2002 BELTWIDE COTTON CONFERENCES, ATLANTA, GA – JANUARY 8-12

COTTON RESPONSE TO POTASSIUM APPLICATIONS

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Abstract

The Agronomic Division of the N.C. Department of Agriculture and Consumer Services (NCDA&CS) conducted a two-year study to evaluate the effect of soil-applied potassium on yield of cotton (*Gossypium hirsutum L.*). Growers in North Carolina routinely make spring applications of potassium to cotton fields to ensure a high level of soil fertility. Historical NCDA&CS soil test data indicate that a cotton crop grown on a soil containing 176 ppm (soil K index 90) of Mehlich-3–extractable K does not require additional potassium. However, many growers continue to apply potassium to achieve "highest possible" yields.

The objective of this study was to determine whether additional potassium is justified. Three rates of potassium (0, 67,134 kg/ha) were applied in replicated plots at three locations having soil K indexes ranging from 70 to 95 in major cotton-producing areas of the coastal plain of North Carolina. Leaf tissue and petiole analyses were conducted weekly from early bloom through fifth week of bloom during the growing season to measure potassium levels within the crop. Mean petiole K values remained 4% or greater for each sampling period over the 2-year study. Overall average yields for the study were 1,006 kg/ha and 1,068 kg/ha for study years 2000 and 2001, respectively. Data indicate no response to soil-applied potassium at all locations. This study validates current NCDA&CS soil test recommendations for potassium applications to cotton.

Introduction

Cotton (*Gossypium hirsutum* L.) growers in North Carolina routinely make spring applications of potassium to their cotton fields to ensure a high level of fertility. The NCDA&CS Agronomic Division does not recommend additional potassium if soil test results indicate the presence of 176 ppm of Mehlich-3 extractable potassium [potassium index (K-I)=90], yet many growers conclude their fields need additional potassium. Therefore, many growers routinely apply more potassium than their soil test report recommends because they think it is necessary to ensure high levels of fertility and highest possible yields. Research was conducted in 2000 and 2001 by the NCDA&CS Agronomic Division to investigate the influence of soil-applied potassium on cotton yield and quality as well as the effect of potassium content of the leaf and petiole on yields.

Objectives

The primary objective of this study was to investigate the influence of soil-applied potassium on cotton yield. Leaf and petiole potassium were measured periodically throughout the growing season to check plant uptake and determine whether potassium is, in fact, a yield-limiting factor.

Materials and Methods

Field studies were conducted in Cumberland, Gates and Wayne counties during 2000 and 2001. Soil samples were collected from each plot prior to planting. These fields had an average pH of 6.3 and an average NCDA&CS soil-test K-I value of 73. Other soil fertility factors were adequate for cotton production at the site.

Plots were laid out in a modified complete block design with three replications. Treatments consisted of three preplant potassium treatments: 0, 67.2 and 134.4 kg of potash (K_2O) per hectare supplied from blended fertilizers. In 2000, all treatments were disked and row beds were established; in 2001, all plots were strip tilled.

Standard cotton varieties for the area were planted in May of each year. These included 'Suregrow 501 BG/RR,' 'Suregrow 501,' 'Fibermax 958' and 'Deltapine 5415 RR.' Cooperating growers implemented all management considerations. Leaf and petiole tissue samples were collected from each plot at four stages of plant growth during the growing season. Plot yields were measured for all locations using standardized open-boll–counting procedure or actual weight measurement taken with a weigh wagon.

Results and Discussion

In 2000, varied growing conditions existed for each test, with the Gates County location being very wet, the Cumberland County location being dry early in the season, and the Wayne County location having the most optimum weather for cotton production. Yield data from the three sites show no response to soil-applied potassium (Figure 1). The soil potassium values of the control plots at each site were approximately 140 ppm (NCDA&CS K-I=70) so minimal benefit from extra potassium was anticipated. In 2001, there was also no yield response to applied potassium (Figure 2).

Leaf and petiole data show declining potassium levels after bloom (Figures 3–8). In cotton, the uptake rate and accumulation of potassium reach a maximum at peak bloom then decline until maturity of the crop (Mullins and Burmester, 1990). During the peak period, plants can take up 1.4–1.8 kg K_2O daily.

Sufficiency ranges for leaf and petiole potassium have been compiled, and critical levels of potassium in the leaf and petiole have been shown to decline after bloom (Anderson et al., 1971; Bassett and MacKenzie, 1976; Hodges and Hadden, 1992). At bloom, the critical value for leaf potassium is 1.5 percent (NCDA&CS K-I=50). As plants mature, the accepted critical value is 0.75 percent.

These researchers also report petiole potassium critical values during bloom and document declining values as bloom progresses. The critical value is 4 percent at bloom and 3 percent four weeks after bloom. Data from the current study confirm movement of potassium from leaves and petioles, but even so, leaf and petiole potassium levels remained well above critical values for each fertilizer regime.

Conclusions

Current NCDA&CS recommendations for potassium soil applications in cotton are validated by these tests. Cotton does not require additional potassium fertilizer if soil potassium levels are 140 ppm or higher, or if the NCDA&CS soil-test K-I value is 70 or higher. Yield and grade of cotton were not affected by fertilizer regime since an adequate supply of extractable potassium was available to the plants. Leaf potassium and petiole potassium data indicate that the test plants were never deficient in potassium.

References

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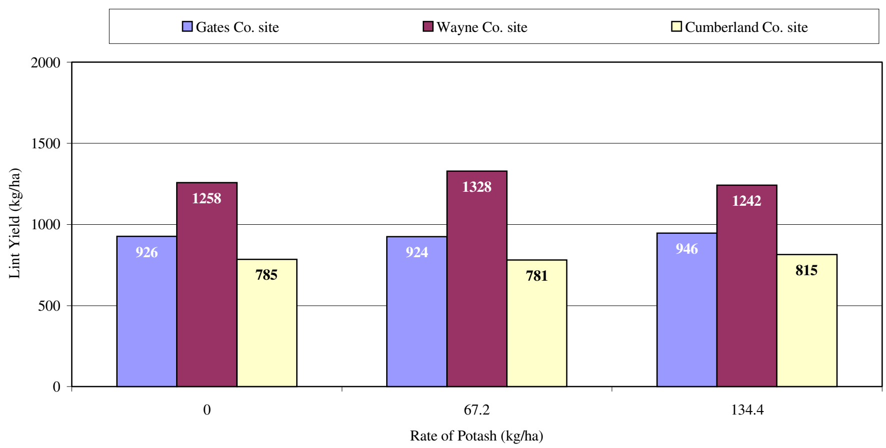

Figure 1. Cotton yield, 2000.

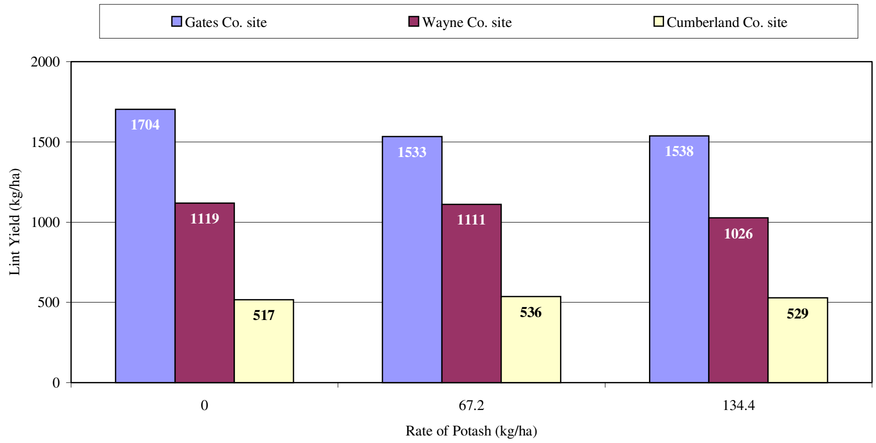

Figure 2. Cotton yield, 2001.

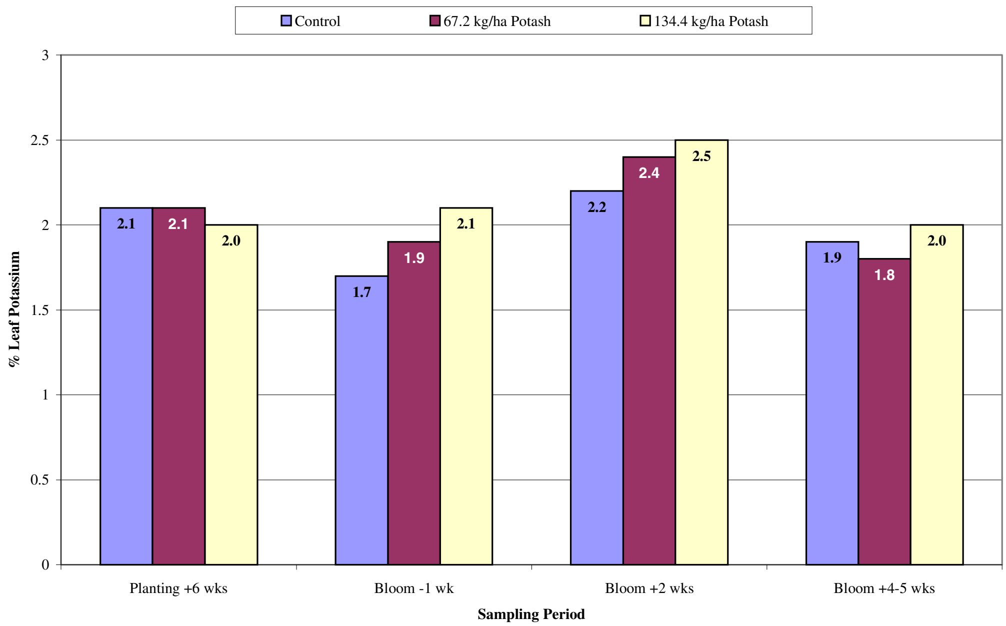

Figure 3. Cotton % leaf K, Cumberland County, 2000.

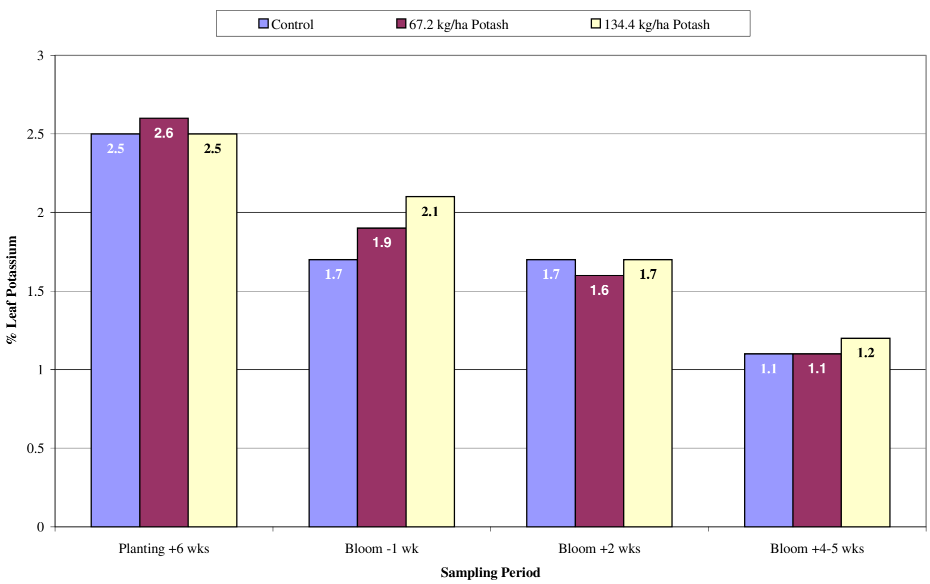

Figure 4. Cotton % leaf K, Gates County, 2000.

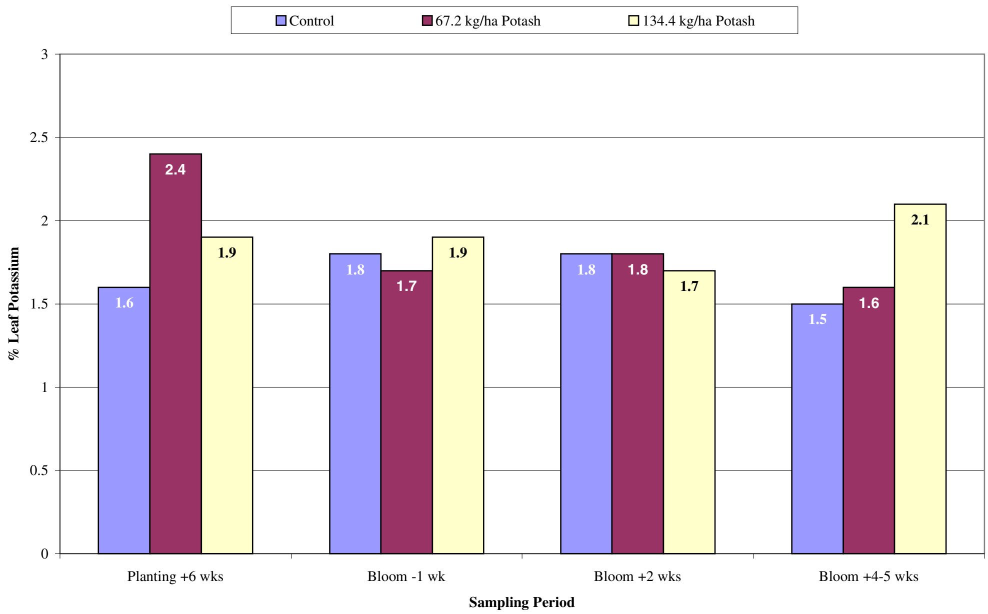

Figure 5. Cotton % leaf K, Waynes County, 2000.

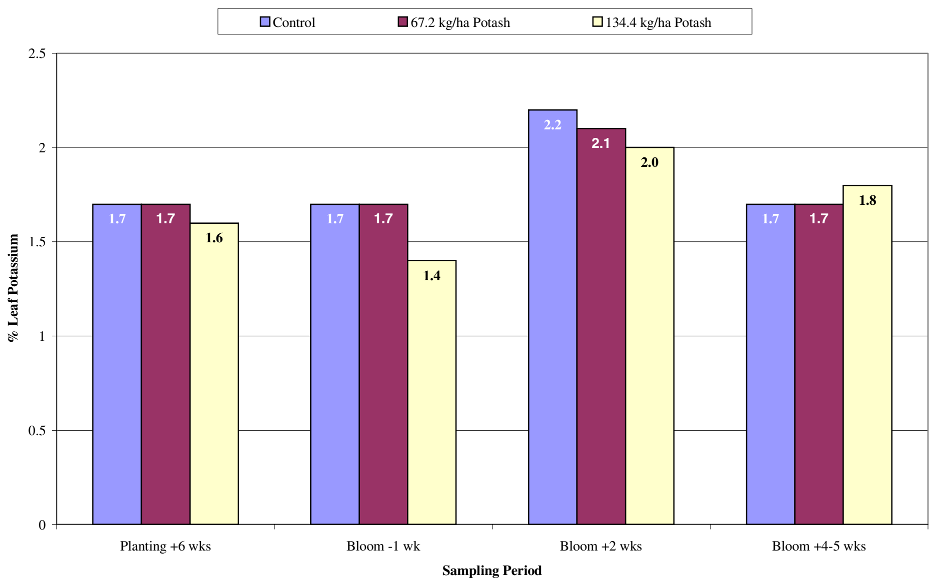

Figure 6. Cotton % leaf K, Cumberland County, 2001.

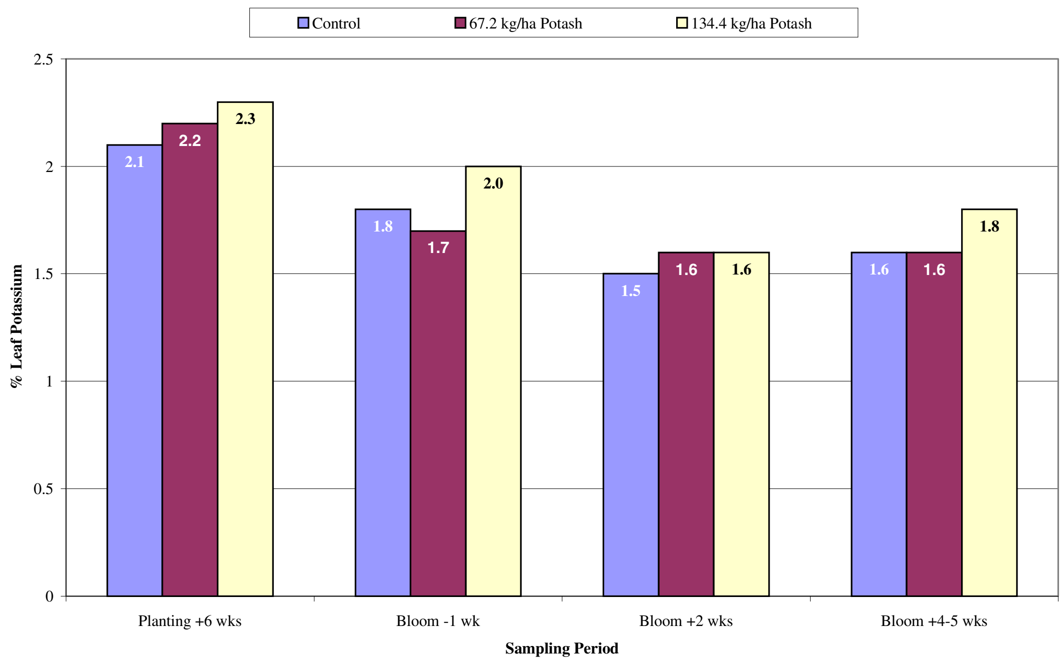

Figure 7. Cotton % leaf K, Gates County, 2001.

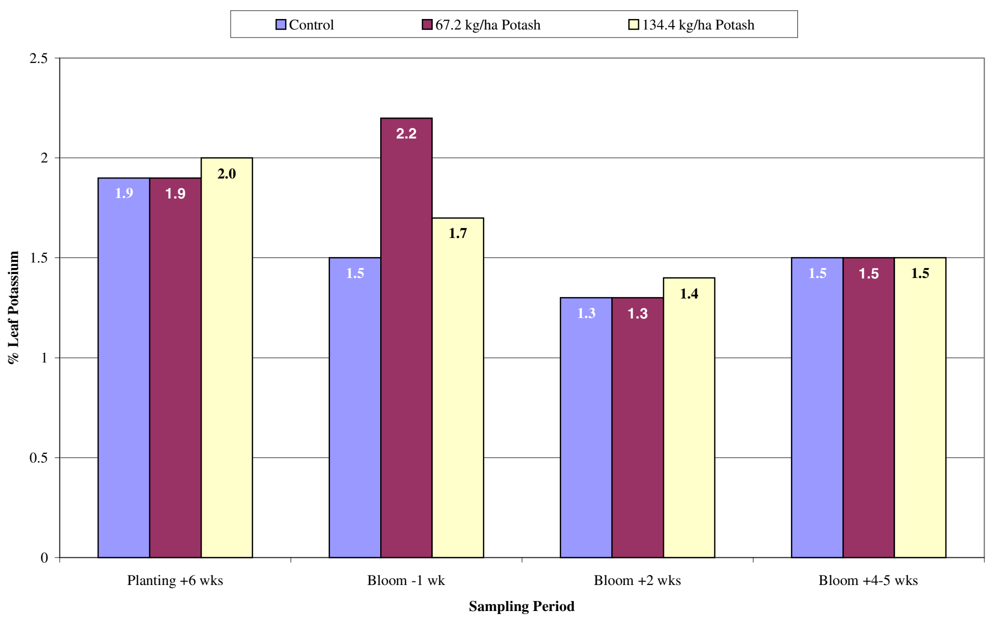

Figure 8. Cotton % leaf K, Wayne County, 2001.