# Water Watch

**A newsletter for the Maquoketa River Watershed**


## Project news

# Manure demonstrations include P and N treatments

*by Chad Ingels, manure and nutrient management specialist, Maquoketa Watershed Project*

Eight on-farm demonstrations hosted by Maquoketa River Watershed Project cooperators show that manure is a valuable resource that can reduce the need for commercial nitrogen (N) and phosphorus (P) applications.

The crop year 2000 demonstrations started soon after the 1999 crop harvest with the rate of manure application on each demonstration site determined with in-field calibration of the cooperating producers' usual manure application rate. Maquoketa Watershed Project staff secured a sample of manure for nutrient analysis when it was applied to the demonstration site. Soil sampling was completed at all sites to determine P and potassium soil test levels before manure application.

Five of the manure demonstration sites were planted to soybeans in 1999 and three were corn following corn. There were nine replicated treatments at each demonstration site. Fall application of P at the 150 bushel per acre corn crop removal rate (46 pounds of P per acre) was applied to three plots within each demonstration as was P at the manure P application rate (determined by the calibration rate and analysis of the applied manure). Another set of treatments was the crop removal plus manure P rate combined.

As a check, no manure or N was applied to three treatment areas in each demonstration. To compare commercial N to the N available in manure, 100 pounds of N was applied on replicated areas on soybean sites and 150 pounds of N on replicated areas on corn following corn. The replicated manure treatment areas were three treatments each of 0, 50 or 100 pounds of commercial nitrogen added to the manure and commercial N at the first-year crop available N rate applied in the manure resource.

Eight site average manure and N corn yield results are shown in figure 1. The highest yield was 50 pounds of commercial N in addition to the manure application, that averaged 172 pounds of first-year plant available N in the eight manure resources evaluated.


The manure management demonstration adjacent to Iowa Highway 3 west of Starmont Schools was one of the stops on the July headwaters watershed tour.

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IOWA STATE UNIVERSITY
University Extension

Issue No. 89, December 2000

## Manure demos, cont.

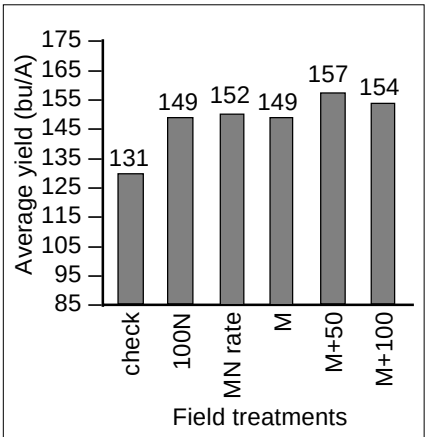


Figure 1. Average corn yields, eight sites of manure and N demonstrations, crop year 2000.

The addition of 100 pounds of N to manure often results in lower yields than the manure plus 50-pounds per acre treatment. Similar results were obtained from 24 manure N demonstrations conducted from 1994-1998 near Postville by Northeast Iowa Demonstration Project staff. This year, six of the eight sites had lower yields when 100 pounds of N was added to the manure, compared to the addition of 50 pounds of N.

Figure 2 provides profitability trend lines for manure and manure plus N, based on 20 cents per pound for N and corn valued at

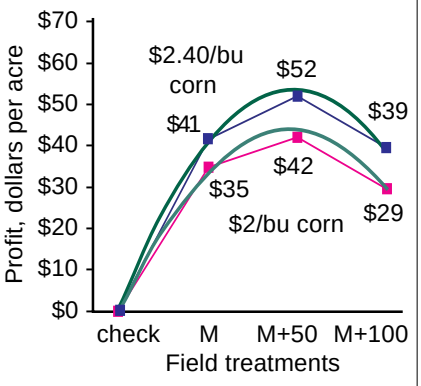


Figure 2. Profitability of manure and additional N (N at $0.20 per pound and corn at $2.40 and $2.00 a bushel).

$2.40 or $2 per bushel. Compared with the check (no manure or N) the dollar return to applied manure was $41 for $2.40 per bushel corn and $35 for $2 per bushel corn.

Residual nitrate-N in the eight-inch cornstalk segment six to fourteen inches above the soil following plant maturity is an indication of the adequacy of N available to the corn plant. Figure 3 indicates that the check treatment stalk nitrate level at 239 parts per million (ppm) nitrate-N was below 700 ppm, which is the lower end of the optimum range of 700 to 2,000 ppm.

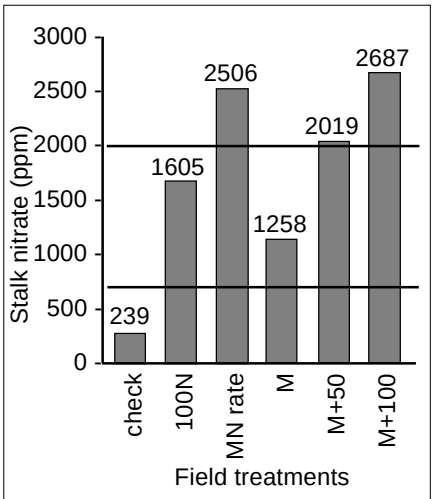


Figure 3. Average stalk nitrate, eight site manure demonstrations, crop year 2000.

Excess N was available with the commercial N applied at the manure N rate (172 pounds per acre) and the 50 or 100 pounds of N applied in addition to the manure. These results were predictable in June when the late spring nitrate test was used on the various N and manure treatments (figure 4).

All eight of the manure demonstration sites had P soil test levels in the high or very high range when sampled in October 1999. The yield response was not significantly different to commercial P or to manure P that

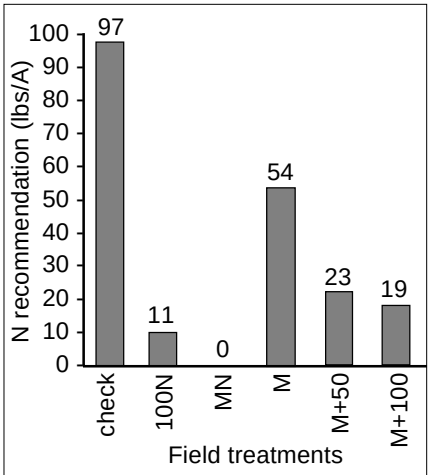


Figure 4. Eight site average of N recommendation from the late spring nitrate test, manure demonstrations, crop year 2000.

averaged 250 pounds per acre (figure 5). The loss in profitability due to commercial P application is nearly equal to the cost of the P applied.

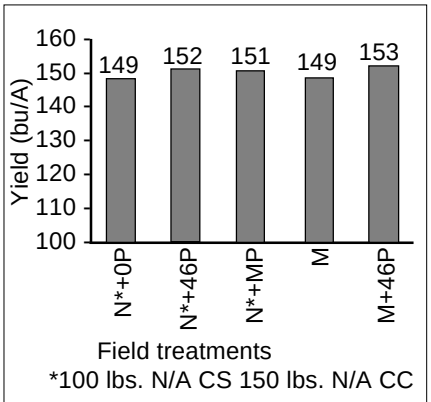


Figure 5. Eight site average corn yields, manure and P demonstrations, crop year 2000.

Maquoketa Watershed Project staff thanks manure management cooperators David Moorman, Verle Jones, David and Richard Venteicher, Rodney and Randy Hamlett, Darrell Rosburg, Northeast Iowa Community College, Marvin Heims and C&J Farms.

For more information on this and other field demonstrations conducted during crop year 2000, contact the Maquoketa Watershed Project staff in Fayette, telephone (319) 425-3233.

# Nutrient transport in the Maquoketa Headwaters watershed

*by James Baker, Department of Agricultural and Biosystems Engineering, Iowa State University**

Transport of nitrogen (N) and phosphorus (P) in various forms to water resources can cause water quality concerns relative to drinking water and aquatic life that has to live in those waters receiving agricultural drainage.

Of particular concern is the fate of nutrients applied as fertilizer and/or animal manures, and their potential transport with runoff water, eroded soil/sediment and leaching water.

An ongoing monitoring study of the Maquoketa Headwaters above Backbone Lake is providing watershed-scale information on nutrient fate and transport.

Stream flow in the Maquoketa Headwaters is made up of a base flow and/or tile drainage and surface runoff, depending on recent precipitation events.

During 1999, nitrate N ($NO_3$-N) dominated nutrient losses with 32.7 pounds per acre lost from the watershed; soluble total N loss, which includes $NO_3$-N, ammonium N ($NH_4$-N) and soluble organic N, was 34.3 pounds per acre. Also 1.2 pounds per acre N were lost with sediment delivered from the watershed.

Total P loss was 0.53 pound per acre; of that, 0.29 pound per acre was lost with the sediment loss.

Survey data taken in 1999 showed that N fertilizer application rates on continuous corn averaged 158 pounds per acre, while on corn following soybeans it averaged 129 pounds per acre. The amount of manure N generated was 671 tons; if there was a 50 percent loss in storage and handling and the N was only applied to the 16,200 acres of corn grown, that would increase N rates by 41 pounds per acre. $NO_3$-N and $NH_4$-N in precipitation add about 12 pounds per acre from 32 inches of annual precipitation.

Assuming crop removal equals N fixation for alfalfa and soybeans, and that corn removed 0.9 pounds of N for each bushel harvested, the net crop removal (over N fixation) is 1,152 tons. N loss in the Maquoketa Headwaters in 1999 was estimated at 697 tons. Although the partial mass balance shows the potential of a 200-ton increase (about 10 pounds per acre) in N in the watershed, the processes of denitrification and $NH_3$ volatilization during manure storage and handling would erase that increase.

Survey data showed that commercial P fertilizer applications are about equal to crop removal, with an additional 179 tons of manure P available to be land-applied; this would average 12 pounds per acre as P, or 27 pounds per acre $P_2O_5$ over the 30,100 acres of corn, soybeans and alfalfa. With a loss of 16 tons with stream flow, and no other major loss, it is estimated there would be an annual net increase of 108 tons, amounting to 5.4 pounds of P per acre.

Nitrogen losses are dominated by $NO_3$-N losses, with those mostly taking place as leaching through tile drainage. The average N concentration in the Maquoketa Headwaters in 1999 at 11.2 milligrams per liter (mg/L) was well above the 1.5 mg/L standard recently proposed by the U.S. Environmental Protection Agency (EPA) for flowing waters in this region. At 20 cents per pound of N, the 35 pounds per acre N loss for the watershed in 1999 represents $275,000 (or $7 an acre). If corn is to continue to be the dominant crop, fine-tuning the rate of N application, including giving credit for manure applied, is one of the first considerations in reducing N losses.

There is potential for a new N fertilizer application method to reduce $NO_3$-N leaching by disrupting macropores and compacting and doming the soil over the knifed-in fertilizer, to reduce the volume of water moving down through the fertilizer zone.

If improved in-field practices are not adequate to meet water quality goals, then to reduce field-to-stream transport of $NO_3$-N, an off-site practice of constructing or reconstructing wetlands may be necessary. Wetlands have considerable potential to remove $NO_3$-N from water through the process of denitrification.

P losses may be dominated by the soluble portion in surface runoff water if soil-test levels are high, or by the portion transported with sediment if soil losses are high. The average P concentration in solution in the Maquoketa Headwaters was 0.167 mg/L, and including P loss with sediment it was 0.259 mg/L. Both of these values are well above the 0.100 mg/L standard recently proposed by the US EPA for flowing waters in this region.

*(*This article was adapted from a paper presented by James Baker, Stewart Melvin and Marius Agua at the Integrated Crop Management conference, Nov. 29-30, 2000, at Iowa State University, Ames.)*

## Fall field days

Mineral Creek Project and Maquoketa Headwaters Watershed councils sponsored fall tillage field days at Onslow on Oct. 31 and Arlington on Nov.1, respectively. (Left) Pete Lawlor (back to camera), research associate with the Department of Agricultural and Biosystems Engineering, Iowa State University, explains research underway on nitrogen fertilizer management to reduce leaching of nitrate nitrogen, using the machine at left. The machine was shown at both field days.

## Maquoketa River projects update

**Mineral Creek Project** watershed council and staff met Nov. 9 to work on the budget and the current plan of work. A second meeting was scheduled for Nov. 30.

The **Lake Delhi Association** will seek Iowa Department of Natural Resources funds through the Delaware County sanitarian to assist with upgrading and maintaining septic systems. The Lake Delhi Water Quality Team is working on an information manual for landowners and homeowners covering septic systems, wells, household waste, shoreline erosion and other topics.

The **Maquoketa Alliance** has $50,000 for demonstration projects in the Maquoketa River watershed. The Alliance is seeking demonstrations of practices that aren't typically funded, such as wetlands.

***Water Watch*** is published bimonthly and funded, in part, by the USDA Extension Service contract 99-EWQI-1-0611, the Iowa Department of Natural Resources through a grant from the U.S. Environmental Protection Agency under the Federal Nonpoint Source Management Program (Section 319 of the Clean Water Act), and Iowa State University Extension. The newsletter is free to project participants and those interested in issues involving farming methods and their effects on groundwater quality. Subscribe by sending your address to ***Water Watch,*** Box 487, Fayette, IA 52142.
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