Trichoderma Fungi

What are *Trichoderma*?-
referencence:http://www.nysaes.cornell.edu/ent/biocontrol/pathogens/trichoderma.html

Trichoderma spp. are fungi that are present in nearly all soils and other diverse habitats. In soil, they frequently are the most prevalent culturable fungi.

They are favoured by the presence of high levels of plant roots, which they colonize readily. Some strains are highly rhizosphere competent, i.e., able to colonize and grow on roots as they develop. The most strongly rhizosphere competent strains can be added to soil or seeds by any method. Once they come into contact with roots, they colonize the root surface or cortex, depending on the strain. Thus, if added as a seed treatment, the best strains will colonize root surfaces even when roots a meter or more below the soil surface and they can persist at useful numbers up to 18 months after application. However, most strains lack this ability.

In addition to colonizing roots, *Trichoderma* spp. attack, parasitize and otherwise gain nutrition from other fungi. Since *Trichoderma* spp. grow and proliferate best when there are abundant healthy roots, they have evolved numerous mechanisms for both attack of other fungi and for enhancing plant and root growth. Several new general methods for both biocontrol and for causing enhancement of plant growth have recently been demonstrated and it is now clear that there must be hundreds of separate genes and gene products involved in these processes. A recent list of mechanisms follows.

- Mycoparasitism
- Antibiosis
- Competition for nutrients or space
- Tolerance to stress through enhanced root and plant development
- Solubilization and sequestration of inorganic nutrients
- Induced resistance
- Inactivation of the pathogen's enzymes

Taxonomy and genetics

Most *Trichoderma* strains have no sexual stage but instead produce only asexual spores. However, for a few strains the sexual stage is known, but not among strains that have usually been considered for biocontrol purposes. The sexual stage, when found, is within the Ascomycetes in the genus *Hypocrea*. Traditional taxonomy was based upon differences in morphology, primarily of the asexual sporulation apparatus, but more molecular approaches are now being used. Consequently, the taxa recently have gone from nine to at least thirty-three species.

Most strains are highly adapted to an asexual life cycle. In the absence of meiosis, chromosome plasticity is the norm, and different strains have different numbers and sizes of chromosomes. Most cells have numerous nuclei, with some vegetative cells possessing more than 100. Various asexual genetic factors, such as parasexual recombination, mutation and other processes contribute to variation between nuclei in a single organism (thallus). Thus, the fungi are highly adaptable and evolve rapidly. There is great diversity in the genotype and phenotype of wild strains.

While wild strains are highly adaptable and may be heterokaryotic (contain nuclei of dissimilar genotype within a single organism) (and hence highly variable), strains used for biocontrol in commercial agriculture are, or should be, homokaryotic (nuclei are all genetically similar or identical). This, coupled with tight control of variation through genetic drift, allows these commercial strains to be genetically distinct and nonvariable. This is an extremely important quality control item for any company wishing to commercialize these organisms.

Pathogens controlled

So far as the author is aware, different strains of *Trichoderma* control every pathogenic fungus for which control has been sought. However, most *Trichoderma* strains are more efficient for control of some pathogens than others, and may be largely ineffective against some fungi. The recent discovery in several labs that some strains induce plants to "turn on" their native defense mechanisms offers the likelihood that these strains also will control pathogens other than fungi.

Life cycle

Fungal thalli are shown in the figure at the beginning of this web page. The organism grows and ramifies as typical fungal hyphae, 5 to 10 µm in diameter. Asexual sporulation occurs as single-celled, usually green, conidia (typically 3 to 5 µm in diameter) that are released in large numbers. Intercalary resting chlamydospores are also formed, these also are single celled, although two or more chlamydospores may be fused together.

Pesticide susceptibility

Trichoderma spp. possess innate resistance to most agricultural chemicals, including fungicides, although individual strains differ in their resistance. Some lines have been selected or modified to be resistant to specific agricultural chemicals. Most manufacturers of *Trichoderma* strains for biological control have extensive lists of susceptibilities or resistance to a range of pesticides.

Uses of *Trichoderma*

These versatile fungi are used commercially in a variety of ways, including the following:

Foods and textiles:

Trichoderma spp. are highly efficient producers of many extracellular enzymes. They are used commercially for production of cellulases and other enzymes that degrade complex polysaccharides. They are frequently used in the food and textile industries for these purposes. For example, cellulases from these fungi are used in "biostoning" of denim fabrics to give rise to the soft, whitened fabric--stone-washed denim. The enzymes are also used in poultry feed to increase the digestibility of hemicelluloses from barley or other crops.

Biocontrol agents:

As noted, these fungi are used, with or without legal registration, for the control of plant diseases. There are several reputable companies that manufacture government registered products. Some of these companies are listed at the end of this web page. *This site will not knowingly list any non-registered products or strains offered for sale in commercial agriculture even though these products are common and their sale is widely ignored by governmental regulatory agencies.*

Plant growth promotion:

For many years, the ability of these fungi to increase the rate of plant growth and development, including, especially, their ability to cause the production of more robust roots has been known. The mechanisms for these abilities are only just now becoming known. Some of these abilities are likely to be quite profound. Recently, we have found that one strain increases the numbers of even deep roots (at as much as a meter below the soil surface). These deep roots cause crops, such as corn, and ornamental plants, such as turfgrass, to become more resistant to drought.

Perhaps even more importantly, our recent research indicates that corn whose roots are colonized by *Trichoderma* strain T-22 require about 40% less nitrogen fertilizer than corn whose roots lack the fungus. Since nitrogen fertilizer use is likely to be curtailed by federal mandate to minimize damage to estuaries and other oceanic environment (see http://www.epa.gov/msbasin/legis98.html; there are a number of other sites on the web dealing with this topic, search for sites dealing with the 'dead zone') the use of this organism may provide a method for farmers to retain high agricultural productivity while still meeting new regulations likely to be imposed.

Fig. 4: Enhanced root development from field-grown corn and soybean plants as a consequence of root colonization by the rhizosphere competent strain *T. harzianum* T22. Enhanced root development probably is caused by a combination of several of the mechanisms noted above.

Fig. 5: Improved survival of pepper plants in the field as a consequence of better root development caused by growth of seedlings in the greenhouse in the presence of T22. The yield of the first picking of peppers was improved as a consequence, as shown.

How It Works
reference: http://www.albrightseed.com/trichoderma.htm

Papers published by research scientists indicated, "When *Trichoderma* is added to soil containing *rhizoctonia*, for instance, hyphae (threads) of *Trichoderma* fungi will wrap around and attach itself to the host mycelium (filament mass)." The invading fungus eventually collapses and disintegrates.

Since the product is living it will continue to multiply after application, which allows for extremely small quantities to have very large effects.

The amazing properties of **trichoderma fungi** are enhanced further by the fact that it is nontoxic to plants, humans and animals; is nonpolluting, safe to use and completely natural.

In a 1988 study of *Trichoderma* applications by the Department of Pathology and Weed Science, Colorado State University, scientists observed radish growth increases of 150 to 250 percent. Similarly, in both steamed and raw soil infested with the fungus, periwinkle flowering was hastened and the number of blooms on chrysanthemums and petunias multiplied. Dry weights of tomato, pepper and cucumber plants increased and treated pepper seeds germinated two days faster than the control plantings.

In erosion control the faster germination and growth and heavier root system are important factors in stabilizing the soil.

Trichoderma fungi fit perfectly into the growing trend toward bio-control of disease and harmful fungi and reduced use of manufactured fertilizers.

Research into these beneficial fungi shows promise they can be part of the answer to increasing ecological concerns.

FOR FURTHER INFORMATION CONTACT

AgriSolutions Pty Ltd

P O Box 81, Darnum Vic 3822

Phone/Fax: 03 5627 8663

info@agriculturalsolutions.com.au

www.agriculturalsolutions.com.au

A.B.N. 72 081 445 141