Director of the Soil Microbiology Laboratory, Semiarid-Prairie Agricultural Research Centre, of Agriculture and Agri-Food Canada, Swift Current, SK. Dr. Hamel's research team is selecting beneficial missing species of the fungi, still present in natural grasslands, and reintroducing them into cropped soils. Part of the technique to achieve this is to successfully grow the needed species in sufficient quantity under controlled laboratory conditions, inoculate the seed of a compatible crop species, e.g. a pulse crop, and grow this crop in rotation with wheat. The use of no-till planting and cropping helps the reintroduced fungi to survive, as tillage itself is disruptive to established fungal hyphae in soils. Many of the so called "lost" species of *M* fungi will increase nutrient availability to crops, after reintroduction using less tillage, cessation of summer fallowing, and growing diverse crops in rotation.

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