



Ground Water Currents

Developments in innovative ground water treatment

Tree Buffers Protect Shallow Ground Water at Contaminated Sites

By L.A. Licht and J.L. Schnoor, University of Iowa

Researchers at the Great Plains/Rocky Mountain Hazardous Substances Research Center (HSRC) are confirming that vegetation-specific poplar trees (*Populus spp.*)—can help keep toxic herbicides, pesticides and fertilizers out of rivers, streams, creeks and ground water. In addition to agricultural pesticides and nitrate removal, the vegetation is being studied at Superfund sites with other organic contaminants and metals. Trees serve to decrease vertical migration of contaminants to, and in, shallow ground water.

At an agricultural test site on an Iowa farm, a poplar crop, planted by a University of Iowa research team, was found to significantly reduce nitrate levels in the ground water. The trees were planted along a stream bank between a corn field and the stream.

One objective of the project was to reduce the nitrate-nitrogen that was leaching out of fertilized fields into surface water. The test buffer clearly met this objective. In 1990, when the trees were three years old, researchers recorded the average nitrate content of ground water leaving the corn field at 150 milligrams per liter (mg/L),

more than three times EPA's permissible limit of 45 mg/L for nitrate in drinking water. In the ground water in the midst of the trees between the field and the stream, the readings were 8 mg/L. Along the creek bank, the nitrate level in the ground water had dropped to only 3 mg/L.

Poplar trees were chosen because they consume such large amounts of nitrogen. The trees take up soluble inorganic nitrogen or ammonium-nitrogen through their roots, converting nitrates into protein and nitrogen gas. After five growing seasons, the average tree contains 33 grams of organic nitrogen in its stem. On land planted with 11,000 trees per hectare, this amounts to 363 kilograms of nitrogen per hectare. The researchers calculated that this means that the trees planted on a hectare of land have transpired, and therefore bioremediated 8.07 million liters of water.

Licht and Schnoor have used poplar trees in a variety of toxicity studies in both controlled chamber and field experiments. In chamber experiments, atrazine labeled with carbon-14 was

transformed into CO₂ both in soil and through plant uptake and metabolism. In field studies, the researchers observed that deep-rooted poplars slowed the migration of volatile organic chemicals.

Trees can serve a variety of other functions at a polluted site. They can serve as a wildlife habitat, as a wind screen, as a filter strip to trap sediment and prevent erosion and as a renewable resource that can be harvested for products such as fuel and lumber. At the Iowa farm test site, a second objective was to produce a cash crop, a strategy likely to increase consumer acceptance of the technology, since farmers would be asked to give

up land that would normally be planted in crops. Poplar wood can be converted into plywood, lumber or clean-burning wood pellets. Licht has calculated that farmers could grow the equivalent of 9,250 liters of fuel per hectare of poplars per year.

For more information, call L.A. Licht (319-335-5050) or J.L. Schnoor (319-335-5649) at the University of Iowa. The Great Plains/Rocky Mountain HSRC also has several initiatives involving the use of vegetation in bioremediation; for more information, call the HSRC's Director, Larry Erickson (913-532-6519).

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