TECHNICAL BULLETIN

Serge Gagné, agr., Ph.D. and Hugues McNicoll, agr., eng.

Premier Tech Biotechnologies, 1 avenue Premier, Rivière-du-Loup (Québec) CANADA G5R 6C1

Mycorrhizal fungi can help to reduce the amount of phosphorus in streams in three ways: (i) increasing the absorption capacity of soil phosphorus by plants, (ii) reducing the application of fertilizer, (iii) reducing erosion by the formation of stable soil aggregates.

Blue-green algae and phosphorus

To grow, cyanobacteria (blue-green algae) need nutrients and particularly phosphorus. However, phosphorus found in rivers comes, among others, from fertilizer use. The root extensions (filaments) provided by mycorrhizae hold soil particles together, which reduces run-off. Furthermore, by improving soil structure, mycorrhizae allow better water penetration, thus slowing down erosion and stabilizing the soil. Therefore, mycorrhizae are a natural solution that can help limit the eutrophication of streams linked to the accumulation of phosphorus. (M. St-Arnaud and C. Hamel 2007).

Increase the absorption of phosphorus by plants

Many researches have demonstrated the important contribution of mycorrhizal fungi in the uptake of soil phosphorus by plants (Bolan 1991; Jansa *et al*. 2003; Li *et al*. 1991; Nielsen and Jensen 1983; Schachtman *et al*. 1998). Roots with mycorrhizae can absorb three to five times more phosphorus than roots without mycorrhizae (Schachtman *et al*. 1998). In addition, Asghari *et al.* (2005) have shown that when plants are mycorrhizal, the amount of phosphorus in the soil encountered in the runoff water was 2 times lower compared to the same soil with plants without mycorrhizae. The work of Liu *et al.* (2003) showed that mycorrhizal colonization increased the P uptake by maize and thereby decreased the concentration of extractable P in soil. This work demonstrates the potential of mycorrhizae to reduce soil phosphorus substantially and thus reduce the proliferation of cyanobacteria in rivers.

Reduction of fertilizer applications

The greater capacity of mycorrhizal plants to absorb nutrients in the soil can reduce fertilization without affecting growth or yield. Marshhner and Dell (1994) reported that mycorrhizal fungi could provide up to 80% of P content, 25% N, 10% K, 25% Zn and 60% Cu to the plant. It is recognized that mycorrhizal colonization can reduce the amount of fertilizer applied up to 30%.

Soil structure improvement

Roots with mycorrhizae produce a network of filaments that trap particles in soil like a net. Moreover, they generate a sticky protein (glomalin) that binds soil particles over a long period of time. Improving soil structure with mycorrhizae leads to a better penetration of surface water that slows the effect of runoff, thus less erosion (Neergaard and Peterson 2000; Rillig *et al.* 2002).

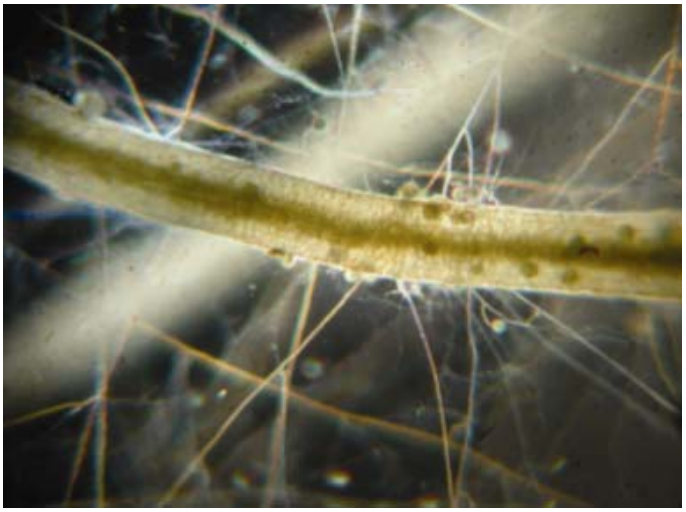

Figure 1. Mycorrhizae form a network of filaments that associate with plant roots and draw nutrients from the soil that the root system would not be able to access otherwise.

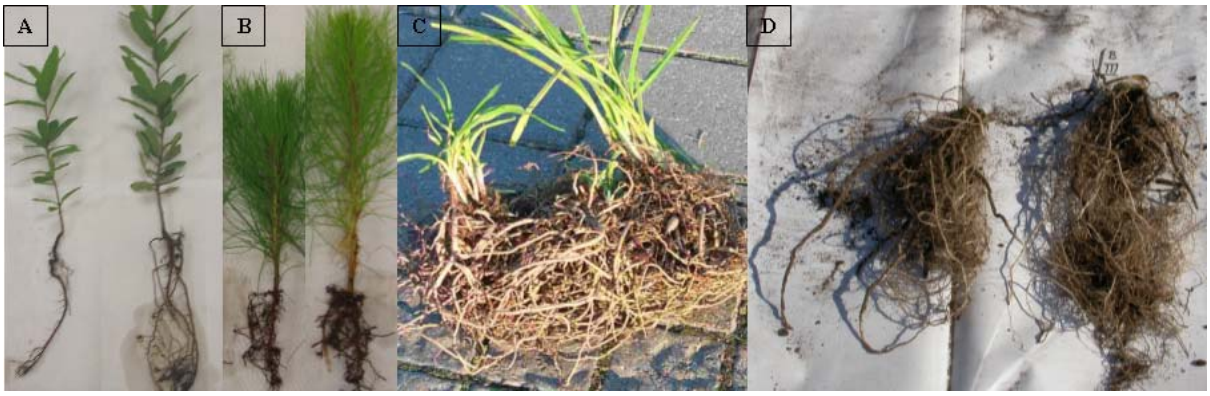

Figure 2. Mycorrhizae formation is one of the strategies developed by plants to optimize their growth. Mycorrhizal plants (right picture) have a root system more developed than controls (left). As examples, the oak seedlings (A) pine sedlings (B), daylily seedlings (C) and maize roots (D).

Table 1. Effect of mycorrhization on growth and P concentration in roots and stems of clover.

	Plants dry weight (g)	**Concentration of P (mg/g dry weight)**	
		In stems	**In roots**
Non-mycorrhizal plants	3,46	1.9	1,2
Mycorrhizal plants	7,55	3,9	3,5

Based on Li *et al.* 1991.

Table 2. Influence of mycorrhizal colonization on the aggregation of soil particles demonstrating that stable aggregates are larger with mycorrhizal plants.

	% aggregates less than 0,5 mm	**% aggregates more than 0,5 mm**
Without mycorrhizae	61,8	38,2
With mycorrhizae	49,7	50,3

Based on Neergaard and Petersen 2000.

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