Chapter 2

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**ABSTRACT**

The astonishing metabolic abilities of the microbes should be harnessed to obtain new breakthroughs in evolution of degradation pathways and development of newer strategies for bioremediation and biotransformation process. *Trichoderma* species are important biological control agents used in plant disease management. Other than biocontrol properties they share a very unique phenomenon of soil bioremediation. In this context, bioremediation of soil cover restoring of soil microbiota is of particular importance. Introduction of microorganisms to soil is one of the most promising current approaches to improving soil production both in agriculture and forestry. The co-culture use of different species/strains of *Trichoderma* has already been reported in higher and quicker ways of solid waste decomposition than the use of a single species/strain. By virtue of the ability of *Trichoderma* spp. to decompose organic matter, they are free-living in soil as saprophytes. However, these species also have the capability to

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live on other fungi, and the ability to colonize plant roots and rhizosphere. In this chapter, the role of different micro-organisms including fungi and bacteria in bioremediation has been discussed. Further, it has been elaborated that how biocontrol agent Trichoderma spp. can be utilized in bioremediation and how it plays significant role in this process of bioremediation.

INTRODUCTION

The current scenario of environmental pollution poses serious threat to health of human beings, livestock, wildlife and eventually whole ecosystem through faulty production, distribution, use, disposal or accidental spills of many chemicals that are mandatory in practiced agriculture. There is an impending need to rejuvenate the polluted system through renewed practices and awareness of the deleterious effects which such unscrupulous use of chemicals is causing to all life on earth. However, it is beyond surmountable limits to calculate the corresponding cost incurred for restoring the contaminated ecosystem to healthy and acceptable level. In view of the fact, microbial bioremediation program offers one such option, which is more cost effective as compared to the traditional methods of physical and chemical remediation of the contaminated sites. The microbial bioremediation is based on the principal of immobilization or transformation of the contaminants to useful products which are no longer hazardous to human health and environment. The government, industry and also the public should be sensitized for implementation of bioremediation program on a larger and extensive scale so as to speed up the process of restoring the damaged environment.

In nature the degradation or detoxification of the harmful chemicals accumulated in the soil, ground water and waste water takes place gradually over long periods of time. The term bioremediation applies to technologies that aid to accelerate the above natural processes. However, the use of microorganisms, predominantly bacteria, for bioremediation or transformation of hazardous contaminants dates back to 600 B.C. Several pre-medieval civilizations such as the Romans and others used to treat their wastewater for detoxification through bioremediation. In present times bioremediation is being used on commercial scale for almost last 30 years (Ramnayar, 2005). Bioremediation is a technique that involves management of waste through use of organisms to neutralize pollutants in a pre-contaminated site. It is a “treatment that uses naturally occurring organisms to break down hazardous substances into less toxic or non-toxic substances”.

In 1972 a sun oil pipeline spill occurred in Ambler, Pennsylvania wherein the first commercial use of bioremediation system was initiated to clean up the site (National Research Council, 1993). Since then, bioremediation has become a well-developed way of cleaning up different contaminants. Information on 240 cases of bioremediation involving treatment of contaminated soil or groundwater in the United States were reported in a survey prepared by the Environmental Protection Agency in 1992 (Alexander, 1999). Over the decades urbanization and modernization of the twentieth century has led to unprecedented increase in population, resulting in rising anthropogenic activities such as industrialization and destruction of the valuable biodiversity causing serious ecological imbalances. This has not only increased accumulation of conventional solid and liquid waste pollutants to critical levels but also produced a wide range of previously unknown contaminants (Ramnayar, 2005). Majority of the contaminants that enter into the ecosystems are in the form of chemicals and exert serious health hazards on man, animal life, plant life and microbes and lead to several ecological problems (Bower, Rittman, & McCarty, 1984). Different scientific approaches have been employed to develop some feasible clean-up process, only a few of them have turned out to be of routine application value