by Dr. D.H. Sander

Less Than Optimum N Rates?

Perhaps. Nebraska researcher warns that reducing N rate much below optimum would produce unacceptable yield and income losses for producer and drive up food prices.

Summary: *Our studies often irrigated corn experiments in three Nebraska counties between 1988 and 1990 showed an optimum N rate of 150 lbs/A producing an average yield increase of 49 bu/A. The response is quite typical of Nebraska soils growing continuous irrigated corn. A primary focus in our study was increasing N-use efficiency and fine-tuning those practices that best protect the environment. From our studies, it would appear N-use efficiency is not significantly helped unless N rates are greatly reduced, which, from a profitability standpoint, would be unacceptable to producers. Applying N at 80 per-cent of optimum, however, would appear to be a workable tradeoff between acceptable producer profits and protection of the environment.*

With an increasing recognition by agriculturists for the need to implement practices that protect the environment, researchers have been trying to fine tune the various aspects of increasing N-use efficiency in fertilizers. If crop uptake of N can be increased, there obviously will be less available N left in the soil after harvest. It is important to remember that while growers have limited control over available and potentially available N in the soil, they have complete control over additions of N fertilizer.

Optimum rate

Figure 1 shows yield response of irrigated corn to N in Hamilton, Merrick, Boone, and Saunders counties from 1988 to 1990. Residual nitrate averaged 72 lbs/A of NO3-N to a depth of five feet, which was adequate for a check yield of 110 bu/A. Applying N in-creased yields 49 bu/A at the optimum rate of 150 lbs/A. Profit at *$2.50* per bushel corn less $0.15 per pound N equaled $100/A. This profit is some-what misleading because it requires a much larger investment in land and equipment to realize this return and does not include application cost. However, it does point out the inexpensiveness of N fertilizer and why it might be tempting to use more than optimum rates.

Declining effect

The response curve in Figure 1 shows a declining effect in the 20-lb/A increments of N applied. Corn yield response drops from 10.7 bu/A for the first 20 lbs/A of N applied to only 1.4 bu/A for the 20-lb/A increment from 140 to 160 lbs/A of N. Looking at it another way, it required an average of only 1.87 lbs/A of N to produce a bushel of corn for the first 20-lb/A increment, compared to 14.3 lbs/A of N to produce a bushel in the 140- to 160-lb/A range. At the optimum N rate of 150 lbs/A (rate for maximum profitability), it required 16.9 lbs/A of N for each bushel of corn.

Since each bushel of corn contains about 0.9 lbs of N, it is apparent that when we fertilize to achieve optimum yield we are applying N at a ratio of 10 to 1 or more in relation to grain N removal. Fortunately, these high requirements of N per bushel are near the top of the response curve. Cutting back N to 80 percent of optimum (120 lbs/A) would decrease yield by only 2.7 bu/A at a loss to the producer of $2.25/A (Table 1). This would seem a small price to pay. Nevertheless, most producer profits occur near the top of the response curve where N efficiency is low.

Increase grain prices?

Certainly this is what would occur if regulations to limit N became too stringent. Figure 2 shows that grain N fertilizer efficiency can be increased

Table 1. Effect on yield of reducing N rate from optimum (150 lbs/A of N) in irrigated corn study, Nebraska, 1998-90.

Optimum %	N lbs/A	Yield bu/A	Yield lost bu/A
100	150	158.6	-
80	120	155.9	2.7
60	90	148.2	10.4
40	60	138.5	20.1

from 29 to 43 percent by reducing N rate from 100 percent of optimum to 40 percent. However, in reducing N rate to 40 per-cent of optimum, grain yield would be reduced from 159 to 139 bu/A or a 20-bu/A yield loss (Table 1). This would be unacceptable to a producer from a profitability standpoint, even though N rate could be reduced from 150 to 60 lbs/A. Thus, if regulations forced such an event, producers would obviously have to raise their grain prices to maintain profitability. This would ultimately be felt at the dinner table.

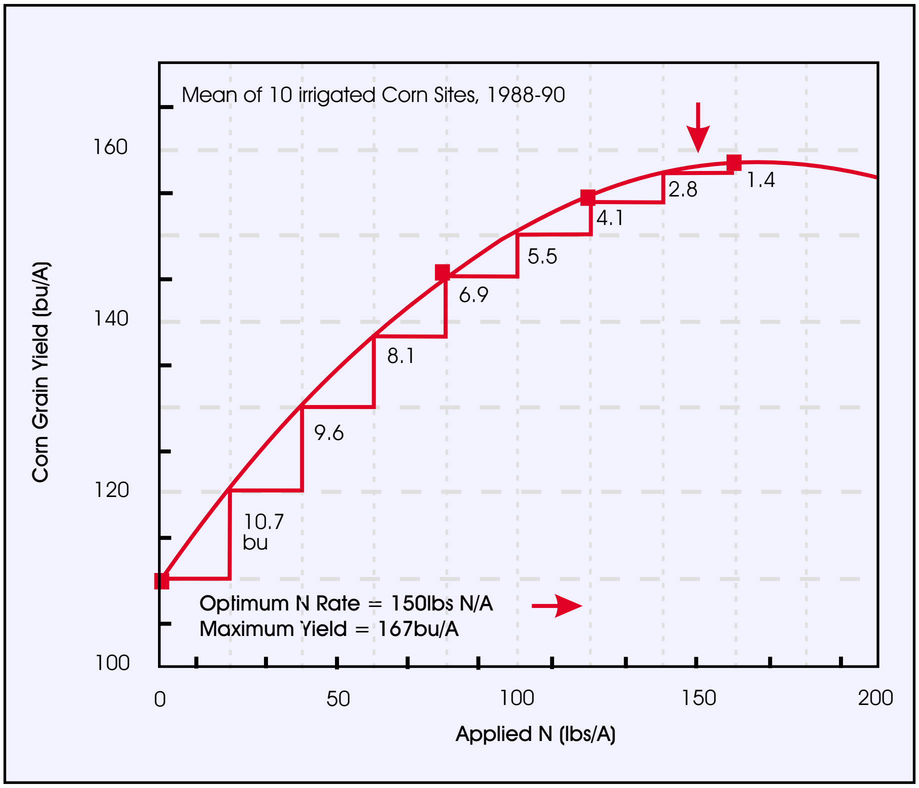

Table 1. Effect on applied N on irrigated corn yield across ten locations in Nebraska, 1988-90.

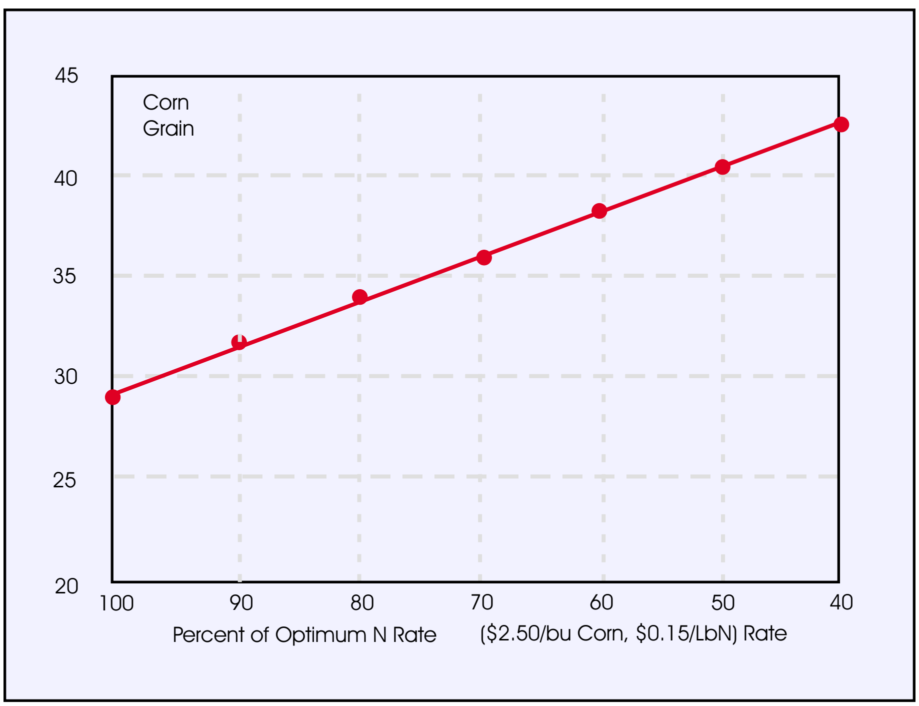

Table 2. Corn grain N-use efficiency of applied N, based on 0.9 lbs of N per bushel from ten irrigated experiments in Nebraska, 1988-90.

The more desirable alternative to head this off is to fine-tune all the tools we have available for increasing N-use efficiency. Improving prediction of N needs, which includes mineralization, is a good place to begin. Better synchronization of applications to the times of plant need, where grain yield is maximized in relation to N uptake, is another area needing work. Frequent N application keeps N in the surface of the soil where water and nitrogen are being used.

New plant sensing techniques and soil nitrate-N monitoring will probably lead the way to improved N-use efficiency in the future.

Shallow depth

Nitrogen uptake is associated with water uptake. Under the irrigation used in this study, which maintained optimum moisture in the top one to two feet of soil, N efficiency of nitrates found below two feet appeared to be quite low.

At the optimum N rate, the crop in the studies had 150 lbs/A of N fertilizer, 72 lbs/A of soil N, and 75 to 100 lbs/A of mineralizable N available at the beginning of each year.

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