



Nitrogen Efficiency in Corn Production: It's Better than it Used to Be

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In recent years, especially in 2005, many Minnesota corn producers were surprised by the fact that high yields were achieved by use of rates of fertilizer nitrogen (N) that did match the high yields. The efficiency of use of fertilizer N certainly was not 1.25 lbs. of N per bushel of corn. This is the efficiency factor that had been routinely used throughout most of the Corn Belt for many years. In 2003, 2004, and 2005, many producers found that the efficiency of fertilizer N use was in the range of 0.6 to 0.7 lb. N per bu. of corn.

Was this grower experience real or was it something that just happened in those three years? The results of nitrogen rate trials conducted at both Research and Outreach Centers and in producer fields can provide part of the answer to this question. Looking at data from sites in Minnesota used as the basis for the new fertilizer N guidelines, it's possible to calculate efficiency of use of fertilizer N. The results of this calculation are summarized in the following table. Results from the corn-corn rotation are separated from the corn-soybean crop sequence. Efficiency for soils formed from two common parent materials are listed.

It's also interesting to examine the percentage of the economic optimum yield that is produced without the application of fertilizer N. These percentages lead to the conclusion that Minnesota soils can supply a substantial amount of N for economic corn production. This amount, however, is not constant. It varies with soils and microclimate in the soil. Those percentages calculated from data used in developing the fertilizer N guidelines are also summarized in the following table.

Use of nitrogen fertilizer (efficiency) in a corn-corn and soybean-corn rotation for soils formed from two common parent materials in Minnesota.

Parent Material	N efficiency		% of economic optimum yield without fertilizer N	
	corn/corn	soybean/corn	corn/corn	soybean/corn
	lb. N /bu. corn		- - - % - - -	
loess	0.87	0.47	56	81
glacial till	0.90	0.69	58	73

Except for the situation where corn follows soybeans on loess soils, the data shown in the above table were collected from numerous sites. The data base is solid.

These data show that in recent times, corn has been much more efficient in the use of fertilizer N. The efficiency was much better than 1.25 lb. N per bu. of corn. This improved efficiency did not occur in a short period of time. Changes have been taking place gradually over a number of years.

When corn followed corn, parent material had no substantial effect on efficiency of use of fertilizer N. At this time, there is no easy explanation for the difference when corn followed a soybean crop.

If the improved efficiency is a reality it's only normal to ask "why?" There is probably no single factor responsible for this improvement. Instead, the improved efficiency is probably the result of a combination of factors.

Comparing **hybrids** used today to those planted 10 to 20 years ago, there's no doubt that the modern hybrids are better. They undoubtedly have better, more extensive root systems because they are better at tolerating a drought. The more extensive root systems should, in turn, lead to improved nutrient uptake.

Today, **weed control** is not the problem in corn production that it was 10 to 20 years ago. Weeds compete with corn for both nutrients and water. With fewer weeds for competition, more nitrogen in the soil system is available for corn and efficiency of use of fertilizer N has improved.

With the widespread use of **Bt corn**, the negative impact of the corn borer on production has diminished substantially. Reduced damage to stalk and ear can only have a positive impact on uptake of both nutrients and water. Therefore, the efficiency of use of fertilizer N is improved substantially as the damage caused by this pest is reduced.

Add a reduction in rootworm damage to the list of positive changes. With reduced rootworm pressure, there is a larger, more effective root system resulting in improved uptake of fertilizer N and efficiency of use of fertilizer N is improved.

Improved efficiency in the use of fertilizer N is a good thing. With improved efficiencies, lower rates of N are needed to achieve optimum yield. These improved efficiencies are reflected in the new guidelines for N fertilizer use for corn production in Minnesota.

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