Water Watch

A newsletter for the Maquoketa River Watershed

Nitrate in surface water – trends and concerns

by John Rodecap, ISU Extension project coordinator

Nitrate is a naturally occurring substance; however, the U.S. Environmental Protection Agency standard, Maximum Contaminant Level, is 10 parts per million (ppm) of nitrate nitrogen (NO_3-N) in drinking water. Drinking water contaminated with NO_3-N can cause blue baby syndrome and recent University of Iowa studies indicate that modest levels of NO_3-N may cause health concerns to humans of all ages.

The long-term trend of NO_3-N in surface water used as a drinking source for the cities of Des Moines and Cedar Rapids has moved steadily upward in the last 95 years as shown in figure 1.

Nitrate-N in streams originates from a variety of sources. Agricultural sources include nitrogen fertilizer, animal manure, mineralization of soil nitrogen and nitrogen-fixing crops. Other sources include human waste from sewage treatment plants, septic systems and landfills and nitrogen produced as a waste or by-product of some industrial processes. Rainfall also contributes some NO_3-N. In a largely agricultural state such as Iowa, agricultural sources predominate.

Organic nitrogen in the soil, or added as manure, can be converted to ammonium through a process called mineralization. If maintained as ammonium and fixed on soil clay surfaces, it is not subject to leaching. However, soil bacteria convert ammonium to nitrate, which is not held on clay surfaces, thus it moves readily through the soil with water. The nitrate form of N is the most used by crops, especially corn plants that require about 300 pounds of N to produce 150 bushels per acre (125 pounds per acre in the grain, 175 pounds per acre left in the roots and stover).

The sharp rise in fertilizer nitrogen use between 1960 and 1980 as shown in figure 2 and the more modest increase in use since 1980 is a focus of concern.

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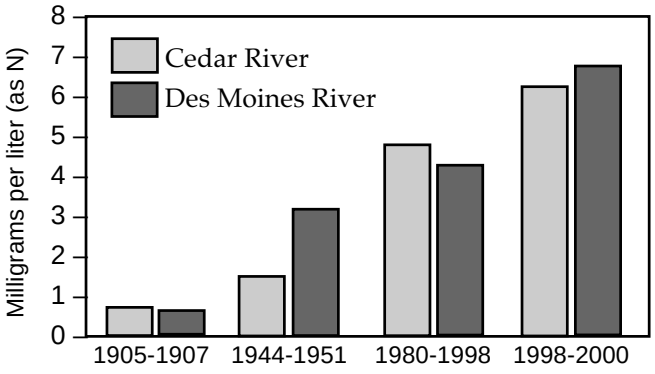

Figure 1. Average nitrate levels (as N) in the Cedar and Des Moines rivers for given time periods. Data from John North, Cedar Rapids Water Works.

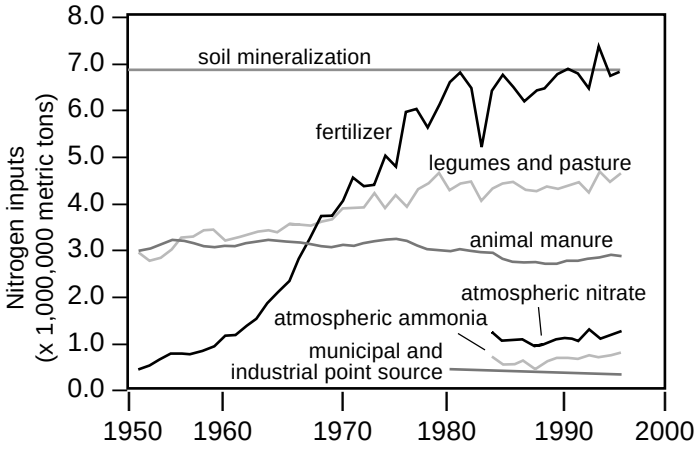

Figure 2. Annual nitrogen inputs to the Mississippi basin from major sources. Source: USGS.

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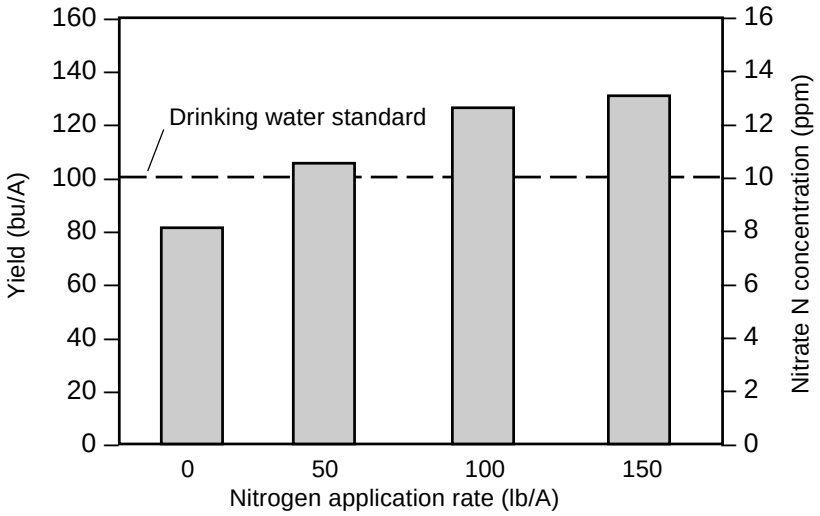

Figure 3. Corn yield and nitrate N concentration of tile drainage for a corn-soybean rotation, 1990-93. Data from ISU-IDALS cooperative project.

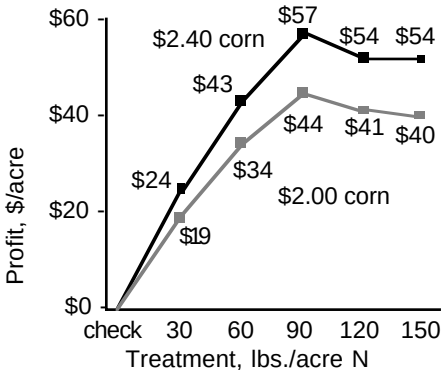

Figure 4. Profitability of additional N in corn following bean rotation on nine Maquoketa Watershed farms, 2000-2001. N at $0.20 per pound and corn at $2 and $2.40 a bushel.

Nitrate, cont.

Iowa Department of Agriculture and Land Stewardship (IDALS) for crop year 2000 reported 1,647 million pounds of commercial N fertilizer used on 12.3 million acres of corn, or 141 pounds per acre. Estimated N removed in the grain by the 1,740 million bushel corn crop in 2000, at 0.8 pound N per bushel, was 1,392 million pounds. An estimated 283 million pounds of manure N was available from the Iowa livestock and poultry population in 2000 (50 percent of the excreted N recovered and 75 percent of that available in the first year). This is an excess application of 538 million pounds of N (80.7 million dollars at 15 cents per pound of N) before taking into account atmospheric and rainfall contributions of 12 pounds of N per acre (147 million pounds on 12.3 million corn acres) and soil organic matter mineralization of N.

Farmers are caught on a commodity treadmill, driven by farm program and loan deficiency payments, that encourages increased acreage and production per acre of corn and soybean.

Relatively cheap nitrogen fertilizer used at rates that assure nitrogen is not the limiting factor to maximize yields is considered a reliable way to produce more corn per acre.

A watershed project cooperator said, "Profit per acre from crop production should be driven by refined and environmentally sound use of resources, including nitrogen fertilization, rather than maximum grain production incentives in agricultural support sections of farm policy."

Data from a tile drainage study for a corn-soybean rotation conducted cooperatively by Iowa State University and IDALS are shown in figure 3.

The graph shows that even with no nitrogen applied, NO_3-N concentrations in tile drainage exceeded eight parts per million (ppm) and at the optimum N rate exceeded 10 ppm.

Expanded and intense surface and tile line monitoring in the Maquoketa Watershed, reported in the February *Water Watch*, provides additional evidence of the large contribution of soluble nitrogen and phosphorus delivered from subsurface (tile) drainage systems.

Maquoketa River Watershed corn producers have been willing cooperators in hosting nitrogen, phosphorus and manure demonstrations on their farms to examine refined and profitable nutrient management alternatives that are environmentally friendly.

Maquoketa Watershed cooperators have demonstrated in corn-following-soybean fields that corn yields increase with N application rates over 90 pounds per acre but the higher yield is not sufficient to provide a net return to N priced at 20 cents per pound, as shown in figure 4.

Scientists conclude that several in-field and off-site strategies will need to be employed to manage the increase in NO_3-N in surface water, including:

- Rate — refine N use to the economic optimum rate, take appropriate manure and legume credits.
- Method/placement — flow control on equipment, applicators that create a protection zone to reduce nitrate leaching and variable rate technology.
- Timing — fall application is not

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Illinois strip-till growers respond to survey

The Illinois Department of Agriculture released in February the results of a survey of 459 growers using strip-till practices in 43 Central and Northern Illinois counties. The growers average 28 years of farming experience and annually grow 555 acres of corn.

Sixty percent of the respondents completed more than half of their strip tillage last fall in preparation for their 2002 corn acres. Prior to using strip-till, 46 percent had used no till, 28 percent some spring tillage and 24 percent used a combination of fall and spring tillage.

Some respondents, 18 percent, used the strip-till toolbar for the single purpose of building spring planting ridges while 15 percent used the ridge-building pass for deep placement of phosphorus and 12 percent for placement of potassium. The deep placement of nutrients results in reduced potential for nutrient runoff during the winter and spring. Late season nitrogen application was completed during the strip tillage pass by 55 percent of the survey respondents.

Producers who own their strip-till toolbar average 3.3 years of practicing this tillage system. Single-pass planting on the ridges that have been built with minimal residue disturbance provides a relatively dry and warm seedbed. This creates a desirable environment for seedling development while minimizing potential soil compaction caused by spring tillage.

Thirty-six percent of the responding growers have experienced improved corn yields while 60 percent reported similar yields compared to their previous tillage program.

Survey participants used the following information sources in the order listed when making a decision to purchase new equipment: University of Illinois Extension, farm magazines, soil and water conservation district, implement dealer and other producers experience. The most helpful information listed was field-size demonstrations, followed by results of current research, local meetings, information from Web sites and coffee shop discussion.

The survey was developed and conducted by Soil and Water Conservation Districts, Natural Resources Conservation Service and the Illinois Department of Agriculture.

IOWATER 2002 workshops scheduled in northeast Iowa

An IOWATER level 1 workshop and two level 2 modules will be offered in Northeast Iowa this summer. The level 1 workshop will be held Friday and Saturday, July 12-13, at Peosta. For more information, contact Bob Walton, telephone (563) 556-6745.

A level 2 workshop will be offered on Aug. 17 from 8 a.m. to 4:30 p.m. at Hartman Reserve Nature Center, Cedar Falls. The level 2 modules on benthic macroinvertebrate indexing and soil monitoring will be offered concurrently on Saturday, Aug. 24, from 1 to 5 p.m. at Bailey's Ford Park, Manchester. Participants must have completed level 1 training.

IOWATER is a statewide volunteer water quality monitoring program. All workshops are open to any individual or group that is interested in water quality. When participants complete the workshop, they will be certified level 1 IOWATER Citizen Monitors. The workshop is based on 10 hours training over two days; exact times varying depending on location. Workshop registration fee is $25, and covers all program fees, meals, and testing equipment.

Volunteers learn to identify bottom-dwelling organisms (benthic macroinvertebrates), chemically test the water and evaluate the stream habitat, including taking stream measurements.

Level 2 workshops are eight-hour training sessions that include monitoring design, introduction to Quality Assurance Project Plans (QAPP), restoration techniques and data interpretation. Additional parameters include chloride and general coliform/E. Coli bacteria.

An IOWATER Citizen Monitor will be certified as level 2 trained when he or she completes a level 2 workshop training and at least one level 2 module.

Additional level 1 and 2 workshops, and advanced training modules are scheduled for elsewhere in the state. A list is available at the IOWATER Web site, http://www.iowater.net.

Workshop registration fee is $25 for Level 2 workshops and $10 for each of the modules. The fees cover all program fees, meals and testing equipment.

For more information, contact Rich Leopold, IOWATER, Iowa DNR, Wallace Office Bldg., 502 East 9th Street, Des Moines, IA 50319.

Brian Hayes, bioligist with Iowa Department of Natural Resources Fisheries, discussed fishing the Maquoketa River during the Riverfest program sessions.

Maquoketa River project updates

More than two dozen agencies and groups took official roles in the **Maquoketa River Alliance**'s Riverfest, held March 22 at the Berndes Center in Monticello. They had displays and their staff gave presentations related to conservation and water quality during the day-long event.

Riverfest was the Alliance's opportunity to let the public see the water quality effort currently underway in the watershed, according to Rick Lawrence, Alliance coordinator.

Presentations covered geology, tourism, watershed involvement, nutrient management, water quality monitoring in the watershed, and current efforts by individual water quality projects.

There was a wide variety of information available to the public from the U.S. Geologic Service, Iowa Department of Natural Resources, Iowa State University Extension, Soil and Water Conservation Districts, and county conservation boards as well as some citizen organizations.

Nitrate, cont.

recommended.

- Form/additives — ammonium nitrogen is bound to clay in soil so it does not leach, additives that prevent nitrification sometimes help.
- Vegetative buffers — reduce the transport of nutrients carried on sediment.
- Wetlands — have the potential to reduce NO_3-N transport by the process of denitrification.

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