PHYTOREMEDIATION: AN EMERGING TECHNOLOGY

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Introduction

The concentrations of heavy metals increase in the environment from year to year. Therefore, decontamination of heavy metal-contaminated soils is very important for the maintenance of environmental health and ecological restoration. Phytoremediation is a word inferred from the Greek "Phyto" which means plant, the Latin word Remedium," denoting to cleanse polluted environments (Cunningham *et al.,* 1997). Phytoremediation process is a factory-based methodology utilized to remove excess nutrients from polluted surroundings. The usage of aquatic plants in wastewater (industrial and agricultural runoff). The phytoremediation technique is veritably powerful due to its significant ability to assimilate and degrade contaminants (e.g., nitrates, phosphates, and heavy metals). Phytoremediation is the varied usage of aquatic plants to degrade, extract, contain, or immobilize pollutants, including heavy metals, insecticides, and hydrocarbons, from soil and water. Phytoremediation is a novel, less expensive, efficient, environment and eco-friendly remediation strategy with good public acceptance (Revathi *et al.,* 2011). A major focus of this article is the mechanisms of phytoremediation, the application of plants in phytoremediation, the advantages and disadvantages of green remediation technology and its conclusions

Application of plants for phytoremediation

Aquatic plants serve a suggestive purpose in the biological treatment of wastewater because they can be applied for phytoremediation through the varied techniques of root filtration, plant extraction, plant sublimation, plant deterioration, decay, and transformation. The disposal of contaminants depends on the exposure time, the contaminants immersion, environmental means (temperature, pH), and factory features (root system, type of species,etc.). However, it's worth observing that dissimilar aquatic plants have been utilized with significant success in the wastewater phytoremediation process. Aquatic plants similar to free- floating plants (*Pistia stratiotes, Salvinia molesta, Lemna spp., Azolla pinnata, Landoltia punctata, Spirodela polyrhiza, Marsilea mutica, Eichhornia crassipes, and Riccia fluitans),* submerged plants *(Hygrophilla corymbosa, Najas marina, Ruppia maritima, Hydrilla verticillata, Egeria densa, Vallisneria americana and Myriophyllum aquaticum), and* emergent plants *(Distichlis spicata, Cyperusspp., Imperata cylindrical, Iris virginica, Nuphar lutea, Justicia americana, Diodia virginiana, Nymphaea spp., Typha spp., Phragmites autralis and Hydrochloa caroliniensis)* have been utilized for phytoremediation processes (Schmidt, 2003). These are the aquatic plants with floating leaves and submerged roots. Some of the free- floating aquatic plants are well

recognized for their capability to exclude metals from the polluted environment. Water hyacinth, duckweed and water lettuce are the most frequently operated free- floating plants for the remediation of heavy metals from wastewater.

Mechanisms of phytoremediation:

Phytoremediation is a variety of bioremediation that uses plants to remove, transport, preserve, extract, or reduce contaminants from soil and groundwater.

- Phytodegradation, organic contaminants are reduced directly, through the discharge of enzymes from roots, or by metabolic activity inside plant tissues.
- Phytostabilization is a technique in which unique plant species are used to immobilise contaminants in the soil and groundwater.
- Phytoextraction is the procedure of contaminant uptake, absorption, and translocation by plant roots into plant shoots, which can also be harvested and metabolised for energy and raw material recycling from the ash.
- Rhizofiltration is a kind of phytoremediation that removes dangerous chemicals and extra nutrients by screening polluted groundwater, surface water, and wastewater through a mass of roots.
- Phytovolatilization is outlined as the uptake and discarding of a contaminant by a plant, followed by the discharge of the contamination or a modified performance of the pollutant into the atmosphere by the plant during transpiration.

Advantages of phytoremediation

The most important of phytoremediation advantages are:

- In principle, plants that engage in phytoremediation of toxic elements could be harvested, thus removing these elements from the polluted site
- Phytoremediation does not require expensive equipment or highly-specialized personnel, and it is relatively easy to implement.
- Planting trees on remediation sites makes the places more aesthetic, and plants can be freely cultivated without much labour.
- It's potentially the least adverse technique because it uses naturally occurring organisms and preserves the environment in a more natural state.
- It preserves the topmost soil, preserving the fertility of the soil.
- It improves soil health, yield, and plant phytochemicals
- It is possible to treat sites contaminated with more than one type of contaminant
- It avoids excavation and transport of contaminated media, therefore reducing the threat of spreading the contaminant.
- The greatest advantage of phytoremediation is its low cost compared to conventional clean-up technologies

Disvantages

In contrast to its many positive aspects, phytoremediation does have a few disadvantages and limitations that are:

- It is restricted to the rooting depth of remediative plants.
- Phytoremediation is limited to the surface area and depth occupied by the roots.

Unfavorable climate is another important consideration because it can limit plant

growth and phytomass production, thus decreasing process efficiency.

Conclusion

Although important remains to be studied phytoremediation will easily play some role in the stabilization and remediation of numerous polluted sites. Phytoremediation can be used as a pontential tool to degrade the huge pasture of pollution uprising from different antroprogenic sources. With the support of biotechnology, genetic engineering, and bioinformatics, there is lots of scope for future investigation in this field.

References

1. Cunningham SD., Shann JR., Crowley DE., Anderson TA., 1997. Phytoremediation of contaminated water and soil. Phytoremediation of soil and water contaminants. ACS symposium series 664. American Chemical Society, Washington, DC. P. 2-19.

2. Revathi, K., Harbabu TE., Sudha, PN., 2011. Phytoremediation of chromium contaminated soil using sorghum plant. *International Journal of Environmental Sciences* 2(2): 417-428.

3. Schmidt U., 2003. Enhancing Phytoextraction: The effects of chemical soil manipulation on mobility, plant accumulation, and leaching of heavy metals. *Journal of Environmental Quality* 32: 1939-1954.

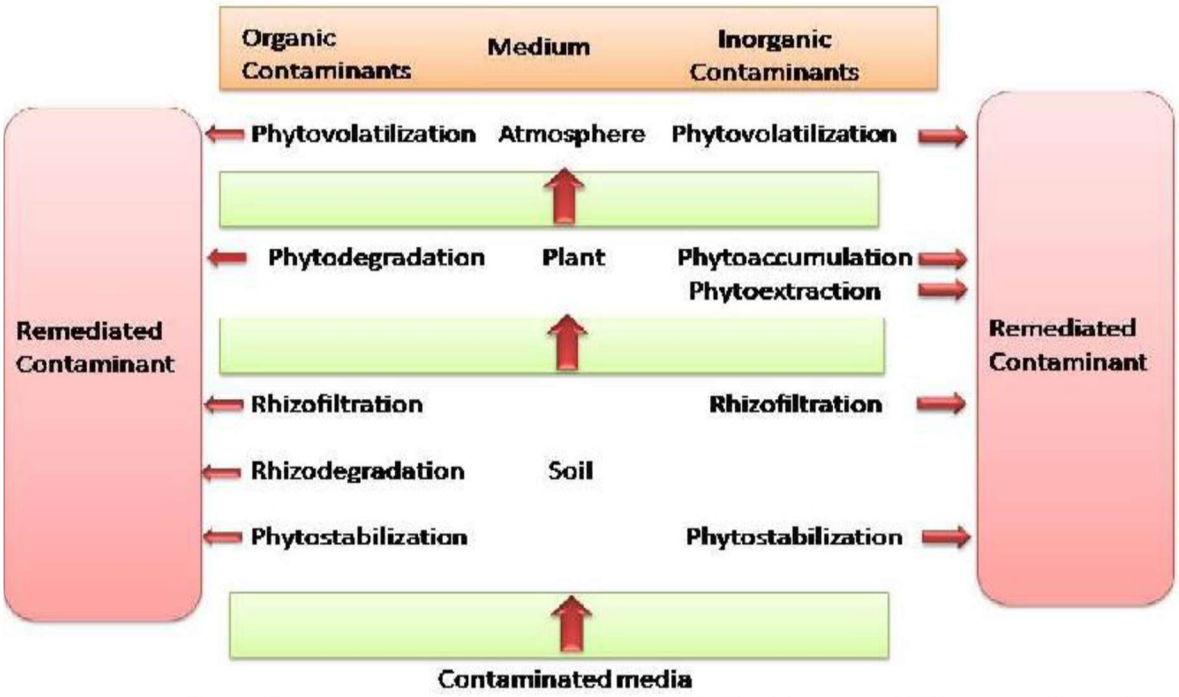

Figure:1 Phytoremediation Technology (ITRC,2009)