

Mycorrhizae, Potato Production Partner

by Gilles Hamel

Mycorrhizal fungi have been known since before the prewar period. At that time, while researchers were working to improve plant productivity, nitrates from the agrochemical industry came about and the results on plants were stunning. Unfortunately, research on mycorrhizae were put aside by many as they concentrated on how to best use synthetic fertilizers and the new advancements being made in pesticides and fungicides.

We can compare the resurgence in interest in mycorrhizal fungi with what is happening in the automotive industry. Gas from oil is the predominant fuel for automobiles, but there are other forms of energy that can operate a car. In recent years, due to increasing costs of oil and gas, there have been some interesting developments in the production of hybrid, electric and hydrogen vehicles as alternatives to gas for the automotive industry. Since we are now in an era where environmental protection has become increasingly important, particularly in agriculture, mycorrhizae represent an effective and natural alternative or supplement for currently used fertilizers in the future.

Mycorrhizae, what's that?

Over 450 million years ago, the first plants appeared on earth, and with them, mycorrhizal fungi. The term mycorrhizae comes from the Greek "mukês", meaning fungus, and "rhiza," which means root. These fungi form a close association with plant roots (figure 1). This symbiosis begins with the formation of a network of filaments that associate with plant roots. In fact, these fine filaments are hyphae (mycelium), which propagate, among others, reproductive structures such as spores (figure 2).

Not all mycorrhizal fungi react the same way. However, a beneficial alliance can accelerate root development and stimulate plant growth through the

Figure 1.



provision of additional water and nutrients (P, Zn, Cu, Mo ...) that would otherwise be inaccessible to the root system. In addition to optimizing the uptake of fertilizers, soil nutrients and water, mycorrhizae can increase plant tolerance to drought and various environmental stresses. Moreover, they can accelerate rooting, increase the vigour and health of plants, promote greater flowering and fruiting, increase plant survival and ultimately, increase yields.

It took several years of research to develop a clean and high quality mycorrhizal product and there have been commercial products developed that are in use in the ornamental horticulture and home gardening sectors. Daniel Harvey, a colleague who works at the Centre de Recherche Les Buissons for the greenhouse production of potato seedlings, found that when using greenhouse soil mix with mycorrhizae, he noticed that the plants with mycorrhizae grew better, were larger, healthier, produced more flowers and gave a higher production of tubers.

In what ways is it interesting for potato production?

Phosphorus plays an important role in agriculture, but it is often fixed in soil by clay, aluminium, iron, calcium (according to pH) and different organic complexes. Thus, it is frequently unavailable to plants. Potato plants have a high need for phosphorus and have great difficulty extracting this element from the soil. To meet the needs of cultivated plants, an additional phosphorus application is often required. Unfortunately, less than 15% of the phosphorus in fertilizers is used by plants during the year of application (Liu et al. Mycorrhizae in 2007 in crop production). Mycorrhizal fungi play a very important role in the uptake of phosphorus by plants.

Sometimes, the lack of water is a restricting factor in the production of potatoes. The network of hyphae formed when the plant is inoculated allows it to reach water that

Figure 2.



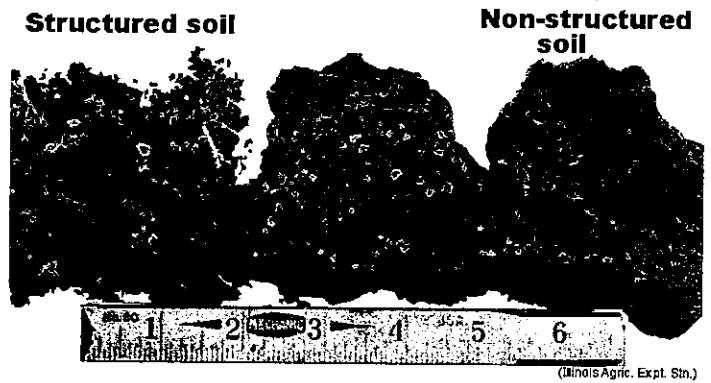
normally would not be accessible. Thus, potato plants are more resistant to drought. In addition, mycorrhizae hold soil particles together, thereby reducing runoff and erosion. The plant provides carbohydrates and other nutrients to the fungi which use carbohydrates to grow and to synthesize and excrete molecules such as glomalin (glycoprotein). The release of glomalin in the surrounding soil results in an improved soil structure because the soil aggregates surrounded by mycorrhizal fungi hyphae are coated with this sticky protein (figure 3). The improved soil structure leads to a better water penetration, thus limiting erosion and stabilizing the soil.

Why add mycorrhizae?

All types of soils contain a variety of mycorrhizal fungi. Some species reproduce more efficiently and others have more significant beneficial effects on plants. In agricultural soils, the natural population of mycorrhizal fungi decreases in time. The main reasons are the following:

- Intensive work of soil (breaks hyphae network)
- Crop rotations (non-host crops such as canola, cabbage, mustard)
- The use of high levels of phosphorus and chemicals

Figure 3.



(mycorrhizae have little impact when there is a strong presence of phosphorus available. Some pesticides have a detrimental effect on mycorrhizae.)

- Soil compaction (physical damages)
- Unequal distribution and effectiveness of indigenous mycorrhizal populations

During the production of potatoes, a large amount of soil is worked, either by subsoiling, harvesting or plowing of rotation crops. Moreover, in many cases, there is no vegetative cover during winter. This lack of host plants means that germinated spores cannot find roots to support their development. All these factors prevent the hyphae network of natural mycorrhizae in the soil from surviving.

When adding the spores of a mycorrhizal fungus known for its beneficial effects, we reduce the time between the meeting of the hypha and the root. By inoculating the seed directly, the contact is done quickly during the germination of seeds and spores. Then, the fast development of mycelium in the soil allows the plant to take advantage of the benefits of the symbiosis. From this can arise healthier plants and improved yields.

Gilles Hamel has been working as an agricultural consultant in Quebec since 1987 under the company name Agreco Inc. He has over 100 potato growers as clients and in addition to consulting work, conducts research projects to look at promising new technologies for potato production in the field.

“Curiosity and interest are immediately aroused when you put into a young person’s hand, a potato.” - Louis Pasteur

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