In view of the environmental concern with nitrates in both surface and ground waters, the United States Department of Agriculture undertook an extensive research and education program involving five major centers and four satellite locations in the Midwestern cornbelt.

Impacts of Farming Systems on Water Quality

The resulting Management Systems Evaluation Areas (MSEA) water quality project evaluated the impact of farming systems on nitrate contamination of water resources, and identified guidelines for improving management practices to reduce nitrate loss. This paper highlights research results and the impacts of modern farming systems on water quality.

▶ Tillage methods reduce nitrate.

Research shows that using reduced tillage methods slows nitrate leaching from the soil and reduces soil erosion and runoff. Farming systems that use ridge tillage or no tillage methods are able to slow the rate of nitrogen release from the previous crop residue until later in the summer when the growing crop’s need for nitrogen increases. Traditional tillage plows or disks under all crop residue and buries the decomposing plants in the soil. This decomposition causes a rapid release of nitrogen, which is converted into a nitrate, a mobile nitrogen form. The amount of nitrate in the soil can be reduced by changing tillage practices, resulting in fewer potential pollution problems.

▶ Crop rotation reduces nitrate leaching.

MSEA research also confirms that farming systems using a corn-soybean rotation make better use of nitrogen in the soil, which reduces the amount of nitrate leaching. The amount of nitrogen needed for corn following soybeans is reduced because soybeans leave nitrogen in the soil. Including alfalfa in a crop rotation can be beneficial in some regions. Cover crops such as alfalfa also are effective in removing residual nitrate from below the rooting depth of crops such as corn.

▶ Fertilizer and water management reduce nitrate pollution.

MSEA research shows that using new management technology can reduce the potential for nitrogen leaching. Soil tests are able to assess the amount of soil nitrate before fertilizer application, making it possible to determine appropriate nitrogen fertilizer rates. By dividing nitrogen fertilizer into several applications rather than one, the nitrate accumulation in the soil is reduced.

Subsurface drainage systems are important to efficient crop production on many soils in humid regions. However, drainage water containing nitrate can add to nitrate contamination of surface waters. By first routing discharge from subsurface drains through wetlands and then into surface streams, nitrate movement into public waters can be significantly reduced.
Soil variability influences nitrogen management.

MSEA research documents the advantages of using site-specific, or precision, farming systems to manage soil variability and nutrient soil requirements. By monitoring nitrogen needs according to the soil properties in each field, each acre can be individually fertilized according to the best nutrient management plan.

Automated sensors, which assess the productivity of the soil, provide information needed to apply nitrogen to fields at variable rates according to crop needs. Monitoring greenness with a plant chlorophyll meter also contributes to effective nutrient management. Use of such technology for innovative management reduces the accumulation of nitrate in the soil and potential leaching, thus increasing nitrogen use efficiency.

Considerations for Future Policy Development

MSEA research results show that many new farming practices developed within the past few decades have considerable merit and help control nitrate movement into water resources. It is important to continue to improve farming systems in order to improve farm production and income, while reducing risks to water resources. Research highlights important considerations for future policy making.

▲ All farming systems are directly affected by weather—a natural force creating unpredictable outcomes on crop production and environmental issues involving water quality.

▲ Site-specific decisions are needed for each farm. Every farm has a unique set of resources and inputs: soils, climate, equipment, labor, capital and managerial skills influence decisions in nitrogen management.

▲ Implementation of more site-specific management decisions is needed to meet the challenge of soil variability in order to produce crops with the least risk to the environment.

▲ Tillage method and timing influence nutrient cycling, management, and soil erosion. Reduced tillage methods, ridge-till or no-till are most suitable for managing soil nutrient and soil erosion.

▲ A corn-soybean rotation protects water quality better than continuous corn, when nitrogen fertilizer levels are reduced to take into account nitrogen carry-over.

▲ Careful management of the timing and amount of irrigation applications helps reduce nitrate loss from fields and reduces nitrogen enrichment of water resources.

▲ Using technology to assist in nitrogen fertilizer rate decisions is key to reducing nitrate contamination in water resources.

▲ Farmers adopt new technologies when shown how a change in the farming system can reduce the economic and environmental risks involved in crop production.

For more information about nitrogen management at the MSEA sites, see the publication Reducing Nitrate in Water Resources with Modern Farming Systems. The publication (IDEA 12) can be ordered from Extension Distribution, Iowa State University, 119 Printing and Publications Building, Ames, 50011-3171, or by calling 515-294-5247.

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