

## Mycorrhizal Fungi in Turf

You may not realise it but fungi are almost everywhere. A general rule in microbiology when it comes to fungi is that everything is everywhere all the time. It is when ideal conditions are realised that the organism becomes evident.

Fungi are one of the most prolific and diverse groups of life on earth. Our general impression of a fungus is of a mushroom; and one would be forgiven to assume that that is the extent of their existence. However the largest part of a fungal organism is generally much harder to see, as it is a huge underground network of filaments and strands called hyphae or mycelium. As a flower is to a huge tree, the mushroom that is observed on the surface is a simple fruiting body, much smaller and much more insignificant than the full organism beneath the soil.

The underground portion of the fungal organism often colonises the root/soil interface (the rhizosphere) of the local plant life, including turfgrass. Many fungi have a specific affinity with plant roots and will colonise the rhizosphere, forming a mutually beneficial relationship with the plant root system. These fungi are termed mycorrhizal, which translates to fungus-root (mycor-rhizae). This is known as a symbiotic relationship, with both parties (plant and fungi) benefit from the arrangement. Some species of fungi are species specific in the plants whose roots they colonise; others are less selective and will form a mycorrhizal relationship with a range of plant species if the conditions are right.

### Did you know?

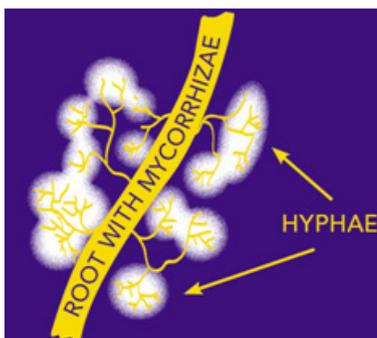
- The largest living organism on earth is a fungus. In Oregon's Blue Mountains in the US there is a single living organism (sharing the same DNA fingerprint) of the fungus *Armillaria osoyae* that covers 965 hectares of forest, and is estimated to be 2,400 years old.
- While many people view fungi as plant-like; from a genetic point of view fungi are actually more closely related to humans than they are to plants.



Hyphae of *Trichoderma* spp. mycorrhizal fungi found in a turfgrass root system.

### Mycorrhizae in Turfgrass Management

Studies have shown that the Poaceae family (to which turfgrasses belong) often require the presence of an established mycorrhizal colony to grow to their full potential (Hardebeck et al. 2004). In a natural setting the fungi will already be present in the soil, allowing the colony to establish amongst plant roots naturally. The artificial root zone environments used in turfgrass construction generally provide a poor environment for soil microbiological activity, including the establishment of mycorrhizal colonies.



In recent years it has become more common for turfgrass managers to introduce mycorrhizal fungi into their turfgrass profiles in the hopes of establishing a colony to assist in plant and soil health. One of the most popular choices of fungi for this has been the *Trichoderma spp.* of fungi. Trichoderma are found naturally on turfgrass roots and have been shown to assist their turfgrass host directly and indirectly in many ways (Hardebeck et al. 2004).

## Nutrient and Water Efficiency

Established colonies of mycorrhizal fungi including *Trichoderma spp.* have been shown to improve nutrient and water availability to the plant root system (Asghari & Cavagnaro 2011). This occurs as the fungal hyphae coats the plant root, greatly increasing the surface area of the root system, thus allowing for improved access to surrounding nutrients and soil water (Asghari & Cavagnaro 2011). On a biochemical level, many of the exudates produced by *Trichoderma spp.* have been researched for their antagonistic properties of some pathogenic fungi, as well as their relationship with other beneficial soil microbes.

*Trichoderma viride*, a unique species of the *Trichoderma* genus has been shown to provide several advantages to plant health and growth. *T. viride* has the unique ability to indirectly increase the population of the beneficial bacteria *Azotobacter* which has the ability to solubilise micronutrients regardless of soil pH. This occurs as *T. viride* produces substances that neutralize the antagonists that attack these important bacteria. In addition to this, *T. viride* has also been found to increase the uptake of nutrients through enhancement of root development. The improvement in root development is likely to be due to reduced plant pathogen incidence as well as the improved micronutrient availability.

The key benefits associated with a healthy established mycorrhizal population can be summarised under the following points:

- Improved nutrient access: the hyphal network that the mycorrhizae fungi develop around the turfgrass root system greatly increases the surface area of the roots, improving nutrient access. Mycorrhizal fungi also exude compounds that can assist in solubilizing certain nutrients to make them available for plant uptake.
- Drought resistance: The fine filament network (called hyphae) that the mycorrhizae create enables the turfgrass plant to access water in pore spaces that its own larger roots cannot access.
- Improved fungal pathogen resistance: Mycorrhizae will also build natural disease defences for the root system by releasing chemicals that inhibit infection and form a protective layer on the outside of root cells.
- Stimulates soil environment: The addition of a mycorrhizal population enhances the diversity of the soil ecosystem, improving the overall health of the soil environment.



The above image is of a field pot trial demonstrating the health benefits associated with a strong mycorrhizal population (right) when compared to the pot with no added mycorrhizae (left).



## Biocontrol of Pathogenic Fungi

Some *Trichoderma* varieties have been shown to produce compounds that are antagonistic to plant pathogenic fungi (Lin et al. 1993). The activity of these compounds in the control of pathogenic fungi is called biocontrol. Research has shown that *Trichoderma* fungi produce compounds such as chitinases, a digestive enzyme that degrades chitin. As chitin is a major component of fungal cell walls, this allows *Trichoderma* fungi to parasitise other fungi including plant pathogenic varieties such as *Pythium*, *Rhizoctonia* and *Fusarium* species.

In a unique characteristic among other *Trichoderma* species, *Trichoderma viride* also produces a compound called Tricholin (Lin et al. 1993). Tricholin is a protein which has been shown to possess fungicidal effects on various plant pathogenic fungi including *Rhizoctonia solani* which causes brown patch in turfgrass (Lin et al. 1993). Field and laboratory trials have shown that successful control of plant pathogens including *R. solani* can be achieved, although the exact mechanism of this control is not yet fully understood. The below trial clearly results demonstrate the effects of *T. viride* derived tricholin against *R. solani* cells in a laboratory setting.

Dosage of Tricholin (µg/ml solution)	Percentage of Inhibition		
	Time (hours)		
	18	27	42
Control	0	0	0
0.04	54	54	0
0.2	45	69	0
0.4	81	52	0
0.8	75	76	48

Cells in exponential phases were incubated separately with indicated amounts of Tricholin. At time intervals cell growth was measured. The values were the summary of several experiments with duplicate samples.

## Trichoderma and Fungicides

Regular applications of soil applied fungicides will often impact of mycorrhizal populations within the soil (Papavizas & Lewis 1983). When attempting to establish and maintain a healthy soil fungal colony it is important to understand the susceptibility of the applied fungal species to various fungicides (Papavizas & Lewis 1983). *Trichoderma viride*, the species present in Nuturf's BioMAX Fortify can be used in conjunction with many commonly used turf fungicides, and can even be tank mixed with some. However the use of some active ingredients including those in the DMI chemical family (propiconazole, tebuconazole, etc.) will generally impact on *Trichoderma* populations. Ask you Nuturf Territory Manager for further information on fungicide compatibility.

### References

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