

Chapter 6

Role of Plant Growth Promoting Rhizosphere (PGPR) on Molecular Mechanisms Transporters Under Heavy Metal Stress

ABSTRACT

In this chapter, the authors discuss the molecular mechanisms transporters used for the removal of heavy metals contaminants from soil and water. The bioremediation method used for soil remediation render the land useless as a medium for plant growth as they also remove other contaminants that harm microbes and maintaining soil fertility with the help generating heat shock protein and metallothiones and also molecular transporters.

INTRODUCTION

Bacteria have ability to tolerance of metals using different mechanism which maintain metal homeostasis with keeping concentration of essential metals (Nies, 2003). Microorganisms involve both actively and passively for metal uptake, remaining or sequestering. Effects of different bacteria on metal uptake, depends on the basis of chromosomally or extrachromosomally which controlled detoxification of metals (Ehrlich, 1997). Several type sequestration

DOI: 10.4018/978-1-5225-9016-3.ch006

mechanism of metal resistant system including efflux pumps to remove metals from the cell and to bind inside the cell. Metals pump out by using adenosine triphosphates two efflux system and through antiports proton generate protein gradient across the cell membrane (Nies, 2003). Researchers indicated about another mechanism about metals resistance in cyanobacteria is sequestration by metallothioneins signaling. Metallothioneins compounds bind to different metals on receptor of plasmamembrane to sufhydryl group of cysteine residue with phosphate groups and activate the channels for the expression of gene to tolerate under stress. More cadmium (Cd) accumulation and tolerance by *Stenotrophomonas maltophilia* and also found Cd efflux pump. Some bacteria produce more extracellular polymeric substances (EPS) which bind to metal and create environment around the plant root for less toxic.

Hyperaccumulation mechanism in plant described briefly that hyperaccumulation is not only depends on plant but also interaction between microbes and present amount available of metals and non metals in soil. Bacterial communities present in soil with tolerable metals like zinc, lead, copper and nickel. According to Idris et al. (2004) were reported that rhizosphere of hyperaccumulating plants such as *Arabidopsis murale* and *Thlaspi goesingense* has an increased proportion of metal resistant bacteria. Many bacteria have tendency that can alter heavy metal mobility for uptake plant easily (Rajkumar and Freitas, 2006). Isolated Ni mobilizing bacteria from Ni rich soil and check their efficiency to promoting plant growth with the using Brassica species (Abou-Shanab et al., 2003). Soil bacteria produce such compounds biosurfactants, siderophores and organic acids which stimulate metal bioavailability in soil and increase root absorption of various ions like (Mn^{2+} , Fe^{2+} and Cd^{2+}).

PLANT GROWTH PROMOTING RHIZOSPHERE

Rhizobium leguminosarum of different strains was showed Cd tolerant and increased the levels of glutathione which indicating about tripeptide allows bacterium to deal under heavy metals stress rather than efflux systems activate (Ma et al., 2013). Metal toxicity occurred in cell or plant organs at that condition important glutathione antioxidant generate to protect against stress. Apart from other mechanism plants also dealing with toxic metals which involve polyphosphates and long chains of thiophosphates for metals sequester (Lv et al., 2012). Biofilm formation from *E.coli* under nickel stress which may serve as as tolerance mechanism and involved in adherence by inducing

12 more pages are available in the full version of this document, which may be purchased using the "Add to Cart" button on the publisher's webpage: www.igi-global.com/chapter/role-of-plant-growth-promoting-rhizosphere-pgpr-on-molecular-mechanisms-transporters-under-heavy-metal-stress/241169

Related Content

Relationships Between Climate Parameters and the Density of Phlebotomus papatasi, the Main Vector of Zoonotic Cutaneous Leishmaniasis

Ahmed Karmaoui and Siham Zerouali (2019). *Climate Change and Its Impact on Ecosystem Services and Biodiversity in Arid and Semi-Arid Zones* (pp. 291-302). www.irma-international.org/chapter/relationships-between-climate-parameters-and-the-density-of-phlebotomus-papatasi-the-main-vector-of-zoonotic-cutaneous-leishmaniasis/223768

Indian River Watershed Image Analysis Using Fuzzy-CA Hybrid Approach

Kalyan Mahata, Subhasish Das, Rajib Das and Anasua Sarkar (2019). *Environmental Information Systems: Concepts, Methodologies, Tools, and Applications* (pp. 1148-1162). www.irma-international.org/chapter/indian-river-watershed-image-analysis-using-fuzzy-ca-hybrid-approach/212987

Does User Feedback Matter for Product Development?

Asl Diyadin Lenger and Aykan Candemir (2023). *Multidisciplinary Approaches in AI, Creativity, Innovation, and Green Collaboration* (pp. 275-295). www.irma-international.org/chapter/does-user-feedback-matter-for-product-development/322882

Heavy Metal Stress Mechanism by Signaling Cascades in Plants

(2020). *Nano-Phytoremediation Technologies for Groundwater Contaminates: Emerging Research and Opportunities* (pp. 133-144). www.irma-international.org/chapter/heavy-metal-stress-mechanism-by-signaling-cascades-in-plants/241173

Global Warming and Pesticides in Water Bodies

Sanjeevi Ramakrishnan and Anuradha Jayaraman (2019). *Handbook of Research on the Adverse Effects of Pesticide Pollution in Aquatic Ecosystems* (pp. 421-436). www.irma-international.org/chapter/global-warming-and-pesticides-in-water-bodies/213519