GOLD NUGGET

Provisioning Services – Biotechnology Part 1

Various groups of soil organisms have the potential to be manipulated and used for a wide range of environmental, commercial and industrial applications, many of which still remain largely unexploited. The use of soil organisms with the aim of generating a useful product or a desired metabolic process is generally known as 'biotechnology'. Such applications are possible thanks to 3 major soil biota traits:

a. their ability to break down substrates and to transform them into new compounds

b. their direct involvement in a multitude of biological processes

c. their high sensitivity to changes in the local environment

Of all soil organisms, microorganisms are particularly easy to cultivate and to manipulate. Available microbial products in our everyday lives can be categorised as follows:

a. microbial cells that can be used as nutrients, immunising factors (e.g. vaccines) or clean-up agents

b. enzymes and other macromolecules, synthesised by viable microbial cells

c. primary microbial metabolites, essential for cell growth and maintenance (e.g. amino acids)

d. secondary microbial metabolites, not essential for cell growth (e.g. antibiotics and steroids)

Each of these microbial products have important environmental, biomedical or industrial applications.

Bioremediation

Remediation is any physical, chemical or biological process used to recover or restore ecosystem functions in contaminated or polluted soil or water. Bioremediation takes advantage of biological activity for the environmental clean-up of contaminants or pollutants, such as pesticides, metals and polycyclic aromatic hydrocarbons (PAHs). It generally has less undesirable impacts on the environment, and is often more cost-effective.

A broad range of environmental contaminants can be immobilised, metabolised into less toxic compounds, or mineralised via soil microbial metabolism. Intrinsic bioremediation is carried out by native microflora and occurs naturally. There are some cases where the local environmental conditions are not favourable for microbial metabolism, biostimulation or tinoculation.

Virtually, all groups of soil microorganisms (bacteria, fungi, viruses, algae and protists) can be effective bioremediation agents. The activity of other larger organisms that can contribute to enhancing the surrounding microbiome, such as earthworms and isopods. Interestingly, some white-rot fungi can be 'tricked' into co-metabolising a contaminant in the presence of suitable substances (e.g. sawdust, wood chips, straw, decaying wood etc.), which are their usual substrates for growth and development.

Plants can also be used for immobilisation and extraction of contaminants from soil, including heavy metals. The plant gradually builds up the contaminant in the shoot and/or leaves, and sometimes in the roots, in a process parallel to its own development. Plant-accumulated metals can then be recovered using specific extraction processes. In a phytoremediation experiment, the potentials of the ribbon and brake ferns to hyperaccumulate arsenic were tested in contaminated hydroponic media as well as in contaminated soil, in the vicinity of a former tin mine. It was found that both could accumulate up to 12 mg and 3 mg of arsenic per plant, respectively. The selection of the suitable organism for any given bioremediation strategy is the key step for the successful removal of pollutants.

To be continued…

Soil Lovers say: ***Can We Ever Over Estimate The Power Of Nature?***

Ref: **A Global Atlas of Soil Biodiversity p100**