Chapter 87
A Prospective Study on Emerging Role of Phytoremediation by Endophytic Microorganisms

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ABSTRACT

Colonies of endophytes are excellent example of beneficial association with most plants in their natural state. Endophytic colonies and plant associations are beneficial in many ways such as supplying biologically fixed nitrogen, regulation of phytohormone production thus enhancing the plant growth, resistance to environmental stress etc. these associations are also important for the agriculture and industries because they produce important medicinal, agriculture and industrial compounds as endophytic metabolites. When we concern about the waste management, degradation and biotransformation of several toxins, the phytoremediation by using endophytes has been developed as important tool. Current chapter reviles, study and collect most of important knowledge, recent ongoing research, technologies, roles and advancements in biodegradation and biotransformation of different types of toxic wastes and their effects on environment with phytoremediation by endophytes.

INTRODUCTION

Bioremediation is a method of removal of pollutants and wastes from the environment by the use of micro-organisms. According to Ministry of environment and forest, Govt. of India, Bioremediation is the use of biological interventions of biodiversity for mitigation (and wherever possible, complete elimination) of the noxious effects caused by environmental pollutants in a given site. Bioremediation is generally considered to include natural attenuation (little or no human action), bio-stimulation or bio-

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augmentation, the deliberate addition of natural or engineered micro-organisms to accelerate the desired catalytic capabilities Thus bioremediation, phytoremediation and rhizoremediation contribute significantly to the fate of hazardous waste and can be used to remove these unwanted compounds from the biosphere. It relies on the biological processes in microbes to breakdown these wastes. Phytoremediation is a technology that is based on the combined action of plants and their associated microbial communities to degrade, remove, transform, or immobilize toxic compounds located in soils, sediments, ground water and surface water. Phytoremediation has been used to treat many classes of contaminants including petroleum hydrocarbons, chlorinated solvents, pesticides, explosives, heavy metals and radionuclides in soil and polluted water. There are several advantages of phytoremediation compared to conventional techniques, such as low cost, low disruptiveness to the environment, public acceptance, and potentiality to remediate various pollutants. In addition, plants as autotrophic systems with large biomass require only a modest nutrient input, and they also prevent the spread of contaminants through water and wind erosion (Cherian, 2005). Candidate plant for phytoremediation should have the characteristics such as high biomass production, extensive root system, and ability to tolerate high concentration of pollutants and withstand environmental stress. Like other treatment technologies, phytoremediation has its disadvantages e.g. climatic and geological limitations, potential phytotoxicity of the contaminant, potential for the contaminant or its metabolites to enter the food chain, and potentially longer timescale compared to other technologies (Macek, 2000). Phytoremediation, the use of plants to degrade toxic contaminants in the environment involves a number of processes including phytoextraction, phytotransformation, phytostabilization, phytovolatilization and rhizofiltration (Prasad, 2011). The uptake and concentration of pollutants into harvestable biomass for sequestration or incineration is known as Phytoextraction (or phytoaccumulation). Phytotransformation involves enzymatic modification resulting in inactivation, degradation (phytodegradation), or immobilization (phytostabilization) of pollutants. Phytovolatilization involves the removal of pollutants from soil and their release through leaves via evapotranspiration processes and rhizofiltration involves the filtering of water through a mass of roots to remove pollutants. While some success has been reported using plants alone in bioremediation, the use of plants in conjunction with plant associated bacteria offers much potential for rhizoremediation (Mejare, 2001).

Plants and their associated microorganisms are characterized by varied and complex interactions which has been the subject of extensive research and diverse applications (Mishra, 2014). Endophytes lives symbiotically within the plants. The interaction between Endophytic bacteria and host plants has not been fully understood, it is well established that some of these interactions are beneficial to the plant. The endophytes close association with internal tissues of host plant has increasingly gained them scientific and commercial interest due to their potential to improve plant quality and growth. A promising field to exploit plant-endophyte partnerships is the remediation of contaminated soils and (ground) water. Like for Treatment wetlands (also known as constructed wetlands) are effective and low-cost operational alternatives to conventional technologies for the elimination of a wide range of contaminants from wastewaters and polluted groundwater (Braeckevelt, 2007; Calheiros, 2007). Many plant growth promoting endophytes can assist their host plant to overcome contaminant-induced stress responses, thus providing improved plant growth and also affects the environment.

Endophytes are defined as microorganisms (fungi, bacteria) that colonize living, internal tissues of plants without causing any immediate, negative effects. The term endophyte was first introduced in 1886 by De Bary for microorganisms (fungi, yeast, and bacteria) colonizing internal plant tissues (De Bary, 1884). One of the latest definitions of endophytes was proposed by Posada and Vega (2005) who used