

## Nitrogen for Cotton--How Much?

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The level of nitrogen (N) fertility probably has more influence on the growth, behavior, and yield of cotton than any other single plant nutrient.

Deficiencies of N can limit growth and, subsequently induction and development of the fruiting parts. Some evidence points to excessive N as a cause of reduced yield and a less fruitful, undesirable plant type on fine-textured soils with poor aeration.

Therefore, we should regulate N nutrition to permit continued vegetative growth and fruiting, yet time the fertilizer applications to avoid deficiencies or harmful excesses.

Analysis of the petiole--that part of the plant called the leafstalk--for nitrate-N aids in determining the N status of the plant throughout the growing season. A soil analysis, made prior to planting time for nitrate-nitrogen provides a guide to the early N needs of cotton. If the early season N needs are determined by soil analysis or if N is applied at planting, take the first petiole sample at the "square stage" of development. At this time the bracts that enclose the floral bud are obvious throughout the field.

Samples may be taken during the early vegetative growth stages but are not necessary if early N application is made or a soil analysis shows adequate N present in the soil.

The petiole is selected from the most recently fully expanded leaf which is usually the third leaf from the terminal. It is broken from the main stem and then separated from the leaf blade. About 25 to 30 petioles per sample are adequate for laboratory analysis. Collect the petioles from uniform areas that represent the largest part of the field. This sampling should serve as a basis for treatment of the entire field. Samplings are made at two-week intervals until it is too late to apply additional N.

The normal pattern of adequate petiole nitrate ranges from a high level during early vegetative stages of growth to relatively low values during heavy fruiting. (Table 1).

Table 1. Desirable levels of nitrate-nitrogen in Cotton  
Petioles at various stages of plant development.

Stage of growth	Desired level of nitrate-N*
	ppm N
First squares - - - - -	15,000 to 18,000
First flowers - - - - -	12,000 to 14,000
First bolls - - - - -	6,000 to 10,000
First open bolls - - - - -	4,000

\*The levels of petiole nitrate suggested are for Arizona conditions.

The lower limits of nitrate-N shown in Table 1 apply to the Acala varieties and the high values apply to rain belt varieties. These levels are conservative in that slightly lower levels are not deficient at any particular period. Lower levels would indicate, however, that nitrate levels are declining too rapidly and that a deficiency can be expected in the near future.

In cases of borderline levels, it is desirable to take a sample between normal samplings. Thus, N fertilizer needs can be anticipated. An application of nitrogen at that time can prevent the rapid decline of petiole nitrate. Nitrate levels materially below those suggested may not reduce yields seriously if corrected promptly by application of a nitrate source.

A rapid decline in petiole nitrate is normal for plants that are setting a heavy boll load. The effect of fruit initiation and development on petiole nitrate level is one of the many factors that must be considered when interpreting the results during the season. Other factors to consider are source, rate, and time of previous fertilization, previous cropping history, soil texture, and water supplied.

The fruiting pattern of cotton varies some with climatic area and from season to season. It determines to some degree the importance of N timing. In case of a "one peak" flowering pattern, which may be characteristic in a short season area, timing of N is very important to avoid early season N deficiency which reduces the intensity of flowering and the duration of intense flowering.

In "two peak" flowering pattern areas or long seasons, the loss of flowers resulting from early N deficiency may be compensated by heavier fruiting in late season during the second peak with little or no loss in yield. Thus, N timing may be of less importance in long seasons. It is safer, however, to maintain adequate N throughout the season since in some years seasonal conditions may result in a "one flowering peak" in a normal "two peak" area.

In Arizona, the nitrate-N in soil samples taken from the side of the bed after the preplant irrigation and before planting are useful in determining the need for early N application on cotton. The nitrate test cannot be used to predict the amount of fertilizer that must be added or the yield increase that will result. The test helps predict the yield only for which the soil N is adequate.

If a good estimate can be made of the maximum yield possible, the nitrate test can be used to predict if N fertilizer is needed. The combination of soil and petiole analysis for nitrate-N are best used to insure adequate N for the entire season. The interpretation of the soil nitrate test (Table 2) is based on a standardized method of sampling discussed earlier.

Table 2. Relation of initial soil nitrate level to early season nitrogen needs of cotton.

Soil* nitrate	Stage of growth at which N fertilizer may be needed
ppm nitrate	
0-10 - - - - -	At planting or as soon after as practical
10-20 - - - - -	By 6-leaf to square stage
20-30 - - - - -	By time of first flower
30 plus - - - - -	Use petiole test to determine if needed

\*When soil nitrate values are reported as N, multiply by 4.4 for use with this table.

Soil and petiole analyses can serve as guides for developing an adequate but not excessive N fertilizer program. These techniques can not be used to increase the maximum yield possible or to correct any factor limiting yield that is not nutritional. Therefore, their most effective use does not always increase yields. These "tools" aid only in insuring that adequate N is available for the attainment of the maximum yield under existing conditions.

In many cases the only benefit that the grower derives from the use of these tools is the assurance that the N fertilizer program is adequate and that excessive fertilizer was not used.

Some growers who collect their own samples feel that other benefits are realized. For example, these growers see more of their cotton more often and take a closer look at how the plants are growing and fruiting. They also learn of insects, water penetration, diseases, and many other important factors that otherwise might go unnoticed though essential in the total management of the cotton crop.

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Nitrogen and Manure Effects on Cotton

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In 1960 a long-term experiment was initiated at the Cotton Research Center, field D-1 in which four levels of N fertilizer were imposed on four main treatments. The main treatments of border size were: (1) cotton annually, (2) alternate years of fallow and cotton, (3) cotton with 10 tons of manure annually, and (4) alternate years of sesbania and cotton.