Chapter 9
Role of Bacillus spp. in Agriculture:
A Biofertilization and Bioremediation Perspective

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ABSTRACT

The advent of the industrial revolution and intensified agricultural practices have posed irreversible impairment in the soil by accumulating various xenobiotic compounds. Soil, being a core constituent of Earth, not only supports plant growth but also acts as a water filter, buffering pollutants and conserving myriad microorganisms. Untreated industrial effluents, dumping of plastics, and overuse of pesticides are some of the major contaminants enrooted for soil pollution causing severe threats to living beings and the biosphere. Bioremediation using microbes has been recommended as a safe and viable method for the soil fertility restoration due to their adaptive nature modulated by the environment. Among the microbes, Bacillus sp is considered as an effective bioremediating agent as they are the warehouse of copious enzymes, eco-friendly products, and plant growth-promoting metabolites that play a key role in agriculture, textile, food, leather, and beverage industries and thereby ensure soil sustainability.

BACKGROUND

Human activities over the last few decades led to a high pollution status over the exploitation of natural resources and its reprehensible wastes disposal (Figure 1). Rapid increase in global population coupled

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with accelerated level of Industrialization leads to exponential increase in accumulation of noxious waste in environment. As the quality of life in the biosphere is directly related to the quality of environment, the accumulation of these obnoxious pollutants has a direct correlation to human health. The frequent use of conventional methods to decontaminate the polluted soil leads to unintended alteration of the physicochemical and biological characteristics of that soil. These traditional methods, although widely applied, often fails to prove as ecofriendly and sustainable strategies for pollution management and for restoring soil fertility. As a result, multiple measures were put forward to determine the most useful strategies to deal with polluted areas. Soil microbes take part in degradation and transformation of contamination in soil as they are major contributors in carbon, nitrogen, phosphorus, oxygen, sulfur and heavy metal cycles (Chandra et al., 2019; Teng & Chen, 2019). Microbial remediation offers a promising potential to reinstate contaminated soil in an ecofriendly manner thereby emphasizing a sustainable waste management strategy. The multifunctional microbial enzyme system clearly makes them important candidates for restoring the physicochemical properties of contaminated soil by wide array of process for removing or mitigating environmental contaminants. Exploring the mechanisms that control the growth and activity of microbial enzymes in the contaminated areas can open new windows towards their widespread application in bioremediation.

INTRODUCTION

Environment materialized with non-renewable resources like air, land and water is acclaimed not only for aesthetic appearance but also to sustain the vibrant living of corporeal creatures. Their intact correlation contributes to the sustenance of humans in concert with other living entities. But the advent of science and technological progression to ease the lifestyle of an overgrown population has derogated the holistic function and intrinsic value of indispensable reserves (Kalavathy, 2004). Blooming of industries and rapid urbanization poses a significant challenge in resources management in the past few decades. Pollution is defined as the undesirable alterations occurring by physical, chemical or biological means which adversely affects the wellbeing of humans and environment (Wong, 2012). Contamination of natural resources occurs in a number of ways, among which soil pollution is of paramount concern as it acts as a universal sink for various pollutants (Kirpichtchikova et al., 2006).

Soil characterized by organic and inorganic layers forms the basis for agriculture. It nourishes plants and microbes, maintains biodiversity for the habitual regulation of biogeochemical cycles and a balanced ecosystem (Dixit et al., 2015). Despite their intrinsic values, soils get contaminated naturally or by anthropomorphic sources. Soil contamination arises from several activities like discharge of untreated industrial effluents, leaching of solid waste, overuse of pesticides and herbicides and runoff from storage tanks resulting in the accumulation of xenobiotic compounds at high concentrations (Khan et al., 2008; Wuana & Okieimen, 2011). Particles that depreciate soil fecundity and reduce biotic balance are reflected as soil pollutants among which heavy metals and industrial effluents leave a significant challenge in the disposal site. Almost every wastewater constitutes a substantial amount of heavy metals besides micronutrients and non-degradable organics. Their deleterious effects are influenced by the nature of contaminants and the concentration. The emanation of these untreated or partially treated effluents poses an irreparable damage on agricultural soil and water bodies (Okereke et al., 2016). Thus, there arises an urgent need to imply an effective technology to eliminate these toxins which ensures eco-friendly matrices. Keeping this in view, this chapter summarizes the key concepts of the role of bacteria in soil