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## Optimizing Nitrogen Fertilizer Applications

Crop prices are high but fertilizer prices are rocketing even higher. Farmers are looking for ways to lower their fertilizer bill, especially on nitrogen (N). Almost all N is processed by soil microbes before being plant absorbed. About 85% of N is used to form about 20 amino acids which are converted to proteins and enzymes with about 10% of N used in plant genetics (DNA, RNA). Optimizing N fertilizer is critical.

University recommendations on N has changed over the years. University N research in the 1950's advocated heavy N fertilizer because yield increased as N application increased?? N was relatively cheap and no researcher wanted farmers to lose yield as extra N was a cheap fertilizer insurance policy. That caused a few issues with water quality, so universities adjusted their N rates over the years.

About 10 years ago, universities re-examined that original data and found little direct relationship between higher corn yields and higher N rates. The relationship between N fertilizer and corn yields was quite variable. Factors like temperature, moisture (weather), soil pH, soil oxygen levels, and soil organic matter (SOM) affected plant N uptake. The N relationship to yield is so variable that universities went to a N application rate based on the price of N. As N prices increase, economically it's better to cut back while if N is cheap, the N rate is increased to increase net profit. The real question is how can a farmer optimize crop yield based on N while still making a profit.

Corn uses large quantities of N to grow and produce a corn yield. About 1 pound (#) of N is removed for each bushel of corn produced. A 250-bushel corn crop requires about 250# actual N. When N was cheap, farmers applied 1.2# N per bushel grown. A more reasonable goal is 1# N per bushel but some farmers with good soil health are now applying .5 to .7#N per corn bushel produced and still getting good yields. Some of the extra N comes from cover crops, manure, compost, or higher microbial activity. Here are some ways to look at reducing your N fertilizer bill without sacrificing yield.

SOM is a big factor. Every 1% SOM holds roughly 1000#N with about 1-3% of that N mineralizing or coming microbially available each year. A typical tilled soil with 2% SOM and 1% mineralization releases 20# N per year. Healthy soils with higher SOM and higher microbial

activity release more N. Compare a 4% SOM, 2% mineralization rate, and 80#N released compared to a 6% SOM, 2.5% rate and 150#N. Keeping soils healthy pays dividends when fertilizer prices soar. Virgin soils that have not been disturbed, produce high yields with little or no fertilizer needed until SOM and soil structure are destroyed, or N is lost to denitrification (saturated soils), or leached away. Free living bacteria in healthy soils may produce 20-100# of free N, but these microbes are highly sensitive to soil disturbance and the five factors mentioned above.

One way to increase your N use efficiency is to apply N as close to when the plant needs it as possible. Even with N inhibitors, putting N on in the fall should be avoided. From the seedling stage to V5 (five leaf stage), corn uses about 10% of its total N requirement. The corn plant determines ear size, number of corn rows, and row length at this stage, so adequate N is critical. From V6-V18 (6-18 leaf stage), corn can take up 8# N and grow 4 inches per day. About 65% of a corn plant's N needs occurs by V18. From silking to maturity, a corn plant needs about 35% of its total N needs. Farmers get their biggest corn yield increases from the first 75-100# N fertilizer applied.

Due to time constraints, many farmers side dress N immediately after planting. To get the best N efficiency, apply N when the corn is taller but before it gets knocked down by the drawbar. With Y drops and highboy applicators, farmers can apply N much later and closer to the corn plant stalk and roots. In no-till situations, avoid applying N to the surface residue to avoid N tie up. Farmers can use the pre-side dress nitrogen (PSNT) test when N is applied to adjust N rates. If soil conditions are cold and excessively wet, avoid taking this test. The best and most accurate time to test is right when N is being applied. Producing corn at a profit due to high N fertilizer prices will be a challenge this year.