

SPLASH INTO EXTENSION

Did You Know?

Water is an essential nutrient. Without it human life cannot survive. Water serves as the body's transportation system, it is a lubricant, it is vital to the body's biochemical reactions, it helps defend the body against shock, and it regulates body temperature. Maintaining a healthy

Nixing Nitrate Flow From the Farm

When early settlers arrived in the Midwest, they began constructing an underground network of tile drains to channel water away from the soggy prairies, which then became some of the most fertile crop fields in the country. But now when nitrate from soils and fertilizers leaches out of those flourishing fields, the subsoil engineering also facilitates the discharge of nitrates into nearby streams and rivers.

Because these local waterways are part of the vast Mississippi River Watershed, the nitrates are eventually transported into the Gulf of Mexico, where they can feed the development of oxygen-deficient "dead zones." But nitrate management isn't just an issue for the folks downstream. The U.S. Environmental Protection Agency has mandated that nitrate concentrations in drinking water—obtained either from surface water or ground water—cannot exceed 10 parts per million. Minimizing nitrate loss can also help producers obtain the greatest economic returns from the application of expensive fertilizers. So everyone benefits when nitrates are stopped from contaminating local water supplies.

Agricultural Research Service soil microbiologist Tom Moorman and others at the National Laboratory for Agriculture & the Environment in Ames, Iowa, have spent the last decade studying whether underground trenches filled with wood chips could help stem this nitrate flow. Microorganisms that live in the wood use a process called "denitrification" to convert nitrates in the field leachate into nitrogen gas or nitrous oxide, which then diffuse into the atmosphere.

Soils have some capacity to denitrify field leachate, but it generally decreases with soil depth," Moorman says. "So we wanted to see how well wood chip 'denitrification walls' could protect nearby waterways from the nitrates that leach out of the soil. We also wanted to see how quickly the wood breaks down in the subsoil."

Digging For Answers - Moorman and his team set up experimental sites in a field north of Ames. They installed perforated plastic drainage pipes 4 feet below the soil surface and then dug trenches on either side of the pipe and filled the trenches with wood chips. They buried the trenches and the pipes, and then cropped the fields with a corn-soybean rotation for the next 9 years.

The researchers also filled mesh bags with wood chips and buried the bags at depths of 2 feet and 5 feet in a nearby trench that was also filled with wood chips. The fields above this trench were also cropped with a corn-soybean rotation. Establishing this extra trench allowed them to dig up wood chips to see how fast they decomposed without removing wood from the experimental trenches.

The team found that over the 9-year study period, the wood chip "bioreactors" consistently removed nitrates from the field leachate, with removal rates remaining steady in the last 5 years. From 2001 to 2008, annual nitrate loss in plots with conventional drainage averaged 48.6 pounds per acre, but losses dropped to 21.8 pounds per acre in plots with the denitrification walls.

The data also indicated that, compared to subsoil, the average denitrification potential of wood increased from 31-fold in 2003 to 4,000-fold in 2004. These findings supported an earlier laboratory study by Greenan that indicated denitrification by microbes is the main mechanism in wood chip bioreactors responsible for removing nitrate from leachate.

The scientists also found that the population of denitrifying microbes exceeded 454 million per pound of wood, compared to 45 million per pound of surface soil and 4.5 million per pound of subsurface soil—strong evidence that the wood chips provided a habitat that favored the denitrifying organisms.

Taken in part from: <http://ars.usda.gov/is/AR/archive/feb12/nitrate0212.htm>

This research is part of Water Availability and Watershed Management, an ARS national program (#211) described at www.nps.ars.usda.gov.