Farmers' Fungus That Pays Big Dividends

Hidden from view beneath the soil surface in the farmer's field there is a relationship between fungi and plants that is fundamental to life on the planet. Fungi can't make their own food, they have to absorb their nourishment from living or dead organic matter. Organisms like fungi help assure the earth's resources recycle as they should. There is one particular group of fungi that works in cooperation with important crop species. This article will shed some light on this special "farmers' fungus" that pays big dividends.

We have come to understand that in natural habitats, plant roots are a complex mixture of both fungi and plant. This relationship is called a "mycor-rhiza" which literally means 'fungus-root'. Approximately nine out of every 10 species of plants form an association with these specialized mycorrhizal soil fungi in order to thrive. The plant needs the fungus and the fungus needs the plant. The fungus is responsible for getting the nutrients and water from the soil, and in return, it gets carbohydrates from the plant (figure 1). This is what is called a "symbiotic" relationship; one in which both plant and fungus benefit. The fossil evidence indicates that this plant/fungus relationship dates back over 460 million years.

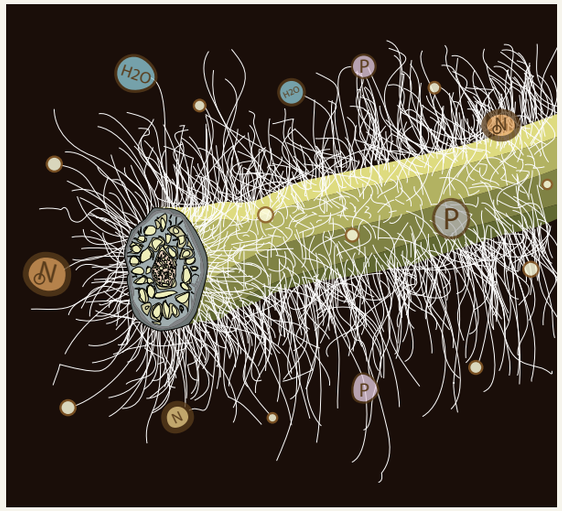

Figure 1.

What are they?

The body of the fungus consists of very thin strands called hyphae (figure 2). In healthy soils, these strands grow from within the root cells of the crop and spread out into the soil, greatly increasing the surface area of the root system. The most widespread type of mycorrhizal relationship are known as arbuscular mycorrhizae (also known as "endo" mycorrhizae) and are formed by most agricultural plants. These plants include most grains, vegetables, fruit and nut trees, vines and turf grasses.

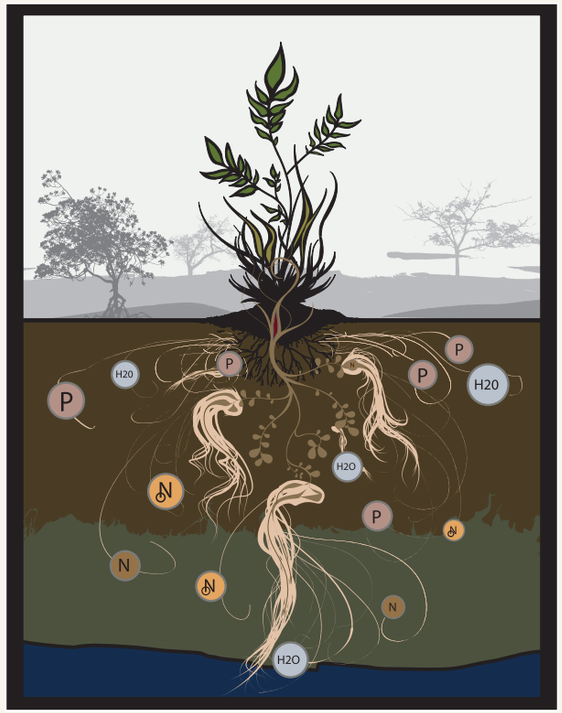

Figure 2.

What they do

The mycorrhizal relationship effect on the root system is dramatic. Most of the absorbing area of the root system is actually fungal hyphae. Hyphae are much thinner than roots or root hairs and are able to penetrate the tiniest pores in the soil. A thimbleful of healthy soil can contain miles of fungal hyphae! As a result, the efficiency of the plants' nutrient and water uptake is increased enormously.

Agricultural soil often contains abundant nutrients but availability to the crops themselves can be limited. Research demonstrates that mycorrhizae are particularly important in mobilizing phosphorus, nitrogen, zinc, iron, calcium, magnesium, manganese, sulfur and other tightly bound soil nutrients, transporting them back to the plant. This plant-fungus relationship can pay off

Continued inside…

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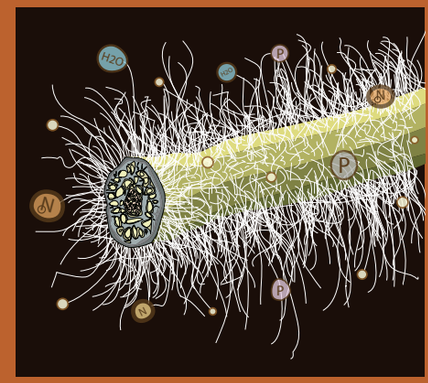

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big on the farm. Crop plants become able to absorb soil nutrients previously unavailable and utilize fertilizer inputs much more efficiently. The result is often significant savings in fertilizer costs (figure 3).

Water, water everywhere?

Agriculture's need for fresh water is growing faster than nature can provide. It's quickly becoming one of the key resource issues of the 21st century. How do natural areas provide for such luxuriant plant growth without irrigation? One key factor are the mycorrhizal threads attached to plant roots scouring the soil for available resources. They absorb water during periods of adequate soil moisture, then retain and slowly release them to the plant during periods of drought. Natural areas have achieved a level of drought tolerance that far exceeds agricultural areas partially because an enormous web of mycorrhizal threads act as a sponge, protecting plant communities from extreme moisture deficits. The mycorrhizal threads can penetrate into the small soil pores to access pools of water that are unavailable to the thicker roots. An extensive body of research has documented the importance of the mycorrhizal relationship for efficient water use and drought protection for a wide array of important crop species. The ever-increasing cost and declining quality of water are formidable issues facing farmers today. Today, mycorrhizal fungi can be a powerful tool for farmers seeking to improve water-use efficiency and lower irrigation costs.

Does my farm have mycorrhizal fungi?

Some modern agricultural practices reduce the biological activity in soil. Fungicides, chemical fertilizers, cultivation, compaction, soil erosion and periods of fallow can all adversely affect beneficial mycorrhizal fungi. Extensive testing of agricultural soils indicates that many intensively managed lands such as agricultural fields lack adequate populations of mycorrhizal fungi. Farming extensive acreage affects the mycorrhizal relationship in two fundamental ways. First, it isolates the crop plant from the beneficial mycorrhizal fungi available from natural settings. Secondly, it increases the need for water, nutrients, and soil structure required to sustain a healthy crop.

Once lost from a farm, arbuscular mycorrhizal populations are very slow to re-colonize, unless there is close access to natural areas that can act as a source of mycorrhizal spores and hyphae to re-populate the affected area. Arbuscular mycorrhizal fungi do not disperse their spores in the wind, but rather grow from root to root. The spores do not easily move long distances back to the farm soil from undisturbed natural sites. Unfortunately, growing crops immediately adjacent to undisturbed natural ecosystems is not always an option on the modern farm.

How do I use mycorrhizal inoculants on my farm?

A farmer can enhance crop root growth, nutrition and yield, reduce irrigation and ameliorate many problems resulting from intensive agriculture by inoculating with mycorrhizal fungi. A more sustainable approach to crop establishment and growth includes using mycorrhizal fungi as an inoculant before, during, or following planting.

The goal is to create physical contact between the mycorrhizal inoculant and the crop roots. Mycorrhizal inoculants come in liquid, powder and granular forms. They can be sprinkled onto roots during transplanting, banded with or beneath seed, used as a seed coating or watered in via existing irrigation systems. Treating seed either before or during sowing produces excellent results. Just one pound of a MycoApply® 4-species concentrated powder can easily treat enough seed to plant one acre. The type of inoculum product and application method depends upon the conditions and needs of the crop and farmer. Generally, mycorrhizal application is easy, inexpensive, and requires no special equipment. Liquid forms of mycorrhizal inoculants are becoming very popular due to the ease of handling, mixing, storage, and their effectiveness in penetrating many soil types and treating existing plants.

It is also now possible to have vegetables, fruit and nut crops which begin their life cycle in a nursery inoculated with mycorrhizal fungi. Unfortunately, most crop plants raised in nurseries are started in sterile soils and receive intensive fertilization, water, and pesticides. Although these artificial conditions can produce vast volumes of plants, they also result in non-mycorrhizal plants that are often poorly adapted to the eventual out-planted conditions on the farm where they will be subject to the harsher environment of the open field. Conversely, nursery-grown plants that have already been colonized with mycorrhizal fungi are better equipped to take advantage of soil resources and can establish rapidly and successfully in the field.

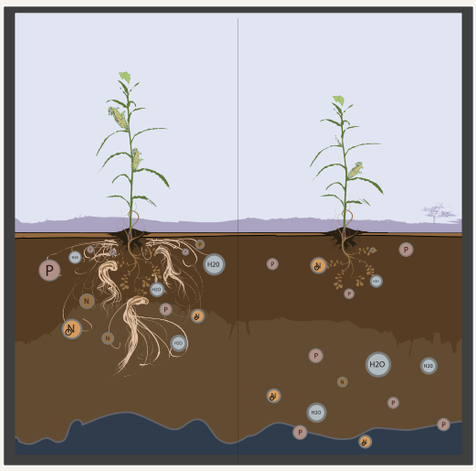

Figure 3. The mycorrhizal corn plant on the left can retain and absorb fertilizer compared to the non-mycorrhizal corn plant on the left.

Are my crops supposed to form mycorrhizae? If so, what kind of mycorrhizae?

Plants that form arbuscular or "endo" mycorrrhizae (80-90% of plant species)

- Legumes, composites, native grasses, bulbs, most ferns.
- Almost all crop species
- Almost all shrubs and some tree species
- Plants that form "Ecto" (5%) *mainly conifers and oak*

Other "specialty" types of mycorrhizae

- Cranberry, blueberry, azalea, rhododendron and related species form special ericoid mycorrhizae.

Non mycorrhizal host plants

- Most annual and many perennial weeds
- Sedges, cattails, bulrush and related species that occupy saturated soils
- Most members of the Brassicaceae (Mustard family), Amaranthaceae (Amaranth family), and Chenopodiaceae (Goosefoot family);
- A few agriculturally important plants do not form mycorrhizae, most notably broccoli, canola, and sugar beets

**Note a more complete list of plants and their mycorrhizal status as well as other valuable information on mycorrhizae and the uses can be found at www.mycorrhizae.com*

What about Fungicides?

Of course, mycorrhizae are fungi so it stands to reason that some fungicides will reduce or eliminate them from the soil and roots. Fortunately, research and experience indicates that certain types of fungicides do not adversely affect mycorrhizae. A list of common agricultural fungicides and their effects on mycorrhizae can be accessed at www.mycorrhizae.com. Sometimes it helps to apply fungicides four to six weeks prior to the mycorrhizal treatment. Mycorrhizal inoculums may also be applied after the use of a fungicide. Follow manufacturers' guidelines for the time required for the fungicide to "clear" the soil media.

Farm fungi pay dividends

Many mainstream agricultural markets are already benefiting from the use of mycorrhizal inoculums, and use continues to increase dramatically. Recent advancements in mycorrhizal research and application technology have made farm use of mycorrhizae easier and more cost effective than ever. The economic return for mycorrhizal inoculation can exceed its cost several-fold, not only from increased yields, but also by reduced fertilizer and water. Using a granular MycoApply® product, Del Gates of North Dakota increased flax yields by 27%. Ron Miller's wheat farm in Nebraska increased its yield of organic wheat by 42% by treating the seed with a MycoApply® powder. Agronomists in California's San Joaquin Valley documented a 20% yield increase of sorgum sudan grass at four different seeding rates following MycoApply® treatment. Other studies have shown similar success with onions, alfalfa, melons, garlic, carrots, rice, strawberries, tomatoes, potatoes, almonds and a host of other crops where yield increases have ranged from 10 – 40%, often with reduced inputs and cost.

Learning about the role of mycorrhizal fungi and the conditions that inhibit or promote their presence in the soil is the first step toward healthier crops, increased yields and lower costs. The next step is to add the fungi to the root zone when planting or transplanting and when restoring distressed soils. Good soil is a precious resource containing millions of years worth of nutrients and microorganism development. However, to be successful the farmer requires an appreciation of the "friendly fungus" that can pay big dividends.

For practical information regarding mycorrhizae and their uses go to www.mycorrhizae.com

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