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The benefits of mycorrhizal fungi on grass

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Grass is a very important element of the contemporary landscape, whether in parks, golf courses or private lands. Care for grass surfaces varies according to use and means we devote to it. In the past, many chemicals were used to maintain lawns subject to various stresses caused by insects, diseases, high temperatures or lack of water, not to mention the additional stresses suffered by the grass on golf courses. Today, many municipalities prohibit the use of chemicals for cosmetic purposes. Golf courses also tend to reduce pesticide use and all are searching for replacement products or new techniques of cultivation, more respectful of human health and the environment.

Endomycorrhizal fungi form a symbiosis with 80% of plant species including turf grass. Studies show that these fungi, by combining with the roots of plants, provide them with the water and nutrients present in the soil and out of the reach of roots. Furthermore, they contribute to improving the soil structure, increasing the resistance of plants during stress and preventing some fungal diseases.

Best establishment rate

Several studies have been conducted on the establishment of grass with mycorrhization. The mycorrhization of bent grass with *Glomus intraradices*, on a golf green, promotes a faster and denser establishment during the first weeks, compared with control seedlings without inoculation (Tardif and Desjardins, 1999; Koske, *and al.*, 1995; Hartin, *and al.*, 2005). A faster establishment is also demonstrated when other turf grasses, fescue, Kentucky bluegrass and ryegrass are inoculated with *G. intraradices* at seeding (Pelletier, *and al.*, 2004). When overseeding an established lawn, the mycorrhization with *G. intraradices* shows an increase in the density of grass (18%) in the first year (Premier Tech, 2005). After two years, mycorrhized grass without fertilization is as dense as non-mycorrhized grass with the recommended fertilization the two previous years (Premier Tech, 2007). In the greenhouse, bent grass and Kentucky bluegrass mycorrhized with *G. mosseae* and grown in pots tend to produce more biomass in time than when non-inoculated (Charest, *and al.*, 1997). Gemma, *and al.* (1997) also evaluated the effect of mycorrhization by two fungal species (*G. intraradices and Gigaspora gigantea*) on the establishment of bent grass, this time in correlation with the rate of phosphorus applied. Mycorrhized cultures produce between 40 and 75% more biomass than the non-mycorrhized ones at low phosphorus fertilization. This growth increase, however, diminishes with increasing phosphate fertilization.

Other trials on golf courses and on mine sites in restoration show that, in general, the addition of the mycorrhizal fungi *G. intraradices* at seeding or when aeration of a lawn leads to increased leaf biomass. Another trial on a golf course compares the addition of mycorrhizae with a mineral or organic fertilization at seeding of a new lawn or on an established lawn. In both cases, an increase of root biomass (69 to 109% for sowing grass and 31 to 62% for lawn) is obtained with both types of fertilization and, in the case of existing lawn, an increase in aerial biomass (62%) is also observed following the mycorrhization. A similar experience on a mine site in restoration shows an increase in aerial biomass (34%) and root biomass (56%) on mycorrhized plots compared with non-mycorrhized ones (MikroTek, 1999).

Better resistance to stress

During the hot and dry summer season, grass can suffer from hydric stress if not watered regularly. However, many municipal regulations prohibit watering of lawns on certain days of the week in critical periods. Mycorrhization paliates the stress caused by drought by influencing the plant at various levels. The mycorrhizal fungus works on the soil structure and promotes the penetration of water into the soil. The hyphae that extend into the soil form a net to capture the water in it, thus allowing the plant to get more water than only by its roots. As well, the mycorrhizal fungi influence the physiology of the plant. Several researchers have studied the phenomenon. Studies in laboratory and in field show that for bent grass mycorrhized with *G. intraradices*, leaves' hydric potential (acquisition of water by the plant) is still higher than non-mycorrhized plants (from 39 to 60% depending on the stress level), and the plants take longer to wilt. The rate of chlorophyll is also higher. By studying an amino acid indicator of hydric stress, the researchers observed that, during a water shortage, the level of this amino acid remained constant among mycorrhized plants, but increased among non-mycorrhized plants (Koske, *eand al.,* 1995; Gemme, *and al.,* 1997). Augé has studied extensively the effect of mycorrhization on plant hydric stress. He concludes that the fungus affects the physiology of the plant (water transport in the leaves, turgor, etc.) and does not only compensate for the lack of fertilization (Augé, 2001).

Reduction of weeds

The annual Kentucky bluegrass (*Poa annua*) is considered a weed of golf greens sowed with bent grass. Two studies of Gange (1998; 1999) were conducted on all the greens of three 18-hole golf courses in the UK, as well as one in a greenhouse. They began by studying the golf greens' mycorrhizal population and noticed that when mycorrhizal flora is abundant, the annual Kentucky bluegrass is less present. By inoculating golf greens with mycorrhizal fungi, they noted increased growth of the bent grass and decreased growth of the annual Kentucky bluegrass.

A dense and vigorous lawn is more resistant to the invasion of weeds. This is what we observed when testing overseeding existing turf (Premier Tech, 2005). In addition to observing an

increase in the density of inoculated grass, we also noticed a significant decrease of 23% of bare spots suitable for establishment of weeds compared to plots not inoculated with mycorrhizal fungi.

Fight against pathogenic fungi

Fungal diseases affect the growth and aesthetics of grass. Researchers have therefore studied the effect of inoculation of mycorrhizal fungi on certain diseases. For example, a study showed that the incidence of the disease called “dollar spot” caused by the fungus *Sclerotinia homoeocarpa* had decreased by 26% in grass plots mycorrhized with *G. intraradices*, compared to non-mycorrhized grass (Pelletier, *and al*., 2000). In another case, the more the mycorrhizal fungi is present in the soil, the lesser “pink snow mold” caused by the fungal pathogen *Microdochium nivale* is observed (Gange and Case, 2003).

Effect of mycorrhizal fungi on soil structure

Good soil structure, consisting of stable aggregates, is important for water and air circulation, which in turn are essential components for proper plant growth. The arbuscular mycorrhizal fungi (AM) secrete a glycoprotein called “glomalin”, a kind of biological glue that binds fine soil particles into stable aggregates. Glomalin is a major component of the soil’s organic matter and represents over a third of the carbon sequestered therein (Comis, 2002; Wright, *and al*., 2006).

A team of Swiss researchers examined what was the contribution of mycorrhizal fungi on the productivity of experimental grassland. The percentage of stable aggregates increased from 79.6 to 85.7% with mycorrhization, a significant increase of 6% after only two growing seasons (van der Heijden, *and al.*, 2006). Moreover, a larger volume of water could seep in a given time, a sign of greater porosity.

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