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IMPROVED PHYTOREMEDIATION OF CONTAMINATED SOILS BY CHANGES IN SULFUR METABOLISM

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Introduction

In developed countries, large areas have been contaminated over centuries with heavy metals and organic pollutants by industrial, mining and military activities as well as farming and waste disposal (Pilon-Smits and Pilon 2002; Peuke and Rennenberg 2005a). These contaminations do not only pose a thread to the environment and to natural resources, they are also a danger to public health, because they can enter the food chain and can be leached out into the drinking water (Dietz and Schnoor 2001). Obviously, there is already a large requirement for cleanup of contaminated soils that will further expand with the industrialization of developing countries. The current costs for cleanup of contaminated soils are staggering (Peuke and Rennenberg 2005a; Pilon-Smits 2005) and the methods applied often do not solve the problem. A high amount of contaminated soils is stored in waste disposals, thereby transferring the problem to future generations. Thus, there is a high demand for low-cost, efficient methods of soil decontamination.

Phytoremediation is a relatively new, low-cost approach for cleaning up not only contaminated soils, but also aquatic environments and the atmosphere. For cleanup of soils, it uses plants and their associated microorganisms in the rhizosphere (Pilon-Smits 2005). Phytoremediation has been proven to effectively remove from soils a whole set of organic pollutants such as trichlorethane, pesticides, explosives, hydrocarbons, fuel additives, or polychlorinated biphenyls, as well as inorganic pollutants such as plant macronutrients, plant trace elements, non-essential elements for plants, or radioactive isotopes (Pilon-Smits 2005). During the last decade phytoremediation has not only received scientific but also commercial attention, but a considerable phytoremediation market currently exists in the USA only (Meagher 2000; McGrath and Zhao 2003; Pilon-Smits 2005). Recently, fast growing trees have been identified as particularly useful for phytoremediation, because they can produce large biomass that can be used for other purposes (wood products, bioenergy, *etc.*) subsequent to phytoremediation, can be cultivated in short rotation forestry plantations similarly to agricultural systems, produce an extensive root system that intensively explores and stabilizes the soil, are in many cases not part of food-chains and can be harvested before flowering. The latter is of particular advantage for the use of genetically modified plants (GMPs) in phytoremediation with respect to biological safety (Peuke and Rennenberg 2005a; b).

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