

Chapter 9

Role of Phytochelatin (PCs) and Metallothionein (MTs) Genes Approaches in Plant Signalling

ABSTRACT

In this chapter, the authors reported that phytochelatin (PCs) and metallothionein (MTs) are actively involved in metal binding and detoxification as observed more in hyperaccumulation plant species. Also, most reports have explained single metal/metalloid detoxification via PCs and MTs; hence, it remains to be seen how plants use these metal ligands at the time of multiple metal stress and generate at the time of defence system against heavy metal stress condition.

INTRODUCTION

Heavy metal pollution is a growing concern all over the world and chemicals released in the in a soil in the form of cadmium (Cd), copper (Cu), cobalt (Co), lead (Pb), zinc (Zn), chromium (Cr), nickel (Ni), barium (Ba), argon (Ag), cobalt (Co), mercury (Hg) and antimony (Sb) and some of these elements are essential for many physiological function in living beings whereas no other known as biological function as required level (Fassler et al., 2010). These elements in (fungicides, fertilizers, urban trash, animal waste, sewage sludge

DOI: 10.4018/978-1-5225-9016-3.ch009

in soil) and deposits of industrial dust can increase the concentration in soil for making them toxic (Fassler et al., 2010). Phytoremediation technique is used because the biological property and physical structure of the soil is maintain and unexpensive and ecofriendly for the environment (Ali et al., 2013). Plants are capable of immobilizing metal in soil by forming insoluble compounds as result of the interaction of plant exudates in the rhizosphere or by adsorption (Kidd et al., 2009). Some species of plants are capable of accumulating heavy metals in their tissue so that contamination removed by harvesting the plant and some plants show toxicity if more amount of metals translocate and accumulate into the tissue (Maestri et al., 2000; Van Nevel et al., 2007). Different plants can present at different tolerance mechanisms in response to the excess of heavy metals including a reduction in the transport through the membrane for the metallothionein (MT) formation, exclusion, phytochelatin (PCs), chelation by organic acids and amino acids and metal compartmentalization in subcellular structure”(Ovecka and Takac, 2014).

PHYTOCHELATINS

Phytochelatin (PCs) are low molecular weight cysteine rich small polypeptide with a general structure (g-Glu-Cys)_nGly, where $n^{1/4}2-11$ and are not only reported in plants but also have found in fungi and other organisms (Yadav et al., 2010; Mirza et al., 2014). Phytochelatin are one of the most important classes of metal chelators that respond to the harmful effects of a variety of toxic metals. Phytochelatin are known to be synthesized in the cytosol in response to the heavy metal toxicity”. Phytochelatin-metal and Phytochelatin metalloid complexes are very stable in nature and are formed and “sequestration in the vacuolar compartments where the toxic effect metals is of less concern (Shen et al., 2010; Dago et al., 2014). The biosynthesis of PCs is catalyzed by the key enzyme of phytochelatin synthase PCs (Kutrowska and Szelag, 2014).

Phytochelatin belong to a family of peptides which were first discovered as cadmium (Cd)-binding complexes in *Schizosaccharomyces pombe* exposed to Cd and were named as cadystins (Inouhe, 2005). The amino acids required for the synthesis of this peptide are L-glutamate (Glu), L-cysteine (Cys), and glycine (Gly). Phytochelatin are synthesized from GSH; therefore, the biosynthetic pathway overlaps with GSH biosynthesis. The general structure of PC oligomer is (g-Glu-Cys)_n-Gly where n usually range from (2-5); but has

13 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-phytochelatin-pcs-and-metallotionins-mts-genes-approaches-in-plant-signalling/241172

Related Content

iTCLab Temperature Monitoring and Control System Based on PID and Internet of Things (IoT)

Basuki Rahmat, Minto Waluyo, Tuhu Agung Rachmanto, Mohamad Irwan Afandi, Ni Ketut Sari, Helmy Widyantara and Harianto Harianto (2023). *Food Sustainability, Environmental Awareness, and Adaptation and Mitigation Strategies for Developing Countries* (pp. 199-210).

www.irma-international.org/chapter/itclab-temperature-monitoring-and-control-system-based-on-pid-and-internet-of-things-iot/319461

Soil, Water, and Agricultural Adaptations

Gaius D. Eudoxie and Mark Wuddivira (2015). *Impacts of Climate Change on Food Security in Small Island Developing States* (pp. 255-279).

www.irma-international.org/chapter/soil-water-and-agricultural-adaptations/118028

Current and Future Trends of Refrigerants Development

M. V. Duarte, L. C. Pires, P. D. Silva and P. D. Gaspar (2017). *Renewable and Alternative Energy: Concepts, Methodologies, Tools, and Applications* (pp. 1900-1951).

www.irma-international.org/chapter/current-and-future-trends-of-refrigerants-development/169661

Climate Change and Agriculture: Impacts, Adoption, and Mitigation

Sunil Lalasaheb Londhe (2018). *Climate Change and Environmental Concerns: Breakthroughs in Research and Practice* (pp. 1-23).

www.irma-international.org/chapter/climate-change-and-agriculture/201691

Applying a Grass-Root Approach to Empowering Change Agents to Transform Pro-Conservation Attitudes and Behaviors in Over-Populated China

Kenneth C. C. Yang and Yowei Kang (2017). *Environmental Issues Surrounding Human Overpopulation* (pp. 120-136).

www.irma-international.org/chapter/applying-a-grass-root-approach-to-empowering-change-agents-to-transform-pro-conservation-attitudes-and-behaviors-in-over-populated-china/173309