Does my soil already contain mycorrhizal fungi?

Mycorrhizal fungi are present in most undisturbed soil ecosystems, along with innumerable amounts of bacteria, protozoa, actinomycetes, worms, insects, etc. Mycorrhizal populations are particularly low, and many times non-existent, in agricultural soils that have been altered by certain pesticides, chemical fertilizers, tillage, compaction, organic matter loss, erosion, and fallow periods. Once lost from a farm, mycorrhizal populations are slow to reestablish. Endomycorrhizal fungi form their spores or "seeds" below the soil surface. Because these spores do not readily move in the air, they do not move long distances from natural areas back to the farm. Nursery grown crop plants available to farmers are often deficient in mycorrhizae. Plants raised in most nurseries receive intensive care and feeding. These artificial conditions, such as high levels of water, nutrients and sterile soil-less mixes at the nursery, produce large quantities of plants for sale. Unfortunately, the high levels of water and nutrients and the lack of mycorrhizae discourage the plant from producing the extensive root system it will need for successful transplanting. Thus these plants are poorly adapted to the eventual substrate condition and must be weaned from intensive care systems and begin to fend for themselves. Application of mycorrhizal inoculum before, or during, transplantation can encourage plant establishment and set the plant on track to feed for itself. Research studies document the need of plants to generate a mycorrhizal root system in quickly to become established.

Mycorrhizal colonization can also be reduced by high rates of available phosphorus. Studies have documented a decline in mycorrhizal colonization when available P rates exceed 80 ppm. On many farms there is an adequate supply of soil phosphorus but it is tied up in the soil and not available to plants. Mycorrhizal fungi such as Glomus mosseae, Glomus intraradices and Glomus etunicatum species produce a high level of phosphatase enzymes that specifically extract tightly bound phosphorus from clay particles and make P immediately available to the plant. Since mycorrhizal fungi are important to P in soil, a healthy mycorrhizal population eliminates the need for high levels of P fertilization. Some scientific studies have shown that following mycorrhizal inoculation growers can decrease their P fertilization by 20-30 percent without any loss of plant productivity. In fact most studies have documented large increases in P uptake when mycorrhizae are present. This has significant implications to agricultural production because phosphorus is second only to nitrogen in terms of its importance to crop growth and development. While some fungicides reduce or eliminate mycorrhizal fungi other research indicates that certain types of fungicides do not adversely affect mycorrhizae. A list of fungicides and their effects on mycorrhiza can be accessed at www.mycorrhizae.com. In addition, mycorrhizal inoculants can be used to 4 to 6 weeks before applying fungicides allowing the mycorrhizae to firmly establish within the plant root. Mycorrhizal inoculum can also be added following the use of a fungicide. Follow the manufacturers' guidelines for the time in which the fungicide "clears" the soil media.

How to use mycorrhizal fungi

Agricultural markets are already benefiting from the use of mycorrhizal inoculum and use has increased dramatically in recent years. New developments in the growing of mycorrhizal inoculum has made using mycorrhizae on the farm more cost effective, easy and affordable. High quality, concentrated mycorrhizal inoculum containing diverse species is the best choice. Because of the wide variety of crops, soils, and climatic conditions that farm ecosystems have, a diverse species mix of mycorrhizae assures the best response. Endomycorrhizal inoculum used to form the mycorrhizal relationship, can contain several selected mycorrhizal species. Glomus intraradices is one of the most studied and known to form the mycorrhizal association over a wide range of crop conditions. Glomus intraradices has been shown to be critical for nutrient and water uptake as well as in the control of parasitic nematodes. Glomus mosseae and Glomus etunicatum produce a superior yield response by stimulating root development, protecting against drought, and increasing P uptake.

What types of mycorrhizal products are available? Mycorrhizal inoculum can be applied in a powder, granular or liquid form. Treatment seed, either before or during seeding, produces excellent results. For example, one pound of the concentrated 4 species, Mycorrhizal mycorrhizal seed inoculant can treat enough seed to sow one acre (figure 61). Del Gates a farmer in North Dakota was able to increase flax yields from 22 to 28 bushels/acre. Ron Miller a wheat farmer in Nebraska increased his organic wheat yield from 12 to 17 bushels/acre using the same mycorrhizal seed inoculum. In Visalia, California, studies by United Agricultural Products documented a 20% increase in the yield of sorghum, sudan grass at 6 different seeding rates following MycoApply® inoculation. Other studies with MycoApply® mycorrhizal inoculants have shown significant improvement in the yield of strawberries, tomatoes, potatoes and many other crops.

Conclusions

It is easy to forget about soil organisms. After all, most of the creatures living in the soil are not out of sight. However, farmers clearly know the look and feel of a productive soil that is the product of the living soil environment. Managing for beneficial soil organisms can create and maintain healthy and profitable soil conditions. The "real dirt" on soil is this: it's much more than minerals, air, water and decaying organic matter. The soil has life and this life supports a productive farm. "Dirt is dead, but soil is alive."
The Real Dirt on Soil:

Understanding native soils

How do soils function in their natural condition? How do native grasslands and forests produce an abundance of plants and animals in the complete absence of irrigation, fertilizers and tillage? The answer lies in understanding certain principles by which native soils function. We have been taught that soils are comprised of four basic components: minerals, air, water and decaying organic matter. What has not been told is that there is another major component of soil. It is the web of life, the “living soil” that supports plant health and growth (Figure 2). Take a look at the amount of soil organisms present in an acre of healthy topsoil:

- 1000 pounds of earthworms
- 1500 pounds of bacteria
- 500 pounds of fungi
- 300 pounds of protozoa
- 150 pounds of actinomycetes
- 100 pounds of algae
- 50 pounds of fungi

The living soil can help farmers develop and maintain productive and profitable soil conditions for today and for future generations. Dr. Arden Anderson, a physician and leader in the field of sustainable agriculture says, “The health of the living soil affects the health of the crop and ultimately humans. Using sustainable technologies, such as mycorrhizal fungi, works with nature and outperforms conventional agriculture” (Figure 3).

When the soil is healthy, alive and managed in a sustainable manner, several positive features emerge:

- Reliance on expensive additives declines
- Land value increases
- Income potential increases
- Natural processes can replace artificial intervention
- Crops are more productive and less susceptible to disease

The real dirt

The living soil, the ‘real dirt,’ should be viewed as a living community and not an inert body. What do beneficial soil organisms do in natural areas that can also benefit the farm? Native prairies and forests functioned for decades and centuries without artificial inputs. The soils are built by soil organisms, not by machinery. They acidify too, microbially fix nitrogen from the atmosphere and convert it to a form readily available to plants. In the natural soil system, fertility is used over and over again and nutrients are not lost to runoff, ground water or by erosion. Jim Trappe, PhD professor emeritus at Oregon State University has studied the living soil for 45 years and published over 250 scientific papers on the subject. Says Jim, “Beneficial soil organisms such as mycorrhizal fungi conserve, process and transport bound up minerals directly to the plants via a microscopic web of fungal filaments. The original ‘world wide web’ of mycorrhizal filaments beneath the soil surface will work for the farmer’s benefit if simply managed for their survival’. There are over 50,000 thousand scientific studies on mycorrhizal fungi. The following paragraphs briefly describe what mycorrhizae are, where they are and how to use them. More detailed information on mycorrhizae and their uses can be accessed at www.mycorrhizae.com.

What are mycorrhizal fungi?

“Mycorrhizae” literally means “fungus” – root and defines the mutually beneficial relationship between the plant roots and fungi. These specialized soil fungi colonize plant roots and extend far into the soil resource. Mycorrhizal fungal filaments in the soil are truly extensions of root systems and more effective in nutrient and water absorption than the roots themselves. A thimble full of healthy soil can contain several miles of fungal filaments that direct soil resources back to the plant roots.

Specific benefits

Mycorrhizal fungi are the most researched aspect of the living soil. Mycorrhizal fungi can produce increased growth because they improve the absorption of soil phosphorus, zinc, copper, calcium, magnesium, manganese and sulfur. Research indicates mycorrhizal colonization increases a crops ability to absorb water from the soil and withstand extended periods of drought. Improved photosynthesis capacity resulting from colonization has also been cited in reducing negative effects of salt and toxic elements. Mycorrhizal can produce hormones that stimulate root growth. Mycorrhizae can also produce synergistic effects in legume crops when the inoculants of fungi and nitrogen fixing bacteria are combined. Roots colonized by mycorrhizal fungi are less likely to be affected by root feeding nematodes. And finally, mycorrhizal plants are more resistant to many soil borne pathogens. Specific scientific abstracts regarding mycorrhizal fungi and these benefits can be accessed through www.mycorrhizae.com.

Soil add and mycorrhizal fungi

A soil that drains well, does not crust and takes in water and oxygen is said to have good tilth. Soil tilth influences the ease of tillage, root penetration and seedling emergence. Soil with good tilth is said to be well-aggregated. Well-aggregated conditions occur when individual soil particles are joined together in stable clusters that improve the infiltration and porosity of the soil. This sticky glue holds individual soil particles in water-stable aggregates which encourages the flow of both moisture and oxygen through the root zone. Glomalin levels are high in healthy well-aggregated soils. Figure 5 is a picture of a healthy well-aggregated soil.

Mycorrhizal filaments act as miners:

Mycorrhizal filaments extract nutrients from the young roots of mycorrhizal treated seed.