AgriLIFE EXTENSION
Texas A&M System

Improving Lives. Improving Texas.

L-5147

Correcting Nitrogen Deficiencies in Cotton with Urea-Based Products

S. D. Livingston and C. R. Stichler*

Nitrogen Requirements. A credible soil-nutrient, soil-moisture-monitoring, and petiole-testing program is the foundation to accurate nitrogen applications. Both nitrogen quantity and timing requirements and the relationship to water uptake are well known for cotton. The demand for water and nitrogen is not high until fruiting and seed development is initiated at the onset of boll filling. Most fields in South Texas, are fertilized in the winter months (November through January) with the majority of producers fertilizing cotton land in January. If preplant fertilization is missed, there is usually adequate carryover of nitrogen and organic matter conversion (mineralization) to support early growth. Any side-dress applications should be made as soon as practical, to avoid nitrogen deficiencies, loosening the soil, and losing important soil moisture.

Soil nitrogen applications should be made to meet expected or historic yield goals. Excessive nitrogen applications increase the potential for rank plant growth and increased mepiquat chloride use. In addition, liberal nitrogen inputs lower profits and increase the risks of nitrogen losses through soil run-off or leaching. Excessive rates of N promote later maturity, larger leaves, and shading which, in turn, increase boll shedding, boll rot, delayed boll opening, and immature fibers. Because of the perennial growth habit of cotton, nitrogen management is increasingly important as the yield expectation increases. Adequacy, balance of nutrients, and timing are important to creating a high yield potential.

The need to build sufficient plant structure and root system to support high yields underlies every successful growing season. **Cotton will effectively use 0.1 pound of nitrogen for every pound of lint produced per acre.** Failure to ensure that adequate nitrogen is available during the square development period will eventually result in decreased yields. If deprived of nitrogen, plants will produce fewer and shorter internodes and a small plant canopy. Too few leaves on the plant will reduce photosynthesis and formation of sugars for boll set and maturation. Plant height is drastically shortened, as is feeder root branching. Foliar fertilization offers a means of increasing late-season plant nitrogen levels if growing conditions increase yield potential over what was planned.

Delayed Fertilization and Stress Periods. Soil-applied nitrogen (both preplant and side-dress) is the most cost-effective and efficient way to meet seasonal nitrogen needs. It is the “meat and potatoes” of crop fertilization. Foliar fertilization should only be considered a “snack” to supplement soil applications.

When problems occur with the application of the soil applications, such as excessive rainfall preceding the planting season and fields not drying well, growers may defer fertilization in hopes of getting cotton planted on time and growing. The option to side-dress later may be even further delayed by extended poor weather. Managing weed and insect control through aerial applicators and adding some foliar nitrogen to these products may provide enough nitrogen to keep the cotton growing through a temporary stress period. (Because of reduced uptake, it is possible that a nitrogen deficit can occur on waterlogged soils even when the field has been fertilized according to soil test.)

Denitrification. These fields have been fertilized, but so much rainfall or irrigation is received that denitrification has reduced the supply of nitrogen. Without a soil test, fields should be side-dressed with 20 to 30 pounds of nitrogen and cultivated as

*Professor and Extension Specialist, Agronomy, and Associate Professor and Extension Specialist, Agronomy, respectively, Texas A&M University

soon as ground equipment can safely reenter fields. This will open the soil to oxygen necessary for new root growth.

High Yield Potential. In some years cotton sets bolls at nearly every fruiting position, and there is a potential for more cotton than fertilizer was applied. Since predicting the future is impossible, the cotton may be too large to side-dress or the late application of soil nitrogen could increase the risk of late growth. Soils may be very dry and the risk of pruning roots with applicator knives could be as detrimental as opening the soil for further moisture loss. Again, these conditions support making an amendment of 5 to 10 pounds or more urea-N with at least 2 to 3 subsequent foliar applications. To obtain significant yield increases the cotton must be able to use the added nitrogen. **If the cotton is drought-stressed, foliar fertilizer will not magically cause the cotton to grow and set fruit.** Foliar nitrogen can be used to supplement root absorption to help set and fill late season fruiting forms. It usually requires at least 3 applications totaling 15+ pounds of actual N. Such applications can be applied every 7 to10 days providing the cotton is not under stress. As much as 50 to 70 percent of the urea deposited on the leaves is taken up by the plants. Urea that misses the leaves may ultimately be recovered if it is washed into the soil by rainfall.

Typical Rates of Foliar Urea Used.

•Biuret is an impurity in urea. For soil applications, it causes no problem. However, when used as a foliar spray, it may cause some injury. Feed-grade urea or low-biuret urea contains very low amounts of biuret and is only slightly more expensive.

•Three pounds of dry urea can be readily dissolved in one gallon of water.

•Feed-grade urea concentrations as high as 3 pounds of urea per gallon of water have been used on irrigated cotton in West Texas without leaf burn. (This equals 1.38 lb. N/gal. or 4.14 lb. N/3 gal./acre if aerial application is desired or must be used because fields are not accessible with ground equipment.)

•Feed-grade urea concentrations equal to 1.83 pounds of urea per gallon of water (0.84 lb. N/gal.) have been successfully used on dryland cotton in Central Texas. (Dissolve 22 lb. of feed-grade urea in 12 gallons of water/acre to deliver 10 lb. N/acre to cotton acreage.)

•Several companies are marketing a 21 percent N urea solutions which should be diluted with water before application as the following examples indicate:

•For Aerial Application: Dilute 2.5 gallons of the 21 percent N urea solution to 5 gallons with water. (4.8 lb. N/5 gal.) Apply at 3 to 5 gallons per acre.

•For Ground Application: Dilute 5 gallons of the 21 percent N urea solution to 15 gallons with water (9.6 lb. N/15 gal.). Apply at 15 gallons per acre.

Urea as an N-Source. Although urea is readily absorbed by the cotton leaf (30% during the first hour after application) a major drawback is the need to make multiple applications of relatively dilute solutions to get enough into the plant. To be profitable, yield increases must be sufficient to offset added costs. As a small organic compound, urea moves rapidly into the plant and urea-N can be detected in bolls within 6 hours. Most of the urea-N taken up by the leaf will have moved into the bolls within 24 hours. If a urea-based product is on the leaves 3 to 4 hours, most of the product will be rain-fast (up to 70%). Cotton will store N in leaves as protein during periods of greater availability for later use during the peak demands of boll setting.

Materials like Coran and Trisert contain altered low-biuret urea that minimizes leaf injury.

Total Nitrogen Management.

•From 10 to 20 percent of the cotton plants' total nitrogen requirement is needed pre-bloom. During the boll development period (60 to 75 days after emergence), ensure sufficient soil and foliar N to supply adequate nitrogen to the plant. It is important to lint yields that the remaining 78 percent of the total nitrogen requirement be available from boll set to maturity. Ideally as bolls begin to open, the soil should be depleted of most remaining N. Low plant nitrogen at the time of harvest aid applications will increase the plant's response to chemicals, defoliate faster and more uniformly, and reduce the chances of regrowth.

Important Considerations.

•Moisture-stressed cotton will usually not benefit from foliar nitrogen. Low-biuret, low-salt index materials may even cause yield reductions when applied under marginal drought conditions. Foliar nitrogen does not "hold the plant" during a drought. Foliar nitrogen will only provide additional nitrogen for additional fruit development.

•The first priority should be given to preplant and/or side-dress fertilizer applications recommended by soil test. Foliar application is a more expensive alternative to be used when conditions result in inadequate nitrogen supplies to the plant or the application of soil-applied nitrogen is not feasible. Weather conditions requiring foliar nitrogen feeding are usually present only two years in five. Under irrigated conditions, foliar nitrogen may be used most years.

•Twice as much foliar urea-N can be applied with a ground rig than with an airplane (due to the amount of water that can be carried).

•The first application should be made at early bloom or no later than the third or fourth week of bloom. Applications should be spaced 7 to 14 days apart to avoid an accumulation of nitrogen salts on the leaf.

•Unless the soil is waterlogged, there should be some nitrogen available to emerging or new cotton plants from crop residues, carry-over N, or soil water. Foliars are most useful as post-bloom treatments when larger quantities of nitrogen are needed.

•At least two applications are necessary to effect substantial yield increases. If trying to correct a serious deficit, applications should be 5 pounds N per acre (or 10 to12 lb. of urea) or more. One pound of absorbed N has the potential to produce 5 to 10 pounds of lint. If 20 pounds of urea-N can be applied in four applications (and it is needed), 100 to 150 pounds of lint should result. Ten pounds would produce 50 to 75 pounds of lint per acre in two applications.

1991-92 County Location	Lint lb./ac. Trt	UTC	Lint
Calhoun 1	1043	927	116
Calhoun 2	1000	885	115
Nueces 1	870	777	93
San Patricio	632	558	74
Nueces 3	221	160	61
Nueces 2	925	878	47
Nueces 4	802	777	25
Victoria 1	870	854	13
Average Lint			68

•In these Texas Coastal Bend tests two applications totalling 10.6 pounds of foliar N were applied. Theoretically 106 pounds of cotton would have resulted, but only a 68-pound average was realized.

•Foliar feeding alone cannot sustain the nitrogen needs of a cotton crop. Some soil-applied N has to be applied preplant or shortly after emergence.

•Foliar N is a corrective tool to fix or avoid nutritional problems. Recommendation to guide foliar N applications to irrigated cotton can be made through a phased petiole testing program (see the Extension publication "Guide to Petiole and Tissue Testing.")

The authors extend special recognition to Dan Kreig, Willis Gass, Mike Hickey, and Dale Pennington for cooperative early work in determining the efficacy of foliar urea as an amendment to cotton.

Elizabeth Gregory, Editor
Rhonda R. Kappler, Graphic Designer

Issued in furtherance of cooperative Extension Work in Agriculture and Home Economics, Acts of Congress of May 8, 1914, as amended, and June 30, 1914, in cooperation with the United States Department of Agriculture. Zerle L. Carpenter, Director, Texas Agricultural Extension Service, The Texas A&M University System.

3M–10-95, New AGR 13,1