TEXAS

Research Tracks Nitrogen Dissipation Patterns in Rice Production

By Garry N. McCauley

Nitrogen is the primary fertilizer nutrient in rice and other crop production. Because it is highly mobile in most soils, it is easily leached and has the potential to reach and pollute groundwater if not properly managed. Further, excess nitrate-N (NO_3-N) in surface water can contribute to algal blooms and result in reduced oxygen for aquatic life. Nitrate-N is the N form that is of greatest concern because of its relationship to human health, particularly infants, unborn babies and the elderly. The U.S. Environmental Protection Agency (EPA) has set a safe drinking water standard of 10 parts per million (ppm) NO_3-N.

Historical data and recent studies have shown that movement of chemicals in groundwater is not a problem in Texas rice soils. These soils have clayey layers with high cation exchange capacities and hold charged chemicals, slowly releasing them back to the soil solution as needed. Nitrate-N moves downward very slowly in these soils. Its leaching into the groundwater is not considered a problem.

This study was designed to measure the environmental impact of N, P and K fertilization of rice under flood management.

Nitrogen (N) is the nutrient most often associated with water quality. Since most Texas rice production is concentrated in areas near the Gulf Coast, N in flood waters leaving rice fields can impact surrounding areas, including coastal waters. This study was established to evaluate the environmental impact of N, phosphorus (P) and potassium (K) fertilization of rice grown under flood management. Earlier articles (*Better Crops*, Vol. 79, No. 3, 1995 and Vol. 79, No. 4, 1995) dealt with P and K. This one discusses N.

Twenty producers in a four-county area (Colorado, Jackson, Matagorda and Wharton) were recruited by county Extension agents to participate in the study. Producers took a water sample at the inlet and outlet of each test field following each rain and flush irrigation. After flood establishment, inlet and outlet samples were taken when the flood reached the bottom of the field and at three day intervals until four samples were taken or at least 12 days after flood establishment.

The 20 producers took a total of 220 samples at 116 different times. There were 104 matched inlet and outlet samples, with 12 outlet samples being taken when no inlet water was available.

Figure 1 shows the concentration distribution of the 220 samples. Most of the samples ... 94 percent ... contained 2.0 ppm NO_3-N or less. Only two exceeded the drinking water limit of 10 ppm. These results support earlier research (1992-93) which showed that NO_3-N concentrations in flood water are low most of the time.

To allow for detailed interpretation, samples were broken into seven groups (**Table 1**).

Studying the seven groups reveals that A through E can only be interpreted

TABLE 1. Seven water sample groups used to determine potential effects of N fertilization.

A = No inlet—outlet non-detectable
B = Concentration declined to non-detectable
C = Concentration declined, still detectable
D = Inlet and outlet samples non-detectable
E = Detectable levels—no change
F = Concentration increased
G = No inlet sample—detectable level in outlet

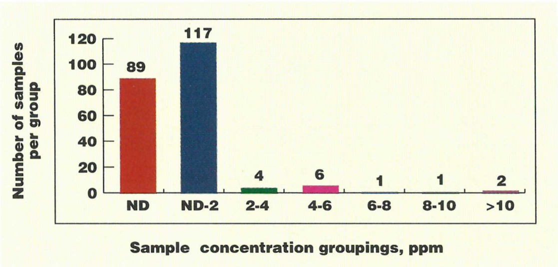

FIGURE 1. Concentration distribution of 220 NO_3-N rice field water quality samples. (ND=Non-detectable, <0.1 ppm)

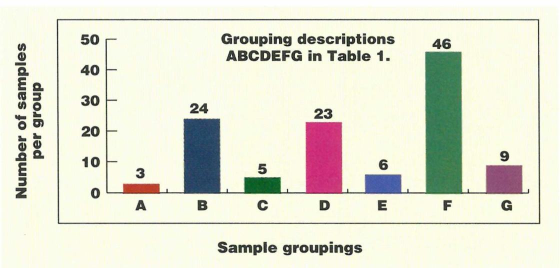

FIGURE 2. Distribution of inlet-outlet sample change in NO_3-N concentration for 116 rice field water samples.

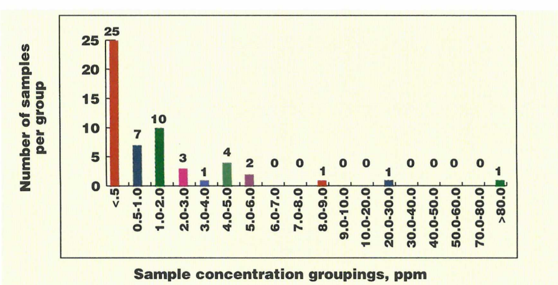

FIGURE 3. Distribution of NO_3-N concentration increases from inlet to outlet for 55 rice field water samples that increased. (ND=Non-detectable, <0.1 ppm)

to have a neutral or positive environmental impact. Group F would be a negative environmental factor, the magnitude depending on the amount of concentration increase. The impact of G group can not be determined because there was only one sample taken, but it is assumed to be negative (conservative interpretation).

Only three of the 55 samples in groups F and G should be of environmental concern (**Figure 2**). They were the ones of the 104 matched sample pairs that showed NO_3-N concentrations high enough to create a potential environmental problem, as shown in **Figure 3**. Nine of the 55 samples could not be evaluated, however, because there was not a matching inlet sample.

The above results support earlier research which showed that in only a small percentage of the cases would NO_3-N in a rice field cause problems if discharged into waterways. The key to water purification in a vegetative lagoon (such as a flooded rice field) is retention or flow time.

In summary, there are few instances where NO_3-N concentrations in rice field runoff may be high enough to be an environmental concern. In those individual cases where concentrations do pose a potential threat to water quality, they should be evaluated to determine how N management can be modified to eliminate the problem. BC

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