Cotton, Upland and Pima

Nitrogen is the nutrient that is required most often and in larger amounts than other nutrients for cotton production. Common rates of fertilizer N applied to cotton range from 50 to 300 lbs. N per acre. The management of fertilizer N is critical, both for insuring optimum lint yield and quality and in minimizing the potential for environmental contamination. Preplant soil analysis and leaf petiole analysis during the season can be very useful in monitoring the nitrogen status of the crop.

- **Early season nitrogen**

Applications of N at or before planting are seldom recommended unless the residual N content in the soil is very low. This is because young stands of cotton have a very low N requirement and soluble nitrates can be easily leached when irrigation water is applied during germination and early season growth. Use Table 38 to estimate preplant N fertilizer requirements.

Table 38.
Estimated preplant nitrogen fertilizer rates for Upland and Pima cotton based on preplant soil nitrate-nitrogen levels.

Preplant Soil Test Level	Apply this Amount of N
ppm NO_3-N	lbs. N/acre
0 - 5	30 - 50
5 - 10	20 - 30
10 - 15	0 - 20
> 15	0

When N is required, an ammonium (NH_4) form such as anhydrous ammonia (82-0-0), monoammonium phosphate (11-53-0), ammonium phosphate-sulfate (16-20-0), solution ammonium polyphosphate (10-34-0) or ammonium sulfate (21-0-0) should be used to minimize leaching losses early in the season. Nitrogen can be broadcast and incorporated into the soil prior to listing or it can be banded near or below the seed placement zone. Two to three inches of soil should separate the fertilizer and the seed. Anhydrous or aqua ammonia should be injected 6 to 9 inches below the soil surface prior to planting and should never be placed near the seed zone in order to avoid seedling injury from ammonia toxicity.

- **Mid-season nitrogen**

At the pin head square stage, collection of leaf petiole samples for nitrate (NO_3-N) analysis should begin. The petiole is the leaf stem which connects the leaf blade to the main stalk. The petiole is selected from the most recently fully expanded leaves, usually the petiole of the third to the fifth leaf from the terminal (Figure 42). Selection of the correct petioles can substantially influence test results. Petioles from leaves which are younger than the first fully expanded mature leaf will have NO_3-N values lower than those from the mature leaves. The NO_3-N levels of petioles from the second and third fully expanded mature leaves are the same as those from the first mature leaf. In general, if any doubt exists about which petioles to use, collecting petioles slightly older than the first mature fully expanded leaf is better than collecting younger petioles.

About 25 to 30 petioles per sample are adequate for analysis. The number of samples tested from each field depends on the uniformity of the field. Samples should be collected from randomly selected plants within uniform areas representing the largest part of a field that can be treated separately. Samplings are made at one- to two-week intervals through July.

Figure 42.
Begin sampling cotton petioles when squares first start to appear. Collect petioles from the youngest mature leaves as shown above.

- **Interpretation of petiole nitrate levels**

The petiole nitrogen level is normally high (with adequate soil fertility) early in the season during vegetative growth and declines as the season progresses and fruit develops. The rate and extent of decline is one key to interpretation of petiole nitrate-nitrogen values. Nitrogen shortages or boll load can cause a reduction in petiole nitrate. Therefore, for the interpretation of a particular petiole nitrate value, the stage of growth and boll load should be considered.

Desirable levels of nitrate-nitrogen are shown in Table 39 and Figure 43. These levels are conservative in that slightly lower levels are not deficient at any particular period. An unusually heavy boll load often causes a rapid decline in petiole nitrate, but this may not be indicative of an actual nitrogen deficiency in the soil. In this case one must choose between making a fertilizer application and waiting for another petiole analysis.

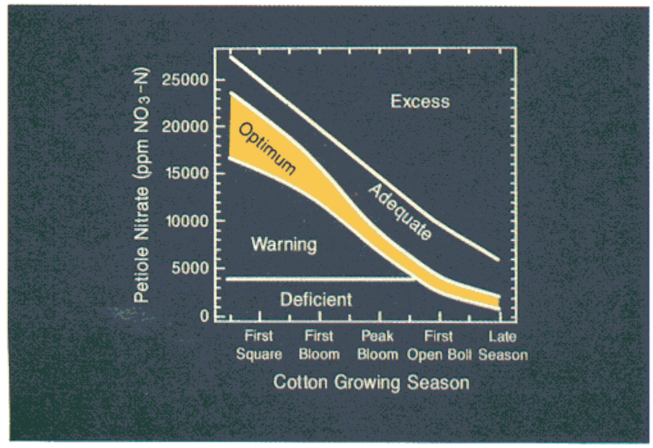

Figure 43.
Interpretation of nitrate-nitrogen levels in Upland cotton petioles at different stages of growth.

Table 39.
Desirable levels of nitrate-nitrogen in Upland and Pima cotton at various stages of growth.

Stages of Cotton Growth	Desirable Petiole Nitrate Levels	
	Pima	Upland
	ppm NO_3-N	
Early Squaring	10,000+	18,000+
Early Bloom	8,000+	14,000+
First Bolls	4,000+	8,000+
First Open Bolls	2,000+	4,000+

A timely application of nitrogen can prevent or slow the decline of petiole nitrate. If the nitrate-N level is about 4000 ppm or below (prior to the first open bolls), application of a nitrate or urea source is recommended. These forms of N move readily in soil solution and are rapidly absorbed by the cotton plant, thus decreasing the time necessary for recovery from a deficiency. At higher levels of petiole nitrate, the nitrogen source is of less importance because nitrification of ammonium (NH_4) sources can take place rapidly enough to permit the resulting NO_3 to be moved into the root zone to supply the needs of the plants. Caution should be used when applying ammonium sources of nitrogen such as anhydrous or aqua ammonia in order to avoid plant injury from ammonia toxicity, especially on very sandy soils.

The effect of kind and amount of fertilizer, time of application, cropping history, and soil texture must also be considered when interpreting petiole nitrate results. For example, when petiole nitrate is approaching a deficient level, and nitrogen in an ammonium form was applied a short time before sampling, petiole analysis would not reflect this application, yet additional fertilizer would not be needed. Cases of low petiole nitrate have been observed when appreciable nitrogen had been applied but frequent heavy irrigations had leached it below the plant root zone. Also, when cotton follows alfalfa or applications of manure, the petiole nitrate value may appear low without an actual need for additional nitrogen because of the continual supply of nitrogen from decomposing organic matter in the soil.

- **Defoliation and N management**

At the end of the season, Upland cotton plants lend themselves best to chemical defoliation when petiole NO_3-N levels have declined below 2,000 ppm. It is important to manage N nutrition to lower petiole NO_3-N levels late in the season without driving the plant into a N deficiency that will diminish yield. This can be done by reducing or eliminating N inputs to the crop after the peak bloom period.

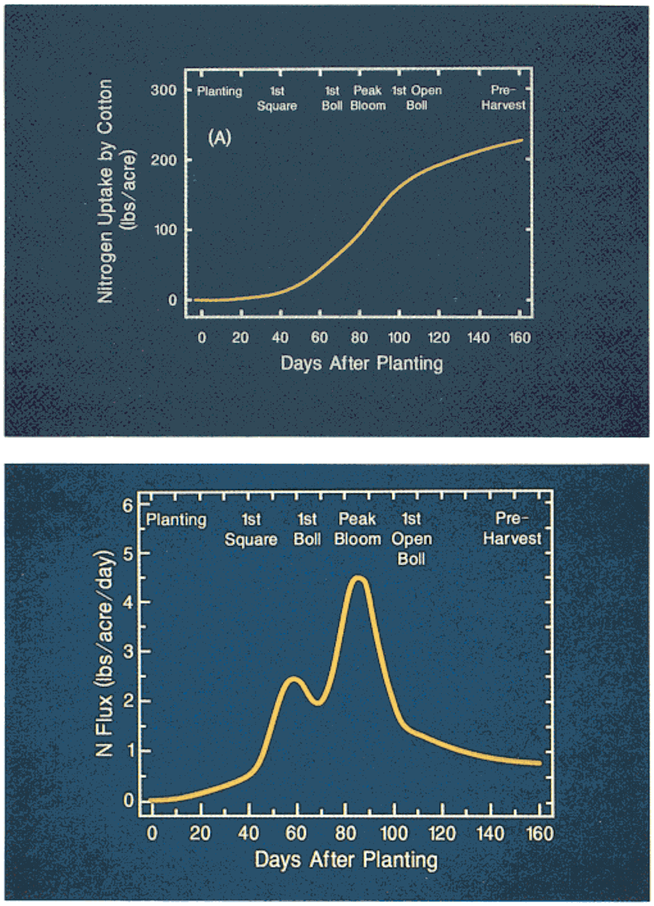

Figure 44.
Cumulative seasonal nitrogen uptake (A) and daily nitrogen flux (B) patterns for DPL-62 Upland cotton at a yield level of 4.0 bales lint per acre.

- **Nutrient removal**

A harvest of 1920 lbs. lint (4 bales) per acre will contain about 120 lbs. of N in the cotton seed removed during the ginning process. The entire crop will contain about 225 lbs. N per acre. About 60 lbs. of N is required for each bale of cotton lint yield.

- **Nitrogen uptake patterns**

Nitrogen uptake by cotton is very low early in the season prior to the pin head square stage. As the plant rapidly grows in size and begins producing bolls, N flux increases sharply. Maximum N flux occurs during the peak bloom stage, exceeding 4 lbs. N per acre per day on high yielding sites. After the first open boll appears, N flux decreases rapidly to less than 1 lb. per acre per day by defoliation time.