PUT N AND P IN THE CROP, NOT THE WATER

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Nutrient management is quintessential for U.S. grain producers to maintain a competitive advantage in the world market place and at the same time a quality environment. Over the last 19 years, average annual Illinois corn prices have varied considerably, averaging $2.44 per bushel. Unfortunately, prices the last 3 years have been tending down (Fig.1) and based on the world grain supply, there is little hope that they will improve in the near future. The price paid for ammonia by U.S. farmers has also tended down over the last 3 years, but there are strong indications that it will make a dramatic upturn in the spring of 2001. The data given in figure 1 for the crop year 2001 are not forecasts, but they could be reality. If so, nitrogen management will be even more crucial than it has been in the past.

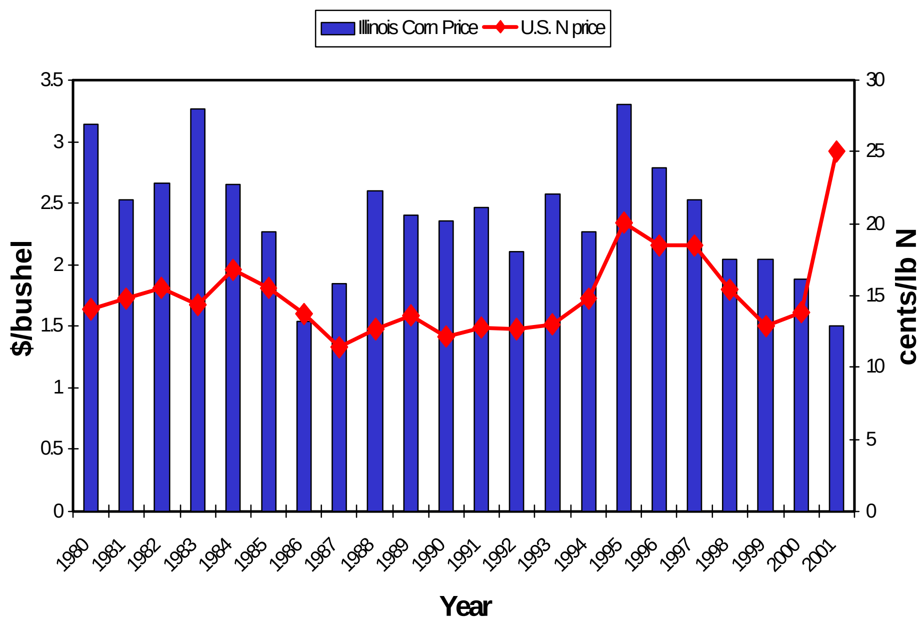

Fig. 1. Historical U.S. retail prices for anhydrous ammonia and the price farmers received for corn in Illinois.

At the same time as economics are becoming tighter, pressure to improve nutrient management because of environment concerns are being stepped up by regulatory agencies. This past year the Mississippi River/Gulf of Mexico Watershed Nutrient Task Force reaffirmed the commitment to reduce N loss to the Mississippi River by 30%, with some suggesting that most of the gain will come from reduction in fertilizer use. While this is an amiable goal, the relationship between fertilizer sales and the size of the hypoxia zone is not strong (Fig. 2).

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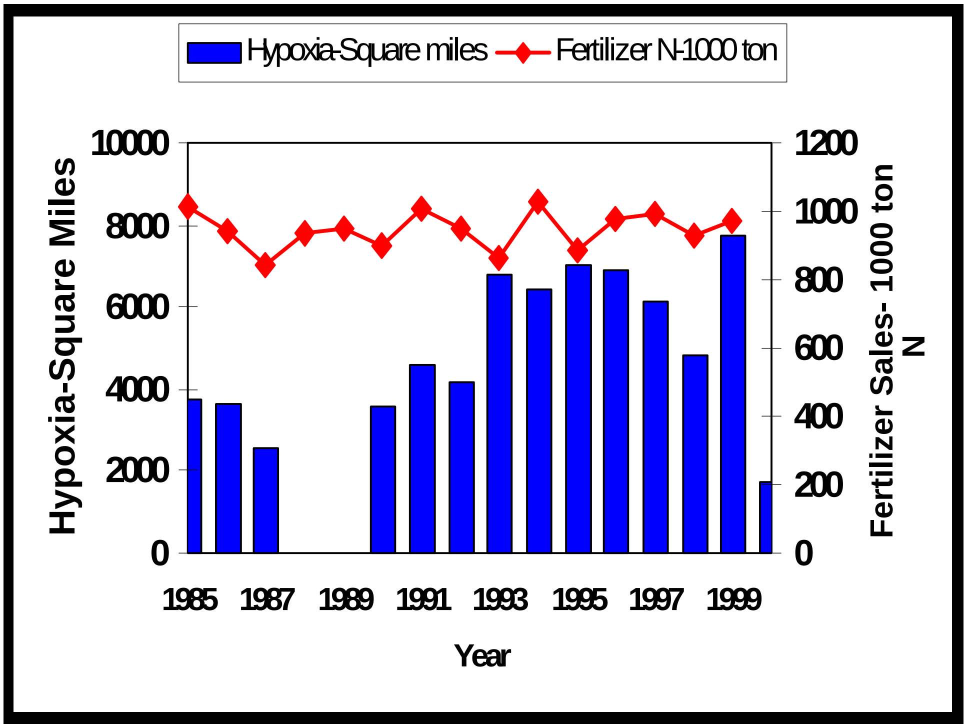

Fig. 2. Size of the hypoxia zone and Illinois nitrogen fertilizer sales. Hypoxia data provided by N.N. Rabalais, R.E. Turner, and W.J. Wiseman, Jr.

EPA, under provisions of the Clean Water Act (section 303d) has required states to submit lists of water bodies that do not meet water quality standards. These lists must be based on TMDL's (total maximum daily load), which is a calculation of the maximum amount of a pollutant that a water body can receive and still meet water quality standards. Illinois listed 738 water bodies with a total of 2,863 impairments. The 2 most frequently listed impairments were nutrients (634) and siltation (563). By comparison, Wisconsin listed 551 water bodies with 942 impairments. Siltation was the third most frequently listed factor (129 incidents) with nutrients being the fifth most frequently listed (48 incidents). In most states, the implication of these activities has not been realized, but it is likely that this will lead to further restrictions on nutrient use.

Do these regulatory activities and tight economics mean that nutrient use will be dramatically curtailed in the future? Not likely, but they do mean that we must use the best management practices that have been identified through research and practical experience.

Nitrogen Best Management Practices:

1. **Use the proper rate:** Most agronomists recognize that rate of application is one, if not the most important factor affecting N loss to the environment. Unfortunately, there is no system that will accurately predict the optimum rate for each field each year. Lack of an accurate prediction system is due in large part to climatic variability, which affects the optimum rate for any given year (Fig. 3).

Years of low N need are often associated with poor growing conditions in that year or the year(s) before. In the example given in Fig. 3, 2 years (1985 and 90) had identical yields, but the amount of N needed to attain it was 50 pounds higher in 85 than 90. The 85 yields followed a good yield in 84, but the 90 yields followed 2 years of low yield. It is surmised that the residual N remaining in the field for the 90 crop year was adequate to give the same high yield as in 84, with much less N. In some fields, especially those that have a history of manure application, use of the nitrate test will help predict where lower N might be needed. Unfortunately, it does not always work. A new test is being developed at the University of Illinois that appears to predict those fields that will not respond to applied N (Fig. 4) and we are hoping that it will assist in identifying fields that need less than the recommended rate of application. Until such new tests are developed, economic analysis of the data indicates that use of the current recommendation system will provide a higher rate of return than using the N rate that is needed to maximize yield in the best of growing years. Fortunately, recently collected data indicates that use of the recommended rate will minimize the potential for N loss through tile lines as compared to those fields that have a history of excessive use over time (Fig. 5).

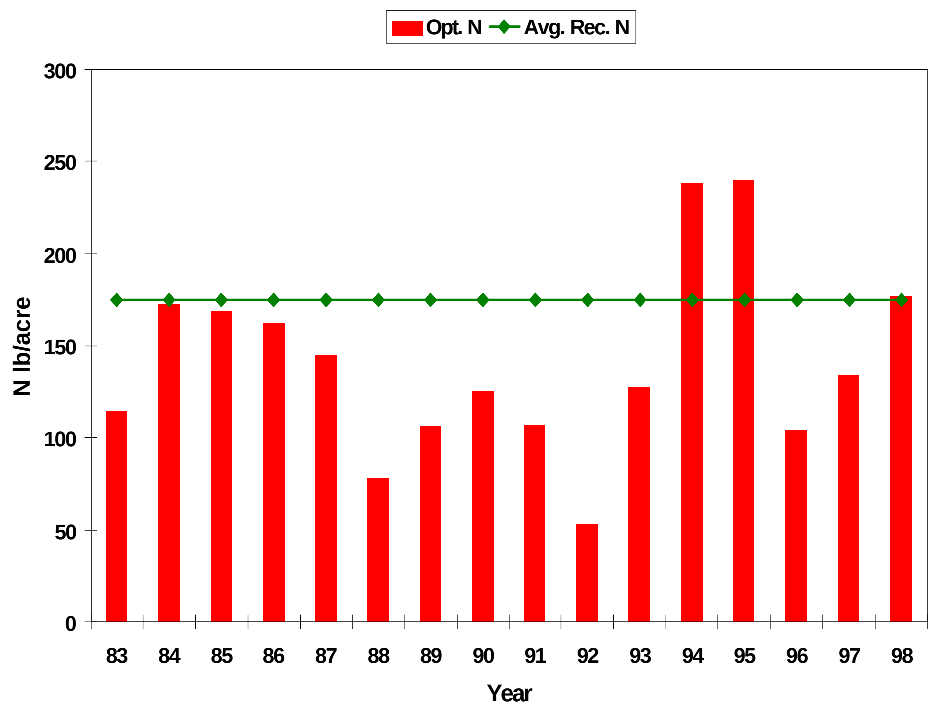

Fig. 3 Variation in optimum nitrogen need over time from a single location

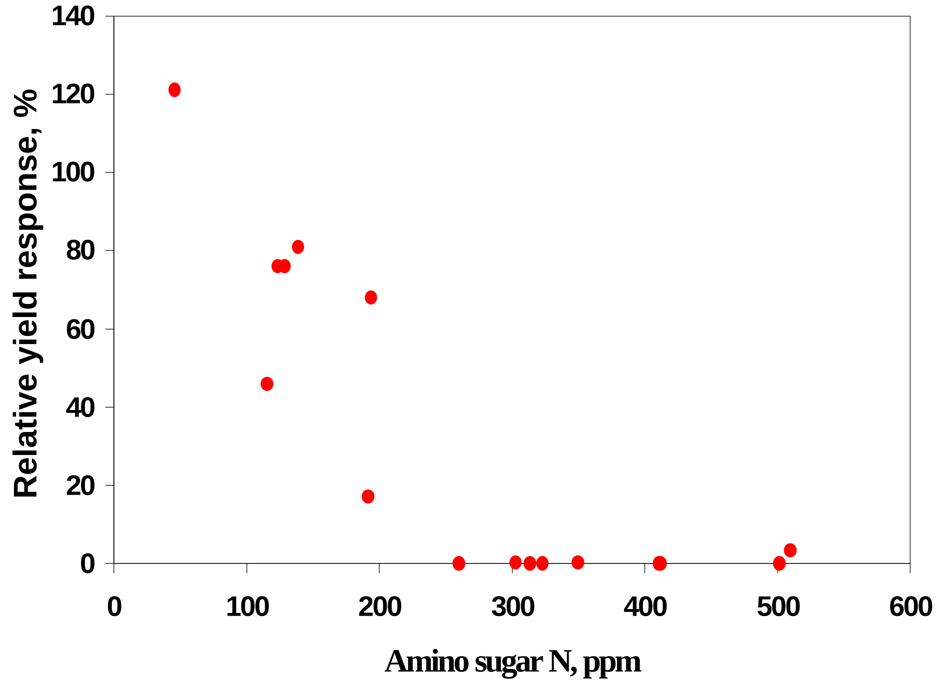

Fig. 4. Relationship between amino sugar N and relative yield

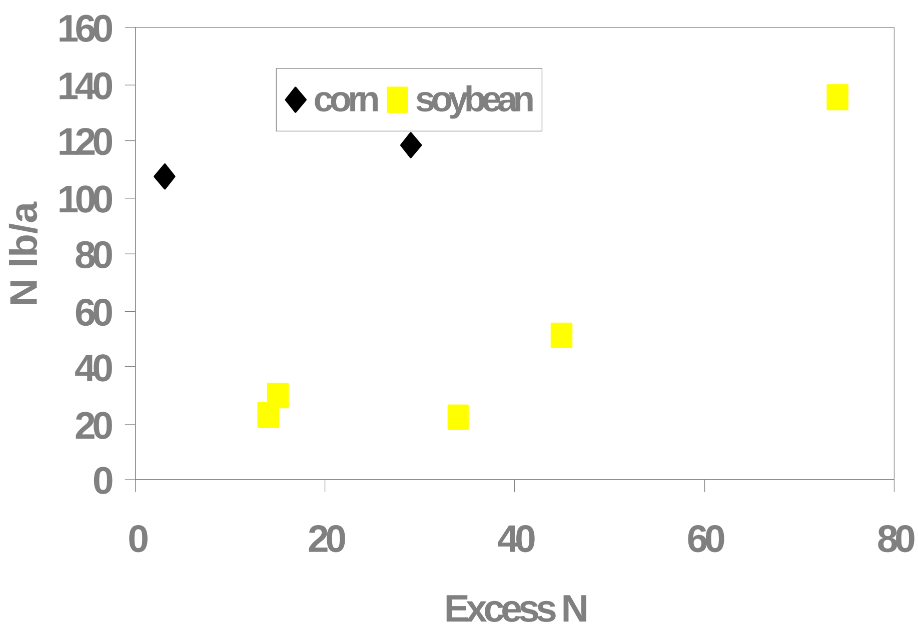

Fig. 5. Effect of excess N application (N rate above recommendation) on N loss in tile lines.

2. **Take credit for home-grown nitrogen:** Research has shown that corn after corn needs more N than corn after a legume. The suggested "credit" for soybean

is 40 lb. N/acre. More recent data suggests that this is a conservative figure and may be closer to 50 lb. N/acre. If manure or sludge has been applied, obtain an accurate measure of the amount of N applied and reduce the rate accordingly.

3. **Take credit for "incidental" nitrogen:** Nitrogen is often applied as a part of another fertilizer treatment or as a part of another farming operation. For example, phosphorus is often applied as an ammoniated phosphate (nitrogen containing material), starter fertilizers almost always contain nitrogen, and many use UAN solutions to apply herbicides. The nitrogen in all of these materials needs to be credited toward the total N need for the crop.
4. **Apply nitrogen at the proper time for your soil type:** The closer the time N is applied to the time N is needed by the crop, the lower the potential for N loss. This is not to say that earlier applications should never be used as there is data to suggest that the difference due to time of application is minimal if done properly, at least as compared to rate of application (Fig. 5). Delaying fall applications until soil temperatures are cool enough will reduce the rate of conversion of ammonium to nitrate (Fig. 6).

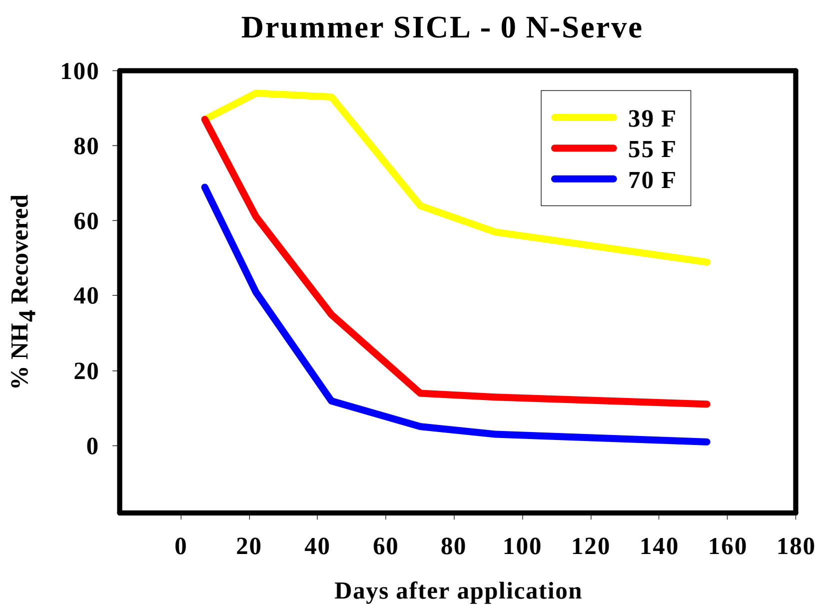

Fig. 6. Relationship between soil temperature and rate of ammonium disappearance (conversion to nitrate).

5. **Use nitrification inhibitors to reduce the rate of conversion of ammonium to nitrate:** Minnesota results have shown that use of a nitrification inhibitor with fall-applied nitrogen will reduce the amount of nitrogen lost in tile lines. Wisconsin and Illinois research has also shown that inhibitors reduce the potential for N loss.

Phosphorus Best Management Practices

1. **Do not maintain soil test P levels above that necessary for optimum crop production.** Soluble phosphorus concentration in runoff is related to soil test level, increasing rapidly with an increase in soil test level above 100 ppm P (Fig. 7). Soluble P loss is greater with no-till than conventional till, but total P loss is greater on conventional than no-till.

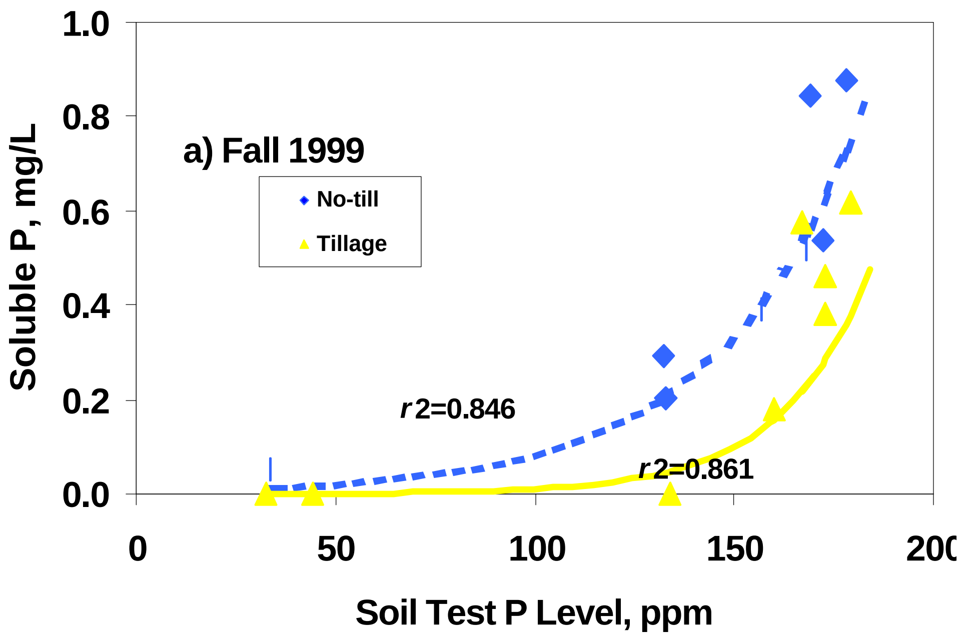

Fig. 7. Effect of soil test P and tillage on soluble phosphorus runoff.

2. **Incorporate or inject manure and fertilizer whenever possible.** Surface applied manure will result in soluble P losses 5 to 20 times greater than observed with injected manure (Fig. 8). When applied at equivalent rates, soluble P loss is greater from manure than from fertilizer.

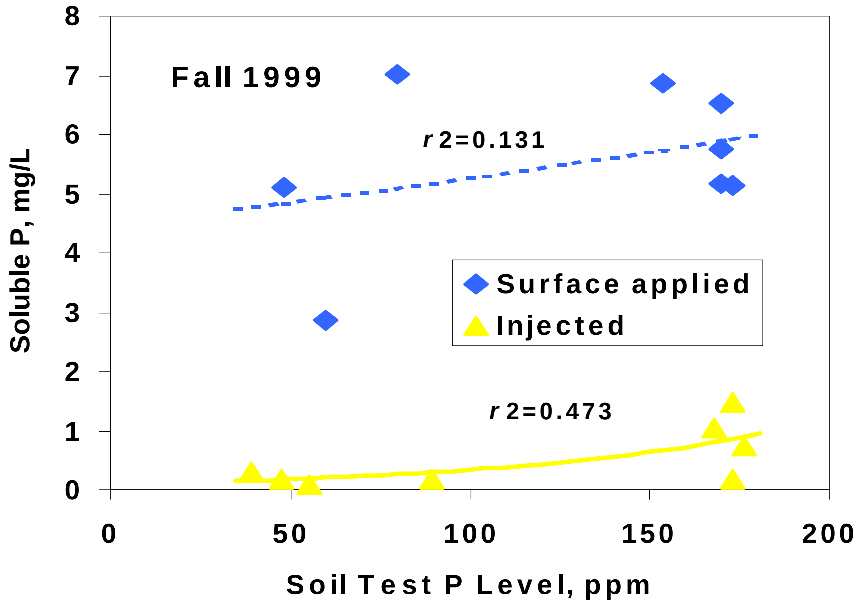

Fig. 8. Soluble P runoff as affected by method of manure application

Summary

The presence of nitrates and phosphorus in surface waters occurred prior to the influence or man. However, it appears that improper use of fertilizers has enhanced the concentrations of both of these elements in surface waters. Through proper management, farmers can minimize the potential for contamination. Following University recommendations will almost always maximize yield and minimize the potential for nutrient loss to the environment.

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