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Soil Bioremediation

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Introduction:

High-growth industrialization and population growth have the accumulation of a wide variety of chemicals. Thus, the frequency and use of "Xenobiotic" chemicals has led to a remarkable effort to implement new Technologies to reduce or eliminate these contaminants from the environment. Commonly used Methods of treatment of pollution had negative effects on the environment; this can lead to the formation of toxic intermediates. In addition, these methods are more expensive and sometimes difficult to perform, like pesticides. A promising Method of treatment is to exploit the ability of micro-organisms to eliminate contaminated sites, an effective alternative treatment strategy, minimal, Economical, versatile and environmentally friendly, is the process known as bioremediation. Subsequently, it has been found that microbes have the ability to transform and / or degrade Xenobiotics, scientists have explored microbial diversity, in particular Contaminated in search of organisms that can degrade a wide range of pollutants. Therefore, the biotransformation of organic contaminants in the natural environment has been Microbial ecology, physiology and evolution because of their Potential for bioremediation. The biochemical and genetic basis of Microbial degradation has received considerable attention. Several genes / enzymes, which Microorganisms with the ability to degrade organopesticides have been identified and characterized. Thus, the microorganisms provide the potential wealth of biodegradation. The ability of these organisms to reduce the concentration of xenobiotic is directly related to their long-term adaptation of areas where there are these compounds. In addition, genetic engineering can be used to enhance the efficiency of such micro-organisms having the appropriate the properties, essential for the biodegradation. About 30% of agricultural produce is lost due to pests. Therefore, the use of pesticide becomes indispensable in agriculture. Abusive use of pesticides for pest control is widely used in agriculture. However, indiscriminate use of pesticides caused serious damage and problems for people, as well as on biodiversity. Problem environmental pollution by pesticides goes beyond the point where it is used. Agricultural pesticides, which are generously spread over the country travel long distances and can move down until it reaches the water level in detectable concentrations, reaching the aquatic environment at a much greater distance. So fate Pesticides are often uncertain; they can infect other areas that are far from the place where they were originally used. Therefore, decontamination pesticide contaminated sites is very complex task. Pesticides are chemicals that kill parasites and herbicides are chemicals that kill weeds. In the context of soil, parasites are fungi, bacterial insects, worms and nematodes, etc., which cause damage to field crops. Thus, in a broad sense, pesticides are insecticides, fungicides, bactericides, herbicides and nematocides that are used to control or inhibit plant diseases and insect pests. Although large-scale application of pesticides and herbicides is an essential element in increasing crop yields, excessive use of these chemicals leads to microbial imbalance, environmental pollution and health hazards. An ideal pesticide should have the ability to destroy the target pest quickly and should be able to degrade non-toxic substances as quickly as possible.

The last "pit" of pesticides applied in agriculture and public health care is soil. The soil, being the storehouse of a multitude of microbes, in quantity and quality, receives chemicals in various forms and acts as a trap of harmful substances. The effectiveness and competence to handle chemicals vary with the soil and its physical, chemical and biological characteristics. Pesticides reaching soil in significant quantities have a direct effect on the microbiological aspects of the soil, which in turn influence plant growth. Some of the most important effects of pesticides are: alterations in the ecological balance of the soil micro flora, continued application of large quantities of pesticides can Soil micro flora, suppression of nitrifying bacteria, Nitrosomonas and Nitrobacter by soil fumigants. Inhibition of N2-binding soil microorganisms such as Rhizobium, Azotobacter, Azospirillum, etc.

How long an insecticide, fungicide or herbicide persists in the soil is of great importance with regard to pest control and environmental pollution. The persistence of pesticides in the soil for a long period of time is undesirable for the following reasons:

(a) the accumulation of chemicals in soil at very toxic levels,

(b) can be assimilated by plants and accumulate in products Edible plants,

(c) Portions of root crops,

(d) being eroded with soil particles and entering watercourses, and eventually leading to pollution of soil, water, air.

The actual persistence of pesticides in soil varies from one week to several years depending on the structure and properties of the constituents in the pesticide and the availability of moisture in the soil. For example, highly toxic phosphates do not persist for more than three months, while chlorinated hydrocarbon insecticides persist for at least 4 to 5 Years and sometimes more than 15 years. From the agricultural point of view, a longer persistence of pesticides leading to the accumulation of residues in the soil can lead to an increased absorption of these toxic chemicals by the plants at the level where the consumption of plant products can prove to be harmful / dangerous for Human beings like cattle. There is a chronic problem of agricultural chemicals, which has entered the food chain at very inadmissible levels in India, Pakistan, Bangladesh and several other developing countries around the world. For example, intensive use of DDT to control insect pests and mercury fungicides to control diseases in agriculture was known to persist longer and thus accumulate in the food chain, leading to food contamination and health hazards. Therefore, DDT and mercury fungicides have been banned in agriculture and public health. Pesticides reaching the soil are subject to several physical, chemical and biological forces. However, physical and chemical forces act on / degrade pesticides to some extent; microorganisms play a major role in the degradation of pesticides. Many soil microorganisms have the ability to act on pesticides and convert them into simpler, non-toxic compounds. This process of pesticide degradation and conversion to non-toxic compounds by micro-organisms is known as “biodegradation”. All pesticides that reach the soil are not biodegradable and chemicals that have complete resistance to biodegradation are called “recalcitrants”. The chemical reactions leading to the biodegradation of pesticides fall into several broad categories which are discussed.

Conversion of the pesticide molecule into a non-toxic compound is known as detoxification. Detoxification is not synonymous with degradation. Since a single chance in the side chain of a complex molecule can make the chemical non-toxic. The decomposition / transformation of a complex substrate into simpler products ultimately leading to mineralization. Degradation is often considered synonymous with mineralization, fungicide is degraded by a strain of Pseudomonas and degradation products are dimethlamine, proteins, sulfolipids, etc. In which a body makes the substrate more complex or combines the pesticide with the cellular metabolites. The conjugation or formation of an adduct is accomplished by the organisms catalyzing the addition reaction of an amino acid, an organic acid or a methyl crown to the substrate, for example in the microbial metabolism Of sodium dimethyldithiocarbamate, the organism combines the fungicide with an Amino acid normally present in the cell and thus inactivate the pesticides / chemical. It is the conversion of the non-toxic substrate into a toxic molecule, for example. The herbicide, 4-butyric acid and the phorate insecticide are transformed and activated microbiologically in soil to yield metabolites that are toxic to weeds and insects. Some fungicides / pesticides are designed to control a particular group of pests / organisms but are metabolized to give inhibitory products to completely different groups of organisms, the fungicide PCNB is converted into the soil into chlorinated benzoic acids that kill the plants. Biodegradation of pesticides / herbicides is strongly influenced by soil factors such as moisture, temperature, PH and organic matter, in addition to the solubility of the microbial population and pesticides. Optimum temperature, humidity and organic matter in the soil provide a suitable environment for the decomposition or retention of any pesticide added to the soil. Most organic pesticides degrade in a short period in tropical conditions. The metabolic activities of bacteria, fungi and actinomycetes play an important role in the degradation of pesticides. Bioremediation strategies: For the successful biodegradation / bioremediation of a given contaminant, the following strategies are required.

1. **Biostimulation:** Practice the addition of nitrogen and phosphorus to stimulate indigenous microorganisms in the soil.

2. **Passive / Intrinsic Bioremediation:** This is the natural bioremediation of the contaminant by indigenous microorganisms and the rate of degradation is very slow.

3. **Bioaccumulation:** A bio-stimulation process by which stimulant gases such as oxygen and methane are added or forced into the soil to stimulate microbial activity.

4. **Composting:** Piles of contaminated soils are constructed and treated with aerobic thermophilic microorganisms to degrade contaminants. Periodic physical mixing and moistening of the piles are carried out to promote microbial activity.

5. **Bioaugmentation:** It is the inoculation / introduction of microorganisms on the contaminated site / soil to facilitate biodegradation.

6. **Phytoremediation:** Can be obtained directly by planting plants those hyper accumulate heavy metals or indirectly by plants stimulating microorganisms in the rhizosphere.

7. **Bioremediation:** The process of detoxifying chemicals / toxic / undesirable contaminants in soil and other media using microorganisms.

8. **Mineralization:** Complete conversion of an organic contaminant into its inorganic constituent by a species or group of microorganisms.