Fertilizer BMPs for Cotton in the Midsouth

By Cliff Snyder

Fertilizer best management practices (BMPs) for cotton in the southern U.S. are becoming more widely understood and adopted. However, there are unique differences between cotton production and other major crops that require a closer review.

A common approach to setting realistic yield goals is selecting a value somewhere between an above average yield and a maximum yield you have achieved on that specific field, or one of similar production and management history. Setting a target of 10% above the 3- to 5-year average of crops not suffering a severe yield loss due to drought, excessive rainfall, or pests is also a commonly suggested method. This requires that individual field records be maintained and that only those fields of similar production potential be considered in making estimates. An example for a cotton yield is shown below and considers the best 4 of the previous 5 years, scaled up by 10%. While short of the maximum yield grown, it does provide a means of striving for yield increases. Remember that, over time, yield goals will increase as long as the average yield continues to increase.

Year	Cotton yield, lb of lint/A	
1997	1,320	
1999	890	Average yield = 1,265 lb of lint/A (not using 1999)
2001	1,055	Highest yield = 1,415 lb of lint/A
2003	1,415	Realistic yield goal = 1,265 x 1.10 = 1,392 lb of lint/A
2005	1,270	

Frequently, crop advisers and farmers find that they can make fairly good estimates of crop nutrient requirements based on what was grown previously and what was applied in a specific field. Information such as previous crop yield, soil drainage class, tillage system, and crop residue management can all be used to estimate the status of a nutrient such as N. For most cotton fields, the year-to-year variation in plant-available supply of phosphorus (P) and potassium (K) from the soil is usually relatively minor, and annual fertilizer application based on a balance between soil test levels and crop requirements can avoid depletion or over application.

The way fertilizers are managed can have a major impact on the efficiency of nutrient use by crops and potential impact on the surrounding environment. In all instances, we are striving to improve fertilizer-use efficiency by increasing the pounds of lint per acre for each unit of nutrient applied, without sacrificing yield potential. This is especially true for N, the major nutrient removed from the soil by cotton.

An example of proper nutrient balance is illustrated in a cotton study conducted in Tennessee (**Figure 1**). Improved P nutrition, in both disk-till and no-till systems, raised yields and increased the lint yield per pound of N applied. Being sure to provide adequate P and K nutrition can enhance crop recovery of applied N.

Placing urea-containing N fertilizers beneath the soil surface and crop residues can reduce the volatile losses of ammonia, minimize immobilization in surface residues, increase yields, and enhance fertilizer effectiveness. Responses to source and rate of N may differ between no-till corn and no-till cotton (**Figure 2**) because of the greater amount of crop residue left on the soil surface with corn.

An important part of optimizing crop re-

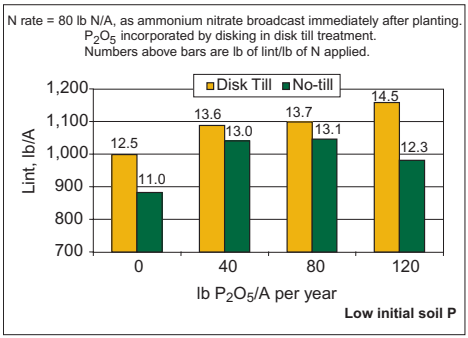

Figure 1. Adequate soil P improves 6-year average cotton yields and response to applied N in Tennessee.
Source: Howard et al., 2001.

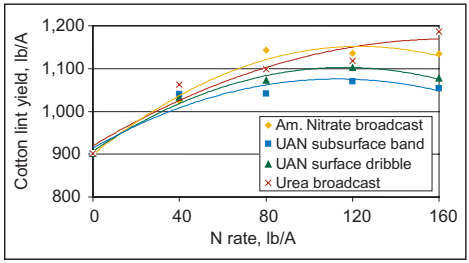

Figure 2. 10-year average response of cotton to N rate and source in Mississippi.
Source: Parvin et al., 2003.

sponse to a fertilizer nutrient is ensuring that the nutrient is placed in such a way that it provides rapid uptake by the crop and reduces potential losses. The mobility of a nutrient in the soil plays a large role in how important placement is. Early research with cotton showed that placement of P becomes less critical as soil test P increases from low to high levels.

Placement can be a powerful management tool to minimize N losses. Where there is an accumulation of surface residues, it is important to place urea-containing N fertilizers beneath the residues. Under ideal conditions, the goal is to apply the N so that it is in the plant-available form and close proximity to roots.

Research in the South has generally shown that when all the N is applied preplant for nonirrigated cotton, yield is optimized (Ebelhar and Welch, 1996; McConnell and Mozaffari, 2004). In irrigated environments, cotton yields and uptake efficiency are often improved with split applications: ¼ to ½ preplant, with the remainder applied before flowering.

Site-Specific Nutrient Management

Fertilizing soils rather than fields is an emerging BMP that continues to gain in popularity with technology development. Using some form of field diagnostic, such as intensive soil sampling, soil sensing, yield mapping, or scouting records, whole fields are divided into management units where the fertilizer application used is independent of the rest of the field.

Aerial imagery and optical plant sensors are being developed which use the crop color and biomass as an indication of N sufficiency. These types of sensing have the potential to provide farmers a practical means of varying the N rate on-the-go. Local calibration of the technology will be needed to make it more useful and economically feasible. In instances where field variability of N is large, this type of application prevents the over-application characteristic of fixed field rates in those areas where the soil N supply is sufficient. While considerable work is underway with corn, there are few cotton studies to draw on (Earnest and Varco, 2005).

Leaching

Leaching occurs when excessive residual nutrients are left in the soil profile and moved below the rooting zone by precipitation. While leaching can be a problem in sandy soils in the humid South, nitrate-N seldom accumulates in silt loam to silty clay loam soil profiles under cotton when the N rate is appropriate for the soil moisture/irrigation regime and the crop yield potential.

While there are no reported incidences of P leaching when fertilizer is used at soil test recommended rates, leached P has been reported with the application of livestock and poultry manure at rates grossly in excess of crop requirements.

Conservation Practices

The retention of crop residues on the soil surface has significantly reduced the water erosion loss of soil, while at the same time improving moisture conservation and cotton yields (Mitchell et al., 2005). When fertilized according to soil test recommended rates, increased cotton yields may lead to higher levels of crop residues returned to the surface of conservation-till fields for erosion protection.

Proper crop nutrition increases crop yields, increases crop biomass, can raise soil organic matter (carbon) content, and can improve the soil supply of organic N. The amount of crop residue returned to the soil is often directly attributed to the positive benefits of fertilization. By allowing crops to capture more carbon dioxide (CO_2) from the atmosphere, more stable soil organic matter can be produced and less atmospheric CO_2…a greenhouse gas…may be released. In long-term rotation studies with cotton in Alabama, yields were found to be highly correlated with soil organic matter content (Mitchell et al., 2005).

The movement of N and P into surface waters with eroded soil poses a serious threat to aquatic ecosystems. Some N and P movement into surface waters may result if relatively water soluble N and P sources are applied when there is a high probability of runoff-producing storm events. Some nutrients are required for the healthy function of aquatic ecosystems, but too much can lead to a decline in aquatic ecosystem productivity. The adoption of conservation practices such as no-till, strip-till, and buffer strips adjacent to surface water have been shown to reduce this unwanted movement of nutrients. In many instances where no-till field management has been adopted, soil erosion and water runoff have been significantly reduced. BC

Dr. Snyder is PPI Southeast Director, located at Conway, Arkansas; e-mail: csnyder@ppi-far.org.

To view a chart listing fertilizer BMPs for this region, plus additional information and references, visit the PPI website: ***>www.ppi-ppic.org<.***

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