Biotechnologies towards Sustainable Development in Malaysia

Zarina Zainuddin

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Chapter 8

Mechanisms of heavy metal tolerance in plants (I) – Avoidance mechanisms

Phang Ing Chia

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Introduction

Heavy metal tolerance is the key prerequisite for phytoremediation. Generally, plants adopt two strategies to prevent the accretion of excess metal concentrations in the cytoplasm that leads to toxicity symptoms: avoidance and tolerance mechanisms. Verkleij and Schat (1990) defined avoidance as the ability to hinder excessive metal uptake into plants. On the other hand, tolerance is defined as the ability to cope with excess metals that accumulate within the plants (refer chapter 9). These complex mechanisms vary depending on the type of metal, metal concentration, plant species, organs, and developmental stage.

At low metal concentration, plants undergo avoidance mechanisms including metal exclusion, translocation and complexation in the cytoplasm. Plants maintain a low toxic metal concentration in the cytoplasm by stopping the metals from being transported across the plasma membrane (Tong *et al.*, 2004; Yang *et al.*, 2005). These plants alter their membrane permeability, change the metal-cell wall binding capability, increase exudation of metal-chelating substances, and stimulate efflux pumping of metal out of the cells (Verkleij and Schat, 1990; Hall, 2002; Yang *et al.*, 2005). The middle lamella acts as the main barrier to prevent metal penetration into cytoplasm (Małecka *et al.*, 2008).