

Dainty Plant Outpowers Cadmium-Contaminated Soils

Working with a cadre of international scientists, agronomist Rufus Chaney, of the Animal Manure and Byproducts Laboratory in Beltsville, Maryland, found a small plant adorned with delicate, white flowers that can remove a large amount of cadmium from contaminated soil. Alpine pennycress, *Thlaspi caerulescens*, can concentrate cadmium in its leaves up to about 8,000 ppm (parts per million).

In 1996, the team of scientists from the Agricultural Research Service, University of Maryland, University of Melbourne-Australia, and Massey University-New Zealand began testing alpine pennycress to remove cadmium. Working with several types of alpine pennycress found in the southern part of France, researchers found that soil metals move into the harvestable plant shoots.

“Harvesting the aboveground vegetation annually makes it possible to gradually reduce the soil concentration of cadmium to safe levels. The cost of this remediation method, called phytoextraction, is about \$250 to \$1,000 per acre per year,” says Chaney. The alternative clean-up method, removal and replacement with clean soil, costs about \$1 million per acre. Most highly contaminated soils can be deemed safe after 10 years of phytoextraction.

Cadmium is a naturally occurring element that is widely distributed in the earth’s crust. It is released into the environment during mining, ore processing, and smelting of zinc and zinc-lead ores. Cadmium is used in metal plating, pigments, and batteries.

Food constitutes the principal environmental source of cadmium. Staple foods such as wheat, rice, and potatoes contain 10 µg to 300 µg of cadmium per kilogram of fresh weight. Rice can accumulate more than 3,000 µg/kg when grown on polluted soil. Even so, according to the Agency for Toxic Substances and Disease Registry, people ingest less than 10 percent of the amount needed to cause kidney tubule disease after a lifetime of exposure.

Cadmium contamination is a worldwide problem, especially in Asia’s flooded soils—called paddies—in which rice is grown. Rice grown in these soils can have 100 times the normal level of this element, Chaney and his collaborators found. A recent survey in Japan found that more than 1.25 million acres are high enough in cadmium to cause rice to exceed the recommended limit of 200 µg/kg.

In 2000, the University of Maryland filed for a patent on use of alpine pennycress for phytoextraction of cadmium from soil. No other similar technologies currently exist for remediation of cadmium-contaminated soils using plants.

Research is under way to develop a super-phytoextraction plant. The southern France type of alpine pennycress is capable of absorbing 10 to 20 times the amount of cadmium as its smaller brethren from the rest of Europe. “We can combine high cadmium accumulation with high yield through traditional plant breeding,” says Chaney. “The only thing left is to win commercial support to advance use of these plants to clean soils.” A company, Phytoextraction Associates LLC, has licensed the right to use this technology and is working with owners of cadmium-contaminated land in the United States and Asia to reach a commercially effective technology.—By **Sharon Durham, ARS.**

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Alpine pennycress doesn't just thrive on soils contaminated with zinc and cadmium—it cleans them up by removing the excess metals.