AgriLIFE EXTENSION
Texas A&M System

Dr. Brent Bean
Agronomist, Texas AgriLife Extension Service
6500 Amarillo Blvd W, Amarillo, TX 79106
Email: b-bean@tamu.edu Ph: 806-677-5600
Website: http://amarillo.tamu.edu/programs/agronomy

Panhandle Ag Extra

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Getting the Most out of Your Nitrogen Fertilization in Corn

With high nitrogen (N) prices, it is essential that producers get the most out of every pound (lb) of N applied. The return per lb of N will only be as good as the overall efficiency of the production system. Sound cultural practices such as uniform plant spacing and establishment, controlling weeds, insects, and diseases, hybrid selection and matching yield goal with irrigation capacity are all essential components of efficient N utilization. Setting a realistic yield goal and then applying only the amount of N needed to meet that goal is imperative. Setting too high a yield goal can lead to over-application of N, which is undesirable, both for economic and environmental reasons. With the current high corn prices, it may be tempting to set a yield goal that is simply not probable given normal environmental restraints. Keep in mind that 2007 weather conditions were the exception rather than the rule.

Soil Sampling

Deciding how much N should be applied as fertilizer must begin with a good soil sample and an analysis conducted by a reputable soil testing laboratory. While sampling and testing for most nutrients can be done anytime after harvest, measurements of how much N is available in the soil at planting are most accurate if the sample is taken relatively close to the planting date. This is because N levels in the soil can change substantially over time due to leaching or volatilization. If part of the N will be applied after planting as a sidedress or by fertigation, consider collecting an additional early in-season soil sample, preferably before the corn is 12 inches tall, to determine supplemental fertilizer N needs.

Sampling Procedure

Sampling is generally achieved with a hand soil sampling probe. These can be purchased online from a number of sources. Costs range from $25 to $150, depending on the type of probe, but good quality probes generally can be purchased for less than $100.

A small shovel can also be used. With a shovel, dig a V-shaped hole to the depth that you want to sample (usually 6 inches), take a 1-inch slice from the smooth side of the hole, and then take a 1 x 1 x 6 inch core from the middle of the slice and place it in a clean plastic bucket.

The soil analysis will only be as good as the soil sample collected. So, it is important that the soil sample be as representative of the field as possible. This means the more soil samples collected the better. It is particularly important that separate soil samples be collected from those areas of the field with known soil differences or a history of production and/or management differences.

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Sampling Procedure continued

In each area that is identified, collect 10 to 15 subsamples, place these in a clean plastic bucket to form a composite sample, mix this sample, and then take a subsample from the bucket and place it in a soil sample bag. Bags can be obtained from any of the soil labs. If an early in-season sample is collected following a banded N application made prior to sampling, it is a good idea to collect the subsamples at pre-determined positions relative to the corn rows. This prevents biasing the results based on the location of the N band. One way of accomplishing this task is to collect consecutive subsamples in a pre-determined pattern relative to the corn row. For example, subsample 1 should be collected in the corn row, subsample 2, five inches from the corn row, and subsample 3, ten inches from the corn row. Continue this pattern until subsamples have been collected every five inches between two corn rows.

Sample Handling Prior to Analysis

If soil samples are wet and cannot be delivered to the soils lab within two days, the samples should be refrigerated or air dried. Do not allow soil samples to be exposed to temperatures above 75°F for any significant period of time. Be sure that all samples are properly labeled and soil forms are clearly filled out expressing the desired soil analysis.

Depth of Sampling

Historically, soil samples for fertilizer recommendations have been collected from a depth of 6 inches, although some labs request an 8-inch sample. This "surface" sample is important for measuring nitrogen, but also to test for other less mobile nutrients (phosphorus, potassium and micronutrients). However, because it is so soluble, plant available N can be deeper in the soil profile. To account for this N, it is strongly encouraged that deeper soil samples be collected. Samples from several depths (0-6 inches, 6-12 inches, 12-18 inches) can be collected and tested from a field to better estimate residual soil N. In some states, deep soil testing for N is routine.

The condition of the soil will largely determine the ease with which deeper soil samples can be collected with a hand probe. Usually, both 0 to 6 and 6 to 12 inch samples can be collected easily. When possible, a 12 to 18 inch or even a 12 to 24 inch sample is desirable. Any N found at a depth of 0 to 24 inches can be subtracted directly from the amount of N normally applied as fertilizer. Better Harvest, Inc. a consulting firm out of Dumas, routinely collects soil samples to depths of 0 to 10 inches and 10 to 20 inches. In the 10 to 20 inch soil samples, collected prior to planting from 86 corn fields in 2007, an average of 28 lbs of nitrate N was found. At a cost of $675 ton/ anhydrous and $415/ton UAN (32-0-0), this is a potential savings of $11.65 and $18.14 per acre, respectively, depending on N source. Regardless of how deep the soil sample is collected, be sure to record the sampling depth on the soil sampling form so that the soils lab, your consultant, or you can calculate the amount of residual N in the field from the sample.

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Interpreting the Soil Analysis

A soil sample analysis will report nutrients, including N, in parts per million (ppm). The ppm value is then converted to lb of nutrient per acre. In the case of N, this is usually reported as ppm nitrate-N. The conversion formula from ppm N to lbs of N per acre is dependent on the bulk density of the soil. In general, one acre of soil at a depth of 1 ft (acre-ft) is considered to weigh approximately 4 million lbs. Some labs will assume a different bulk density which in turn results in a slightly different weight for the soil. This is why the same ppm value reported by two labs may give slightly different lbs of N per acre. If one assumes an acre-ft of soil weighs 4 million lbs, the conversion factors for different soil sampling depths are as follows:

Sampling Depth (inches)	ppm	Multiply ppm by	lb/acre
6	15	2	30
8	15	2.66	40
10	15	3.33	50
12	15	4	60

Nitrogen Application

Once residual soil N has been determined, a fertilization strategy can be developed. All of the N needed to reach the yield goal can be applied in a single preplant application, or in a combination of preplant plus multiple applications throughout the growing season. Multiple N applications generally result in more efficient N use. When N is applied in a single preplant application the following can reduce its effectiveness:

1. Denitrification – Nitrate is converted to a gaseous form of N. Occurs when oxygen levels in the soil are low due to compaction or waterlogging.

2. Immobilization or tied-up – Occurs when large amounts of plant residue are present.

3. Leaching below the root zone – Mostly a problem in sandy soils or when a abundance of rainfall or irrigation occurs after N has been applied.

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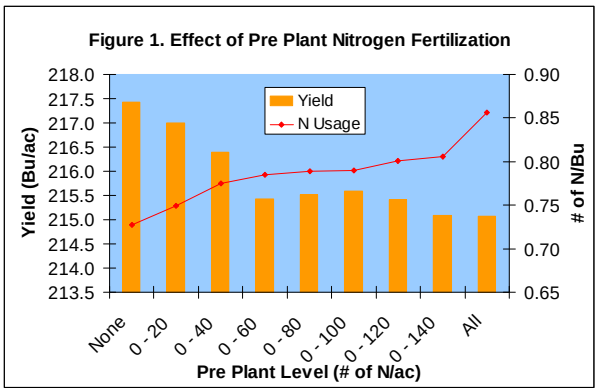
Nitrogen Application Continued

In fields tested by Better Harvest, Inc. from 1998 to 2006, the best yield and N use efficiency were achieved in those fields where no N was applied prior to plant emergence (Figure 1) (with the exception of N as starter or as a herbicide carrier). Although there was not a direct comparison of N application timing in the same field, these data do support the argument for applying the majority of the N fertilizer in-season. Preplant N application is probably most appropriate in no-till or minimum tillage systems where heavy residue is present, or when N residual is especially low. Application of N to the crop residue should help speed up the degradation of the residue. If a preplant herbicide application is needed, 20 to 30 lbs of N could be applied with the herbicide treatment. In general, it is best to limit the amount of N applied preplant to no more than a third of the total N needed to meet the yield goal. If soil test analysis indicates sufficient N in the top six inches of the soil profile, even less N should be applied preplant.



Using Anhydrous Ammonia

Currently anhydrous ammonia (NH_3) is significantly less expensive that other forms of N. Since it is generally much easier to apply NH_3 preplant compared to in-season, more N will likely be applied preplant this year. In strip-till corn, often the NH_3 is placed 6 to 8 inches below the anticipated seed placement. Care should be taken to prevent significant NH_3 from being present too close to the seed at planting. When NH_3 is applied to cool, dry soil the nitrification process that converts the NH3 to nitrate is slowed. The NH_3 also tends to move further away from the injection point in dry soil. To prevent injury to germinating or seedling corn, NH3 should be applied at least 2 weeks and preferably 4 weeks prior to planting. It is best to not apply more than 100 lb N/acre as NH_3. If more than 100 lb N/acre is applied, then apply enough irrigation to wet the soil to a depth of 12 inches. This will speed up the nitrification process and help prevent root burn.

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In-Season Nitrogen Application

To optimize the timing of multiple N applications, it is helpful to know when N is being used by the corn plant (Figure 2). Corn uses very little N from the time of seed germination to about the 6-leaf stage (six visible leaf collars) or about 10 inches tall. However, when planted in cool soils, the combination of N and P applied as a starter has shown to improve establishment and root development. The best method for applying N as a starter is injecting the fertilizer 2 inches deep and 2 inches to the side of the seed furrow. Recent research from Kansas has shown almost as good a result when the fertilizer is dribbled onto the soil surface 2 inches to the side. Although some have had success in placing the fertilizer in the seed furrow with the seed, this can be risky due to possible salt injury.

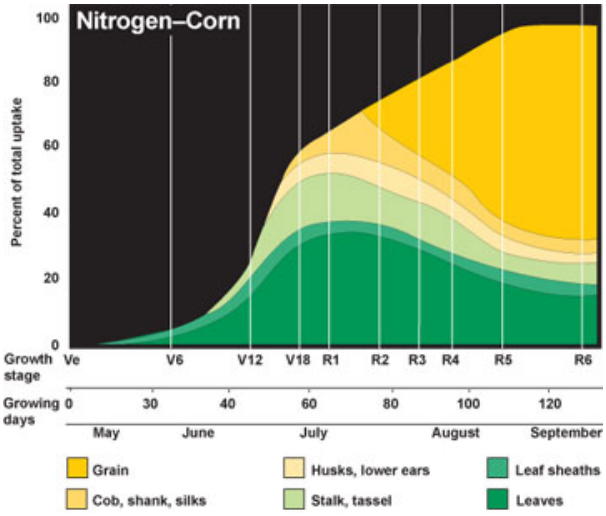

Figure 2. Nitrogen use by Corn.
Credit: Iowa State University Extension.

Certainly no more than 10 lbs of N should be applied with the seed, and even less in dry sandy soil. Corn begins to rapidly use N when it reaches the 8-leaf stage. This is also when ear size is beginning to be determined. The bulk of the N needed by the corn plant should be applied by this time. A sidedress application at about the 6-leaf stage works best. UAN (usually 32-0-0) can be applied by injecting between the corn rows with a knife, use of a coulter rig, or even dribbled on the surface followed by irrigation. A significant amount of the remainder of the N needed to reach the yield goal can be applied at this time. A good system is to apply the remainder of the N needed to reach the yield goal minus about 50 lbs of N that should be held in reserve to apply through the center pivot at brown silk. If sidedressing is not an option, then begin to apply N through the center pivot prior to the 8-leaf stage. Continue to apply N up to brown silk.

Information provided with the assistance of Dr. Mark MacFarland, Texas AgriLife Extension Soil Fertility Specialist