Field Crops, Forages and Soils Updates for NNY *6 November 2018*

What are Mycorrhizae and Should They Factor into Your Crop Management Plans?

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You've probably read about mycorrhizae, their presence in soil and their interactions with crop plants in farm magazines and on internet blogs. Those articles often describe these mysterious soil organisms with distracting supernatural-sounding language and promote their consideration to top priority for crop and soil managers. Is that a good idea? Are they really that important? If so, what do they mean for crops, soils and environment? How about your bottom line? Let's see what science has revealed about these organisms.

Mycorrhizae are what you're read – naturally occurring soil fungi that live symbiotically with plants. They are highly specialized fungi that colonize roots of host plants, providing the host plant greater access to water and nutrients, especially P. They function like extensions on plant roots, exposing the plant to a larger volume of soil from which to find nutrients. Mycorrhizae especially increase a crop's ability to take in P, Zn, Cu and water. This enhancement typically results in increased plant growth, especially under conditions such as drought or low nutrient availability.
In exchange, the host plant shares some of its photosynthesized sugars with the fungus to meet its energy requirements. Mycorrhizae are categorized into a few main groups, but what they all have in common are their close, mutualistic association with plant roots, some so close they actually penetrate plant tissues and cells, and extend out into the soil, extending the root zone. Soil scientists estimate that mycorrhizal fungi make up about 30% of all soil-born organisms.

Scientists estimate that about 80-90% of all terrestrial plant species live symbiotically with mycorrhizal fungi. Notable exceptions are spinach, sugar beets, lupins, and brassicas. Mycorrhizal fungi are noted throughout the fossil record, actually appearing *before* plants, and are believed to be one of the contributing factors leading to the development of early land plants. Today, mycorrhizae are present in most soils worldwide as they are easily transported by wind, water, humans and animals. Some plant-fungus relationships are very specific and while others are less so. Some plants can associate with more than one type of mycorrhiza. Most of the more common mycorrhizal fungi cannot grow or reproduce without their host plant, though reproductive spores can persist in the soil until a host plant becomes available.

Now, all this said, are they important in our NNY forage and grain cropping systems? Simply put, yes, they're likely in all our soils, quietly doing their job assisting corn, alfalfa, clovers, grasses and soybeans. (These fungi are NOT the organisms partnering with legumes to fix N. Those are *Rhizobia* bacteria.) Our present day crop management practices can affect mycorrhizae, however:

- Reduced tillage methods enhance mycrorrhizae growth. Conversely, tillage disrupts development of mycorrhizal development by physically breaking hyphae and reducing growth. Mycorrhizae are also able to colonize crop roots earlier in the season in no-till fields compared with conventionally-tilled fields. Earlier colonization increases spring P and Zn uptake, which can improve overall yield and reduce P fertilizer needs. Those long hyphae also help soil aggregates stick together, improving soil structure.
- Crop rotations and cover crops can influence mycorrhizae populations. Rotations that include non-mycorrhizal crops or bare fallow periods will have reduced mycorrhizae. Non-brassica

cover crops stimulate mycorrhizae populations by bridging seasons and eliminating a bare fallow period. Brassica cover crops are non-mycorrhizal and do not help in this way.

- Pesticides can have variable effects on mycorrhizae. Soil fumigants typically damage mycorrhizae severely in upper soil layers. Herbicides vary in impact, ranging from none to modest reductions in mycorrhizal growth. Insecticides and nematicides generally have little effect while systemic fungicides can reduce growth of some mycorrhizae and foliar fungicides have very little impact.
- Soil fertility and fertilizers can have an impact. When soil phosphorus is plentiful, mycorrhizae growth can be suppressed, while organic fertilizers and manure may increase mycorrhizal growth and diversity.

Commercial mycorrhizae inoculants are commercially available. Do they help? Are they cost-effective? Independent research results are pretty mixed. Researchers have not demonstrated that the use of these inoculants will increase short- or long-term yields. Although mycorrhizae are present in nearly all soils, inoculation could potentially be beneficial in some specific circumstances where populations would be expected to be very low, or where the benefit may be substantial. For example, when soils are very low in available P, where mycorrhizae populations have been reduced through fumigation or intensive tillage, or where non-mycorrhizal plants have been grown continuously or frequently in a rotation, a response to inoculation is possible. As in other similar experimental or learning situations, test an application on a couple of small, marked areas to gain experience before using it widely to reduce risk of unrecovered expense.

Figure 1. Illustration of corn plants with (right) and without (left) mycorrhizal infection. Mycorrhizal fungi can stimulate host plants to 1) reduce root growth while simultaneously 2) expanding its capacity for water and nutrient uptake. 3) Above-ground plant growth or yield is often increased compared with non-infected plants. 4) Networks of mycorrhizae may also connect neighboring plant root systems and communicate warnings about above-ground insect or pathogen injury. (Illustration by Carlyn Iverson.)

For more information about field crop and soil management, contact your local Cornell Cooperative Extension office or NNY Cornell University Cooperative Extension Regional Field Crops and Soils Specialists, Mike Hunter and Kitty O'Neil.

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