PEGGY GREB (K10027-1)

Improved Land-Management Practices Protect Watershed Lakes

Soil scientist Martin Locke measures oxygen concentration in lake water. Vegetative filter strips increase oxygen content of the water and slow sediment input.

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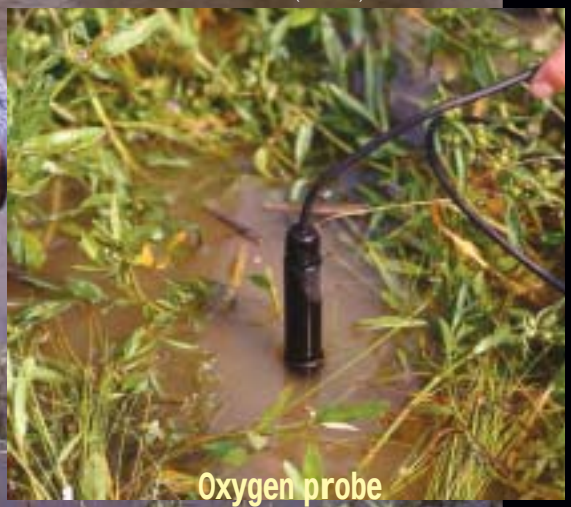

Oxygen probe used to evaluate the effect of wetland vegetation on water quality.

Watershed Lakes

Modern activities have greatly affected the Mississippi River and its tributaries. The Mississippi Department of Environmental Quality lists 581 streams, creeks, and rivers as impaired, largely with sediments, nutrients, insecticides, and herbicides. To help lower this number, researchers at the Southern Weed Science Research Unit (SWSRU) in Stoneville, Mississippi, are developing and testing conservation and weed-management practices to help agriculture do its share in improving the environment.

The Mississippi Delta Management Systems Evaluation Area (MSEA) project began in 1995 with 7,320 acres of farmland under study. A second research phase began in 2000 and is scheduled to last until 2004. This comprehensive study is designed to test and develop cost-effective farming methods that benefit the environment, techniques known as best management practices, or BMPs.

Stoneville is one of ARS' three primary Delta research locations. The others are in Oxford, Mississippi, and Baton Rouge, Louisiana. All three work with the U.S. Geological Survey's district office in Jackson, Mississippi, the Mississippi Water Resources Research Institute at Mississippi State University, and other organizations in the MSEA consortium.

Keeping Soil Down on the Farm

Three small oxbow lake watersheds along the flatlands of Mississippi's Yazoo River basin were the focus of the study during its first phase (1995 through 1999). Various combinations of farming practices and conservation techniques were assessed in each watershed.

Oxbow lakes are formed when river channels cut through their own meandering paths and form shorter courses, leaving standing bodies of water. These kinds of lakes allow direct evaluation of the impact of watershed agricultural practices on surface-water quality.

During the first phase of MSEA, researchers found that high levels of suspended sediments in the oxbow lakes were causing big problems by reducing sunlight and hindering beneficial algal growth. They also discovered that use of strict conservation techniques and BMPs significantly reduced movement of sediments into the lakes. Less sediment increased the populations of bacteria and algae—the first links in the aquatic food chain—and resulted in abundant and healthy fish in two of the three study lakes. (See "Mississippi Delta MSEA," *Agricultural Research*, June 1999, p. 4.)

Low-till and no-till practices are important to reducing erosion and slowing movement of agricultural chemicals to surface waters.

"To achieve wider acceptance, we need to give growers more information on managing conservation systems and to demonstrate their potential benefits for soil, rivers, lakes, and streams," says soil scientist and SWSRU research leader Martin A. Locke. "Conservation tillage raises organic matter in the soil surface, which also increases microbial activity. That in turn increases the capacity of the soil to bind herbicides."

Harnessing Herbicides

The researchers have now turned their attention to herbicides and their influence on the quality of lake water. A study on one of the three oxbow lake watersheds showed that the traditional cotton herbicide fluometuron was not as effective in soils with high organic matter and clay content. Weeds tended to recur more frequently in herbicide-treated soils containing more than 30 percent clay and more than 2.8 percent organic matter. But sandy soils were commonly weed free for 2 years, according to results from studies carried out by Locke's former postdoctoral assistant, Lewis A. Gaston.

"Herbicide binding to soil organic matter and clay lessens herbicide efficiency," Locke said. "Effective weed control could be reached by using less herbicide in sandy areas with low organic matter content. Herbicide could be applied on an as-needed, where-needed basis, reducing the potential for environmental contamination."

In the Delta, wider use of genetically modified, herbicide-tolerant cotton also means less use of fluometuron and less making its way into MSEA lakes, says microbiologist Robert M. Zablotowicz. But as Delta growers shift to corn production, Zablotowicz has found that concentrations of the herbicides atrazine and metolachlor in MSEA lakes are similar to those found in surface waters of the Midwest. A recent 2-year study surveyed the potential for atrazine degradation in Mississippi Delta soils.

"Even after a short history of atrazine use, results indicate that microbes in Delta soils have developed the ability to rapidly

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Biologist Wade Steinriede (left) and technician Keysha Hamilton measure residues from a rye cover crop among no-till cotton. The cover crop inhibited weed growth, enhanced soil quality, and reduced soil loss.

PEGGY GREB (K10038-1)

Microbiologist Robert Zablotowicz (left) and technician Earl Gordon record location coordinates of a soil sample they obtained in a MSEA riparian zone. Riparian soils will be evaluated in the laboratory for herbicide breakdown within them.

break it down," Zablotowicz said. "This might reduce the potential for off-site movement of herbicides, but it might also reduce atrazine's ability to control weeds."

Nature's Way: Vegetative Strips, Riparian Zones, Microbes

Runoff water often leaves agricultural fields through riparian zones—forested or grassed areas along riverbanks. If riparian vegetation is left undisturbed, organic matter accumulates in the soil and enhances microbial activity, which promotes degradation of certain herbicides, says Zablotowicz.

Like riparian zones, vegetated filter strips help reduce erosion by slowing runoff; increasing water infiltration; and minimizing loss of sediment, dissolved nutrients, and herbicides. They also support higher populations of those beneficial microbes. Research conducted by Bill Staddon, a former postdoctoral scientist working with Locke, showed that enhanced microbial populations in the soils of 60-foot-wide filter strips planted with a mix of grass and legumes broke down metolachlor three times faster than adjacent field soil did. This means that filter-strip soils might degrade herbicides before they have a chance to move into nearby lakes.

Stoneville postdoctoral scientist Mark Weaver is using DNA fingerprinting and traditional microbiological tools to determine how preserving and improving the rich microbial wetland environment can help filter out nutrient and pesticide contaminants.

Drainage ditches are commonly installed at the edges of fields to carry runoff. In collaboration with ARS researchers at the Oxford ARS site, the Stoneville team converted one drainage ditch leading into a MSEA lake into a constructed wetland. They did this by excavating a portion of the ditch and constructing a series of berms to retain water. Another drainage ditch was left unaltered. The two ditches' effectiveness in sediment control and removing pollutants will be compared with that of a riparian zone and a natural wetland.

The Next Phase

Locke reports that the focus for MSEA's next few years will shift from looking at combinations of conservation practices in the three oxbow lake watersheds to a more detailed look at individual practices that have proven successful. Researchers plan to monitor the precise contributions of cover crops, no-till farming practices, and vegetative buffers to reducing specific pollutants in bodies of water.

"The Mississippi Delta MSEA project is showing farmers steps they can take to combine successful farming with improved environmental quality," adds Locke. "Our research will continue to target environmental issues related to sediments, nutrients, and herbicides, giving farmers tools they need to help make the Mississippi Delta a better place to live."—By **Jim Core,** ARS.

This research is part of Water Quality and Management (#201) and Soil Resource Management (#202), two ARS National Programs described on the World Wide Web at http://www.nps.ars.usda.gov.

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Postdoctoral research associate Mark Weaver examines a soil core from a newly constructed wetland designed to capture agricultural runoff. Microbes in the wetland help to improve water quality by breaking down pesticides and removing nitrates.