Agronomic Technical Bulletin

SULPHUR ADDITIONS ENHANCE COTTON PRODUCTION

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Cotton is produced in 17 states that range from the Carolinas to California. It is a primary crop in 6 states with Texas producing more cotton than the next 9 highest production states. Good management is critical to growing cotton profitably. A manager's ability to recognize, adapt to and minimize yield-limiting factors such as diseases, insects, soil conditions, moisture stress, and soil fertility determines success or unsatisfactory results. Cotton farmers should strive to exclude the possibility of nutrients becoming limited during the flowering and fruiting growth stage as this is when the greatest demand for uptake occurs. Optimum soil fertility management is a key factor in crop development and yield response (National Cotton Council). Obtaining and maintaining sufficient nutrients in soil throughout the growing season is imperative to achieve challenging yield goals. However, where biotechnology traits such as Bt and glyphosate resistance increase the yields due to reduced insect damage and/or weed competition, more nutrients may be removed from the system in seed cotton. Thus higher levels of nutrient replacement would be required to optimize nutrition of future crops and avoid soil fertility decline (Rochester et al., 2011).

Nutrient Requirements

"Nitrogen (N) is probably the most important fertilizer used on cotton, yet it is the most difficult to manage" (Harris, 2016). Optimum N rate should be based on yield goal, soil type, soil fertility status, field history, and previous crop. The optimum N application rates vary by state; therefore, refer to local university extension recommendations. Unwarranted N rates result in too much late season growth, boll rot, and reduced fiber quality, and below optimum N rates lead to undesirable yield and lower quality. In most situations, split N applications are advised to enhance greater N utilization by the cotton crop. The general suggestion is to apply approximately 25-30% of N pre-plant or at planting and the remainder of N applied as sidedress. Cotton exhibits N deficiency with general yellowing of leaves as shown in Figure 1.0. Nitrogen is mobile within the plant and results in the N deficiency symptoms displayed in the older leaves. Cotton will take up approximately 60-75 pounds per acre (lbs/ac) of N per each 480 lb bale of cotton produced.

Figure 1.0
Nitrogen deficiency symptoms in cotton.
Photo: (State of CA)

"Phosphorus (P) uptake is most critical early in the growing season because it is necessary to stimulate early root development and early fruiting" (Oldham & Dodds, 2015). Low soil P tends to result in shorten plant internodes which displays stunted plants. "Low levels of phosphorus may reduce lint yield, fiber strength, and micronaire" (Main, 2012). Cotton uptake of P will be approximately 25-30 lbs/ac per bale produced (Stewart, 2005). Phosphorus should be applied broadcast pre-plant. If the soil P is below optimum, 20-30 lbs/ac should be applied as 2 x 2 at planting and remainder broadcast (Jones et al., 2011).

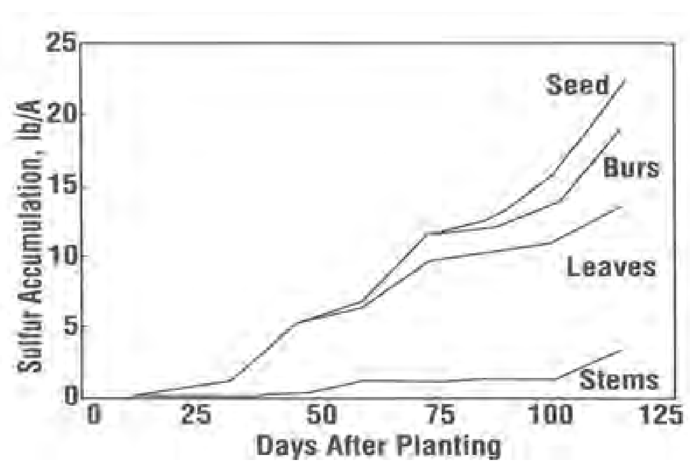
Cotton growth and development is greatly influenced by the availability and uptake of **potassium (K)**. It is an activator of many enzymes which control biological processes within the plant. "Potassium reduces the incidence and severity of wilt diseases, increases water use efficiency, and affects fiber properties like micronaire, length, and strength. It is important in maintaining sufficient water pressure within the boll for fiber elongation. Thus the need for potassium increases dramatically during early boll set" (Stewart, 2005). Cotton will take up approximately 60 lbs of potassium per bale harvested.

Sulphur (S) is absorbed by cotton roots as the divalent anion sulphate (SO_4^{-2}). It can also be absorbed through the leaves as sulphur dioxide (SO_2). Root absorption is more important in plant health and nutrition. Sulphur is a component of amino acids contributing to protein synthesis and is involved in enzymes and other plant metabolism processes (Main, 2012). Sulphur deficiencies in cotton have become more common in recent years. Sulphur deficiency resembles nitrogen deficiency with general yellowing of leaves. The primary difference is sulphur deficiency appears on the young leaves and nitrogen deficiency is displayed on the older leaves as shown in photos 2.0 and 3.0.

Photo 2.0
Sulphur deficiency in cotton. (Univ. of Tenn.)

Photo 3.0
Early stages of sulphur deficiency in cotton. (IPNI)

Cotton will utilize approximately 15 lbs of S per bale of cotton harvested. Ample S needs to be available for uptake as the cotton plant demands it throughout the growing season. Graph 1.0 illustrates the accumulation of S which continued to increase throughout the growing season until cotton matured. This shows the need for S availability especially during the reproductive growth stage.



Graph 1.0
Average sulphur uptake in cotton. (Mullins & Burmester, 1995)

Adequate sulphur fertilization is important where higher rates of nitrogen are applied. Plant tissue analysis is suggested to monitor nutrient status within the plant and prevent hidden hunger. The N:S ratio within the plant can be an indicator of sulphur nutrition (Harris, 2016). There is a wide range of acceptable N:S ratios 10:1 – 15:1 in published literature. Therefore, consult a professional agronomist or your local university extension professional for guidance in your specific production area.

Micronutrients that cotton tends to respond to are boron (B), zinc (Zn), and manganese (Mn). Generally, cotton will not respond to all three micronutrients in same trial or field. Response to each micronutrient is more regionalized; therefore, utilize soil sample analyses and plant tissue analyses to determine the needs on a field-by-field basis. Otherwise, the advice of a professional agronomist or university extension professional is suggested for specific recommendations.

Supporting Research

TIGER-SUL strives to enhance our products and determine the most appropriate application rates of our products that provide the optimum return on your investment. To that end, research trials were established in various areas to evaluate crop response to sulphur and micronutrients. Figure 2.0 reveals a 449 lbs/ac yield increase of seed cotton with TIGER 90CR sulphur. This trial was an average of 23 trials over 3 years. The application rate was 30 lbs/ac S with 33 lbs/ac of TIGER 90CR. In the Mississippi Delta region there were 11 on-farm field trials established with TIGER sulphur and micronutrient products to evaluate cotton response. TIGER Zn 18% provided a 500 lbs/ac yield advantage and TIGER Boron 2% resulted in a 300 lbs/ac greater yield compared to the untreated control. These trials received 30 lbs/ac of actual S, 7.5 lbs/ac Mg, 8.3 lbs/ac Zn, 0.75 lb/ac B (Fig. 3.0). In both data sets the control and TIGER treatments received N, P, and K based on soil test analyses as the farmer normally maintained his nutrient management program.

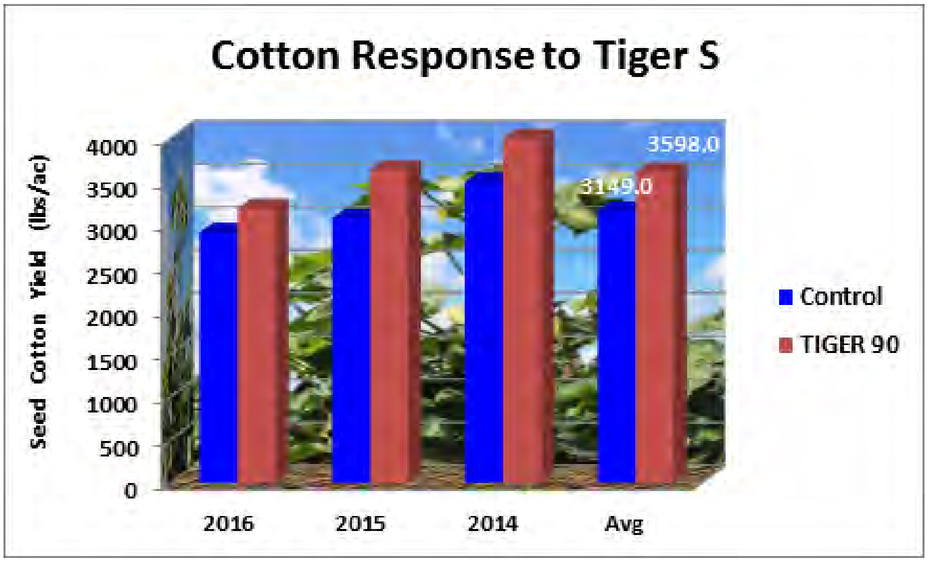


Figure 2.0 Sulphur contributes to cotton yield.

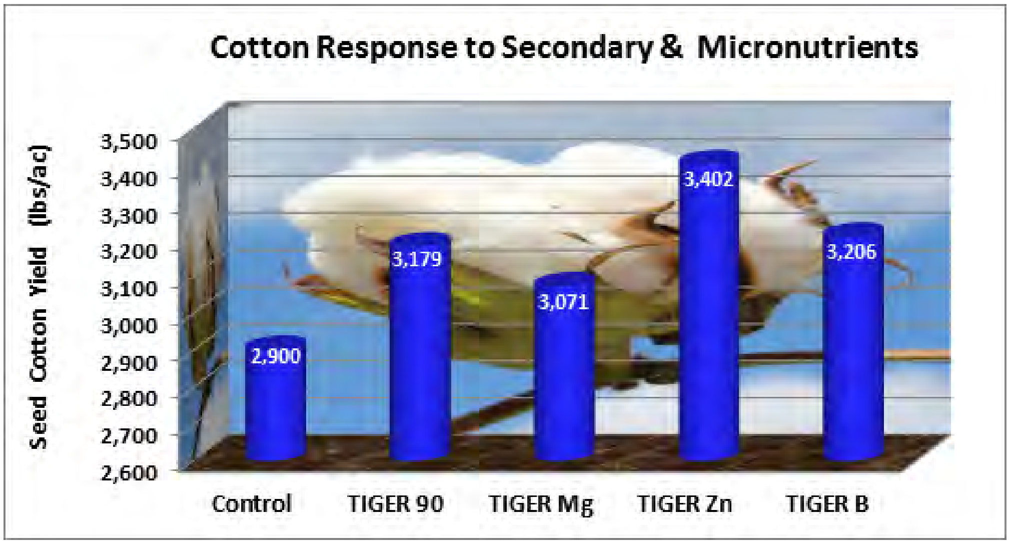


Figure 3.0 Influence of S, Mg, Zn, and B on cotton yield. Average of 11 trials in 2016.

"A complete fertility program is critical to achieving optimum cotton yields and maximum profit. Balancing nutrient inputs with other critical management inputs, including water, variety, tillage, and rotation, helps ensure that maximum efficiency of production and profit is realized" (Steward, 2005). The gradual S conversion to SO_4 with TIGER products provides ample SO_4 to cotton plants throughout the growing season. Including TIGER-SUL products in your cotton nutrient management program is a major step toward optimizing returns on your fertilizer investment.

References:

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