DEGRADATION OF PESTICIDES AND OTHER TOXIC CHEMICALS BY MICROORGANISMS.

Definition

- Biodegradation or biological degradation is the phenomenon of biological transformation of organic compounds by living organisms, particularly, microorganisms
- It involves the conversion of complex, toxic organic molecules to simpler, non toxic ones.
- Biodegradation provides an effective and economic means of disposing toxic chemicals.

Xenobiotics

- These are unnatural, foreign, synthetic chemicals such as pesticides, herbicides, refrigerants, solvents and other organic compounds.

Table 10.1 A selected list of microorganisms and the pollutants (xenobiotics) that are degraded by bioremediation

Microorganisms	Pollutant chemicals
Pseudomonas sp	Aliphatic and aromatic hydrocarbons—alkylaminoxides, alkylammonium benzene, naphthalene, anthracene, xylene, toluene, polychlorinated biphenyls (PCBs), malathion, parathion, organophosphates.
Mycobacterium sp	Benzene, branched hydrocarbons, cycloparaffins
Alcaligenes sp	Polychlorinated biphenyls, alkyl benzene, halogenated hydrocarbons.
Nocardia sp	Naphthalene, alkylbenzenes, phenoxyacetate.
Arthrobacter sp	Benzene, polycyclic aromatics, phenoxyacetate, pentachlorophenol.
Corynebacterium sp	Halogenated hydrocarbons, phenoxyacetate.
Bacillus sp	Long chain alkanes, phenylurea.
Candida sp	Polychlorinated biphenyls
Aspergillus sp	Phenols
Xanthomonas sp	Polycyclic hydrocarbons
Streptomyces sp	Halogenated hydrocarbons, phenoxyacetate
Fusarium sp	Propanil
Cunninghamella sp	Polycyclic aromatics, polychlorinated biphenyls

Pseudomonas

- *Pseudomonas*- most prominent in biodegradation of more than 100 toxic compds.
- Can degrade hydrocarbons, phenols, organophosphates, polychlorinated biphenyls (PCBs), polycyclic aromatics and naphthalene

Consortia of microorganisms

- To degrade a particular compound, it usually requires a synergetic action of a host of Microorganisms

Factors affecting Biodegradation

1. Chemical structure of the compound
2. The capability of the individual microorganisms
3. Nutrient and O2 supply
4. Temperature and pH

General features of Biodegradation

- Aliphatic compds are more easily degraded than aromatic ones
- Presence of ring structures and long chains decrease the degradation efficiency
- Water soluble compds are more easily degraded
- The presence of halogens makes compds more resistant

How to increase efficiency??

- Biostimulation: microbial activity can be enhanced by increased **supply of nutrients** or by addition of certain **stimulating agents**(e.g., electron acceptors)
- Bioaugmentation: increase efficiency through **manipulation of genes**. (GEMs)Can also be achieved by the use of a consortium of microorganisms