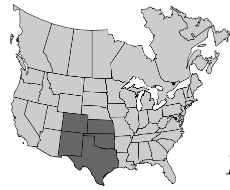
NEWS & VIEWS

A regional newsletter published by the
Potash & Phosphate Institute (PPI) and the
Potash & Phosphate Institute of Canada (PPIC)



Dr. W.M. Stewart,
Great Plains Director
Beltwide 2000 Edition

Fertilize Cotton for Optimum Yield and Quality

A MAJOR component of profitable cotton production is adequate and balanced nutrition. Sound cotton fertilization practices ensure improved economics of production, efficiency of nutrient use, and environmental protection. Following are some important facts concerning cotton development and fertility.

An effective way of assessing the development, or progression of physiological events, of a cotton plant is with heat units or growing degree days. A heat unit is expressed in degrees Fahrenheit and is defined by the following equation: Heat Unit = [(daily maximum temperature + daily minimum temperature) ÷ 2] -60.

About 2,400 heat units are required from planting to the termination of the crop. The average number of heat units required to reach various stages of growth is listed in **Table 1**.

Table 1. Average number of heat units required to reach various growth stages of cotton (Krieg).

Growth Stage	Heat Units
Planting to seedling emergence	100-120
Square to white flower	450
Planting to first flower	1000
White flower to open boll	780-800
Planting to crop termination	2000-2400

In most of the western half of the Cotton Belt, water is the primary environmental resource limiting growth and productivity. Research conducted at Texas Tech University has shown that cotton produces about 50 lb of lint per inch of water consumed.

Nutrient uptake by cotton is directly related to dry matter accumulation, which follows a sigmoidal pattern (**Figure 1**) and is determined by water and nutrient supplies, radiation, and temperature. Selected nutrient needs for the production of one bale of cotton are listed in **Table 2**. During the summer months nutrient uptake is greater than in the cooler spring months. The greatest nutrient demand occurs during June and July.

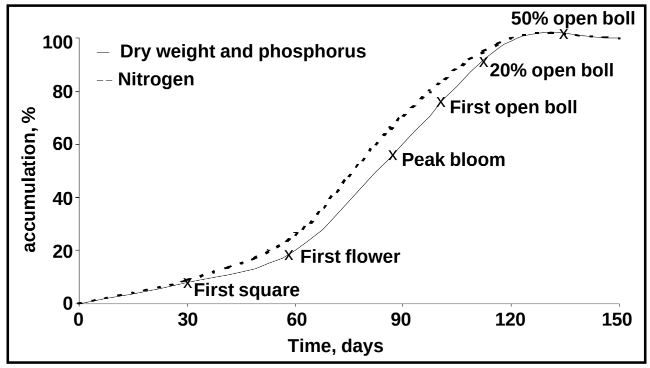


Figure 1. Cotton dry matter accumulation. Phosphorus accumulation is directly proportional to dry matter accumulation, while N accumulation is slightly higher through most of the season.

The cotton plant has a taproot that is capable of extracting mobile nutrients like nitrate nitrogen (NO_3-N) from greater depths than many other plants. Also, cotton will store N in leaves during periods of adequacy for later use in the boll fill period. **Nitrogen is a part of plant proteins and is essential for the development of all plant organs including shoots, buds, leaves, roots, and bolls.** Research at Texas Tech has demonstrated that about 5 lb of N are required per inch of water consumed.

Table 2. Approximate uptake of selected nutrients by a one bale (480 lb lint) cotton crop (Hake, Cassman, and Ebelhar, 1991).

Nutrient	Uptake, lb/A
Nitrogen	55-60
Phosphate (P_2O_5)	22
Potash (K_2O)	61
Sulfur	12
Magnesium	14

Co-authors:

Dr. W.M. (Mike) Stewart
Great Plains Director, PPI
P.O. Box 6827
Lubbock, TX 79493
Phone: (806) 795-3252
Fax: (806) 795-5997
Email: mstewart@ppi-far.org

Dr. Cary Green
Dept. of Plant and Soil Science
Texas Tech University
Lubbock, TX 79409-2122
Phone: (806) 742-0116
Fax: (806) 742-0775
E-mail: c5cjg@ttacs.ttu.edu

Dr. Dan Krieg
Dept. of Plant and Soil Science
Texas Tech University
Lubbock, TX 79409-2122
Phone: (806) 742-1631
Fax: (806) 742-0775
E-mail: dkrieg@ttacs.ttu.edu

Uptake of N is limited prior to squaring, and the majority of total N is taken up after first bloom, peaking at about 2 to 3 lb/A/day during fruiting. About 10 to 20 percent of the crop N needs should be supplied to the plant before bloom, and the remainder should be available during the boll development period. Split applications of N fertilizer, for example preplant and at or before first bloom, improve the chances of meeting crop needs during peak demand periods, especially where N leaching during the season is likely. Split application through irrigation water is common in some areas. Texas Tech researchers have found that, under average conditions on the Texas High Plains, the optimum fertigation rate is about 10 lb of N per inch of irrigation water applied. Foliar application of urea may also be an effective method of "fine tuning" N management. As much as 30 percent of foliar-applied urea can be absorbed into the leaf within 1 hour and 70 percent in 24 hours. Since cotton is an indeterminate perennial, too much N late in the season may cause excessive vegetative growth and should be avoided. Thus, soil N should be depleted by the end of the season. Soil and petiole tests can be helpful in determining preplant and midseason N management strategies.

Phosphorus (P) is important in early root development, photosynthesis, cell division, energy transfer, early boll development, and hastening of maturity. A common recommendation for the High Plains of Texas is for an $N:P_2O_5$ application ratio of about 5:2. For a 2 bale cotton crop this would require about 100 lb N/A and 40 lb P_2O_5/A. Insufficient P results in dwarfed plants, delayed fruiting and maturity, and reduced yield. A soil test should be used to determine the optimum P application rate.

Research at Texas Tech University is evaluating the efficacy of multiple applications of N and P fertilizer to cotton. Conventional preplant application of P is being compared to split applications either through a low-pressure drop nozzle type irrigation system (LEPA), or chisel applications split into preplant, first square, and first flower timings. The fertigation is applied at least four times starting at first square. During the first two years of this study, P fertilization (40 lb P_2O_5/A) has increased lint yield by about 13 percent. The fertigation treatment has performed on average better than the other methods of application. An especially interesting component of this study involves the effect that P has had on seed quality. Over two years and 15 varieties, P applied preplant or by fertigation has significantly increased micronaire and seed density. Greater details from this study will be reported as they develop.

Potassium (K) is an extremely important nutrient in cotton production. It affects fiber properties such as micronaire, length and strength, functions in enzyme systems, is important in reducing the incidence and severity of wilt diseases, and increases water use efficiency. Bolls are major sinks for K. It is important in maintaining sufficient water pressure within bolls for fiber elongation. Thus, the need for K increases dramatically during early boll set. About 70 percent of uptake occurs after first bloom, and uptake peaks at about 2 to 3 lb/A/day.

A shortage of K reduces fiber quality and yield, and results in plants that are more susceptible to drought stress and diseases. Potassium deficiency may be expressed as a full season deficiency, or it may not appear until late season during the period of greatest demand. Preplant applications of potash, and in some cases mid-season foliar applications, are effective in correcting K deficiencies. Like N, K is stored in leaves for later use by developing bolls. When a heavy boll load is set, the demand for K may exceed the ability of the soil and leaves to supply this nutrient, resulting in a late season deficiency. In some areas, mid-season foliar K fertilization has been effective in correcting late season deficiencies. However, soil application should be the foundation of a K fertility program. Potassium deficiencies may occur when cotton follows a crop with high K requirements, such as forages. Soil and tissue tests should be used to determine K needs.

Secondary nutrients and micronutrients are also critical to profitable cotton production. A high yielding cotton crop can take up more than 30 lb each of sulfur (S) and magnesium (Mg). Cotton responds to micronutrients like boron (B), zinc (Zn) and manganese (Mn) where they are deficient. Micronutrient availability, except for molybdenum (Mo) and chloride (Cl), is generally reduced in alkaline and calcareous soils. In west Texas, Zn is commonly the most limiting nutrient after N and P. Soil tests, plant analyses, and field history should be used to establish the need for these nutrients.

A complete fertility program is essential to attaining maximum profit in cotton production. Furthermore, balancing nutrient inputs with other management inputs like water, variety, tillage, and rotation helps insure that maximum efficiency of production and profit are achieved. ■

RN 99178