Chapter 9
Role of Phytochelatines (PCs) and Metallothionines (MTs) Genes Approaches in Plant Signalling

ABSTRACT

In this chapter, the authors reported that phytochelatines (PCs) and metallothionies (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, phytochelatins (PCs), chelation by organic acids and amino acids and metal compartmentalization in subcellular structure"(Ovecka and Takac, 2014).

PHYTOCHELATINS

Phytochelatins (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). Phytochelatins are one of the most important classes of metal chelators that respond to the harmful effects of a variety of toxic metals. Phytochelatins are known to be synthesized in the cytosol in response to the heavy metal toxicity". Phytochelatins-metal and Phytochelatins 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 phytochelatins synthase PCs (Kutrowska and Szelag, 2014).

Phytochelatins 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). Phytochelatins are syntheisized 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

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