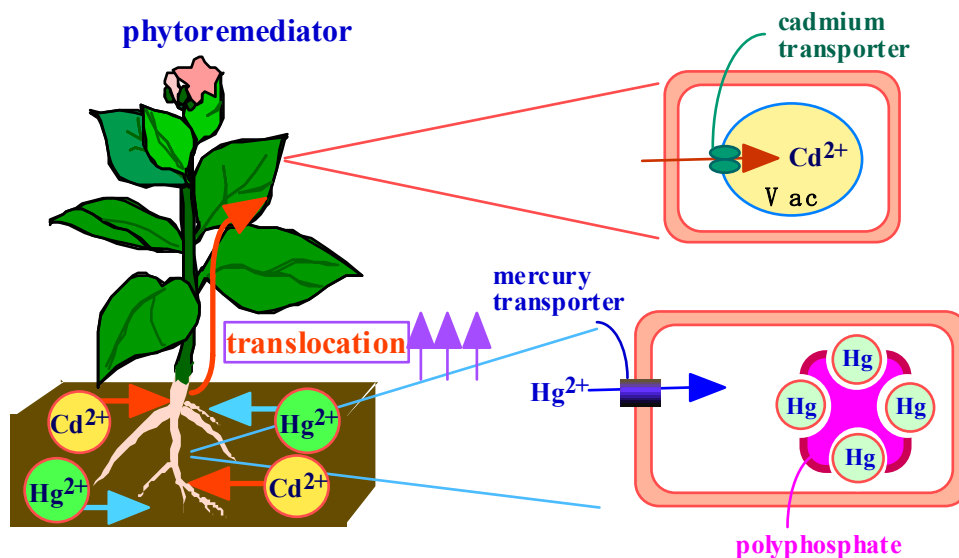


Technical Subject:

Phytoremediation of heavy metals by polyphosphate-coupled transport engineering.

Corresponding Applicant: Kazufumi Yazaki (Kyoto University)
 Co researcher: Masako Kiyono (Setsunan University),
 Hidemitsu Pan-Hou (Setsunan University)



Goal & Contribution to well-being for all humanity :

We are aiming to establish a new phytoremediation system, by which contaminated soils by heavy metals of wide area is cleaned and remediated by use of novel bioengineering technique. In this new plant biotechnology design, a combination of metabolic and transport engineering is employed, and by the new phytoremediation technology, we contribute to the restoration of the soil environment that brings human health as well as the healthiness of the earth.

Method / Approach :

To create a remediator plant that possesses a high capacity to accumulate heavy metals such as mercury and cadmium, the genes encoding transporters specific for these metals, *merT* for the former and *ycf1* for the latter, respectively, will be constitutively expressed in tobacco as molecular tools for the new phytoremediation. Polyphosphate kinase gene, *ppk*, is co-expressed in the transgenic plant to confer strong heavy metal tolerance, as well as the fixation ability to those pollutants by forming a stable chelate complex with the polyphosphate localized in the cytosolic space. Furthermore, vascular tissue-specific promoter is applied to express these transporter molecules for the accelerated translocation of the cadmium from the root tissue to aerial part, in which plasma membrane-anchored protein is engineered. This phytoremediation technique is based on the new concept that brings a dramatic increase in the remediation efficiency and also the facility of cadmium recovery.

<Basic design of the system>

- 1) Transporter proteins specific for heavy metal uptake are expressed in heterologous host plant.
- 2) For mercury *merT*, and for cadmium *ycf1* genes are utilized, respectively.
- 3) Polyphosphate synthetic gene is co-expressed with each transporter in the host plant to confer high resistance and high accumulation capacity to heavy metals.
- 4) The phytoremediators function basically only with water and solar energy.
- 5) The membrane localization for transporter molecule is controlled via creating chimeric proteins.
- 6) By use of vascular tissue-specific promoter, the translocation of heavy metal from root to aerial part, which enables both high efficiency of heavy metal uptake and facilitated recovery of heavy metal.

Introduction / Position in the session :

Environmental pollution by heavy metals arising from dispersal of sewage sludge and mining becomes a serious social problem. Although heavy metals are necessary for industrial resources, they cause severe health hazard of human, and removal of those metals from soils is very difficult. Phytoremediation is an attractive strategy to dissolve this problem, i. e. absorbing heavy metals from the contaminated soils and accumulating them safely in the plant body that can be recovered for recycling. Based on a new biotechnological design, we establish novel phytoremediators showing high remediation efficiency and recycling facility for heavy metals in soils.