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Dr., Mary Page
Office of Environmental Management
Science Program
US Department of Energy
FAX [202), 586-4883

Dr. Gregory Dillworth
Dr. James Tavares
Office of Basic Energy Science
US Department of Energy
ER-17, GTN
19901 Germantown Road
Germantown, MD 20874-1290

RE: Progress Report: Office of Environmental Management Grant: DEFGO7-96ER20253, P.I. Dr. J.I. Schroeder

Dear Mrs. Page, Dillworth and Tavares,

In the following I report on progress on our Department of Energy Grant from the Office of Energy Research and Office of Environmental Management on the topic of Molecular characterization of a novel heavy metal uptake transporter from higher plants and its potential use in phytoremediation (Grant #DEFG07-96ER20253). In this research we are investigating the following hypotheses:

1) A novel metal transporter cDNA isolated in my lab functions as a plasma membrane heavy metal and Ca^{2+} uptake transporter in plants roots.

2.) Over-expression of this cDNA in plants can be used to enhance plasma membrane metal uptake into plant tissues.

LCT1 provides a pathway for uptake of the toxic metal sodium.

The transport of cationic metals across membranes in higher plants plays an essential role in many physiological processes including mineral nutrition, cell expansion and the transduction of environmental signals. In higher plants the coordinated expression of transport mechanisms is essential for specialized cellular processes and for adaptations to variable environmental conditions. Because many different metals interact during uptake from soils we further characterized the uptake activity of LCT1 for important metal cations.

We found that the toxic alkali metal sodium is also effectively transported by LCTl. Interestingly, preliminary data indicatc that calcium ions compete effectively with sodium uptake and inhibit this uptake. These data correlate to whole plant studies in which calcium is known to strongly compete with sodium such that calcium greatly ameliorates salt toxicity in plants. A patent application was filed for the use of LCT1 in transporting toxic metals. Patent Protection of these findings is essential for providing incentive to industrial partners to pursue biotechnological use of the LCTl gene.

To further investigate the molecular physiological potential of LCT1, Arabidopsis plants' are being transformed with constructs over-expressing the LCTl transgene. In ongoing research transgenic plants will be investigated for metal transport and the specificity of LCTl for additional toxic metals as well as for the nutrients Ca^{2+} and iMg^{2+} will be analyzed. Also mutant complementation is being developed to study the Ca^{2+} uptake capacity of LCTl. In addition the initial success in isolating the LCTl cDNA by performing a dual screen combined with yeast complementation is being pursued to isolate futher plant genes that play important roles in heavy metal resistance and transport in plants. Futher research for this DOE project can provide valuable information for future remediation of toxic wastc sites with high levels of metals in soils and waters.

Sincerely,

Julian I. Schroeder, Ph.D.
Associate Professor of Biology