A REVIEW

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Helping the ecosystem through mycoremediation

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The sciences of mycofiltration, mycoremediation, mycoforestry and Mycorestoration are part of an emerging field of study. While fungi promise to play an invaluable role in repairing many forms of environmental damage, the parameters, techniques and time lines for implementation are still in development. Though the concept of mycoremediation is in its infancy, this evolving technology holds great promise. Fungi can be introduced into a contaminated environment relatively cheaply.

Mycoremediation is a form of bioremediation, the process of using mushrooms to return an environment (usually soil) contaminated by pollutants to a less contaminated state. The term mycoremediation was coined by Paul Stamets and refers specifically to the use of fungal mycelia in bioremediation.

Fungi are non-photosynthesising, heterotrophic organisms that derive their energy from a saprophytic or parasitic existence. They are unicellular, amoeboid, or filamentous, never having the leaves, stems, and roots characteristic of higher plants. Reproduction occurs by sexual or asexual spore formation. One of the primary roles of fungi in the ecosystem is decomposition, which is performed by the mycelium. The mycelia of fungi like roots of plants, secretes extracellular enzymes and acids that break down lignin and cellulose, the two main building blocks of plant fiber. These are organic compounds composed of long chains of carbon and hydrogen, structurally similar to many organic pollutants. The key to mycoremediation is determining the right fungal species to target a specific pollutant. Certain strains have been reported to successfully degrade the nerve gases VX and sarin.

Researchers in Britain have demonstrated that inoculating contaminated soils with fungi enhances the degradation of multiple chemicals, such as simazine, trifluralin and dieldrin. This beneficial activity occurs even at levels of soil hydration that would be hostile to plants. Impact of *Trametes versicolor* and *Phanerochaete chrysosporium* on differential breakdown of pesticide mixtures in soil microcosms at two water potentials and associated respiration and enzyme activity.

In an experiment conducted in conjunction with Thomas, a major contributor in the bioremediation industry, a plot of soil contaminated with diesel oil was inoculated with mycelia of oyster mushrooms; traditional bioremediation techniques (bacteria) were used on control plots. After four weeks, more than 95% of many of the PAH (polycyclic aromatic hydrocarbons) had been reduced to non-toxic components in the mycelial-inoculated plots. It appears that the natural microbial community participates with the fungi to break down contaminants, eventually into carbon dioxide and water. Wood-degrading fungi are particularly effective in breaking down aromatic pollutants (toxic components of petroleum), as well as chlorinated compounds (certain persistent pesticides).

Mycoremediation is being carried out in the United States by Battelle Laboratories in Washington State.

The three types of fungi; saprophytic, parasitic, and mycorrhizal species, vary in use for the type of bioremediation processes :

– Saprophytic Fungi use enzymes to decompose biologic material

– Parasitic Fungi are able to destroy bacteria and other pathogens

– Mycorrhizal Fungi remove substances from the biosphere

Saprophytic fungi are responsible for breaking down all types of organic matter. They breakdown organic matter by secreting enzymes as well as other exodates which breakdown the hydrocarbon chains that are found in all organic matter. The byproducts of these reactions are usually more readily available for the uptake and or further break down by other biologic organisms. Many fungi

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