Chapter 8
Mechanism of Heavy Metal ATPase (HMA2, HMA3 and HMA4) Genes

ABSTRACT

Heavy metals are the most important pollutants that are non-biodegradable and increasingly accumulate in the environment. Phytoremediation can be defined as the use of plants for the extraction, immobilization, containment, or degradation of contaminants. It provides an ecologically, environmentally sound and safe method for restoration and remediation of contaminated land. Plant species vary in their capacity of hyper-accumulation of heavy metals. The chapter reviews the current findings on the molecular mechanism involved in heavy metals tolerance, which is a valuable tool for phytoremediation. The heavy metal tolerance genes help in the hyper-accumulation trait of a plant. Heavy metal transporter ATPases (HMAs) genes help in the refluxing of heavy metal ions from the cytosol, either into the apoplast, the vacuole, or other organelles, which help in the hyperaccumulation of metal. Understanding the signaling mechanism of transporter genes will be an important tool to understand the genetics of hyperaccumulation.

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INTRODUCTION

Heavy metal contamination is world wide problem to human and animal health. Using hyperaccumulator plants for specific metals cleanup from the environment over the last 20 years and recently it thunder to be used phytoremdiation technology (Rocca et al., 2009). Some heavy metals like (Se, As, Cd, Hg and Pb) are not essential element for plant growth and anyother function. Meanwhile such as Zn, Ni, Mn, Mo, Cu, Co, and Fe are essential elements required for normal plant growth and physiological and metabolism function in plants. At low amount of these metals use as micronutrients for plant and if their concnetration increase to high values can easily go ahead to poisoning (Park et al., 2014). Numerous physiological processes and metabolism activity in plants as they caused molecular and cellular level were toxicity by heavy metals and also inactivating of some enzymes, blocking functional groups of metabolically important molecules for normal plant growth. Some where they were generating reaction against displacing or substituting for essential elements and distrupt integrity of plasmamembrane and increase antioxidant acitivity (Quartacci et al., 2001). However, phytoremediation can be considered for the decontaminated land.

Phytoremediation is the most popular advantage is that, its low cost and effectiveness technique for decontaminated land (Memon and Schroder, 2009). The processes of phytoremediation include the number of techniques i.e, phytodegradation, phytoaccumulation, phytostabilization, phytovolatilization and rhizofiltration (Salt et al., 1995). The basis of the genetics of metal hyper accumulation in woody plant species is largely still unknown but molecular mechanisms of the adaptation to metals in model plants viz *Arabidopsis* are well understood (Becher et al., 2004). Broad spectrum of plant yield is controlled by the involvement of different genes and it's very difficult to tell about to promote by single gene insertion in specific plants. This capter focus on the function of different gene involvement in diverse plant species to metals tolerance and translocation in plant organs". Rascio and Navari-Izzp, (2011), suggested about the specific metal localization through different metal transporters in various plants are essential for the developing genetically modified plants to acumulate heavy mtals in plants organs with the following uses in either phytoremediation to decontaminated or to improve human nutrition by biofortification process. Remove contaminats from soil and water followed phytoremediation process are more appropriate for agriculture