【Workshop1】Development of phyto-technology for decreasing heavy metal in food

Possible role of root cell wall properties in heavy metal uptake in hyperaccumulator plant species

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Phytoremediation is an emerging technology in Japan for remediation soils contaminated with heavy metals especially Cd. Amongst the metal accumulators, the rice cultivars, especially chokoukoko have attracted considerable attention because of their ability to grow in polluted soil together with its capacity for metal ion accumulation.

The success of phytoremediation depends mainly on bioavailability of the metal, and the ability of the plant to absorb and accumulate metals in shoots. In general, hyperaccumulators can uptake sparingly soluble metals from rhizosphere by two common mechanisms include the release of root exudates which can directly solubilize and sequester metal ion from the soil; and solubilization of hardly soluble metals by active substances of root cell wall.

The objective of this study was to assess the phytoextraction potential of various monocot plant species and explore the possible role of the root cell wall properties and root exudates in metal uptake in plants. A pot experiment was conducted with nine cultivars of four monocot plant species (rice, sorghum, barley and maize) in volcanic ash soils or alluvial soils. Concentrations of heavy metals were determined both in the soils and the plants. The concentration of total Cd, Pb, and Zn in the volcanic ash soils were higher than the alluvial soils. The results showed that shoot biomass of test plant species were smaller in the volcanic ash soils than in the alluvial soils. Among the plants species studied, the rice cultivars especially, choukoukoko, WRC28 and WRC30 showed best heavy metal accumulation properties irrespective of soil type.

The metal solubilizing potential of the root cell walls and the root exudates was also assessed in vitro using sparingly soluble metals. The results of metal solubilization by root cell walls showed that the rice cultivars namely, WRC30 and Sasanishiki were more efficient at solubilizing Cd and Pb than other plants, and that nipponbare was better at solubilizing Zn than others. However, the concentrated root exudates collected from test plants did not significantly solubilize the metals except Pb. An increase in metal solubility due to root cell walls is likely to be an important cause of the relatively high Cd, Pb and Zn accumulation in rice cultivars. Our results support a possible role of root cell wall properties in heavy metal uptake in hyperaccumulator plant species.