EVALUATION OF COTTON YIELD, QUALITY, AND PLANT GROWTH RESPONSE TO SOIL APPLIED POTASSIUM

Michael C. Spiegelhauer
Texas A&M University
College Station, TX
Gaylon D. Morgan
Mark L. McFarland
Dennis L. Coker
Dale A. Mott
Tony L. Provin
Texas A&M AgriLife Extension Service
College Station, TX

Abstract

The frequency and severity of potassium (K) deficiency symptoms on the highly productive clay soils in the Central Blacklands and Gulf Coast regions of Texas have increased in recent years. While continuous dry conditions have undoubtedly contributed to this consistent occurrence of deficient K symptoms, the frequency and widespread geographic nature of the K deficiencies in multiple row crops, specifically cotton, is a major concern to producers and scientists. Two locations in the Central Blacklands and Gulf Coast regions were chosen based on soil sampling for low to medium soil K levels. Five rates of injected liquid K and four rates of dry broadcast K were evaluated. During the season, plant measurements were taken including height, total nodes, and nodes to first fruiting branch. There was some variation in height and total nodes between differing amounts of K applied, but the biggest visual differences between plots were the presence of K deficiency symptoms in the leaves. Plots with higher rates of K, showed fewer signs of K deficiencies. After the growing season, plots were harvested, seed cotton weighed, and then ginned. After ginning, samples were sent to Cotton Inc. for HVI analysis. Plots with higher rates of liquid K showed the greatest yield response, the greatest fiber quality response and the greatest return on investment.

Introduction

For the past decade, Texas has continued to dominate U.S. cotton production. Much of the state's cotton is produced on clay soils in the Blacklands of Texas and Gulf Coast. Although K deficiencies have been reported in these regions in various years over the past 20 years, the frequency of reported K deficiency symptoms seems to be on the rise, and the geographic occurrence seems to be increasing as more K is mined from the soils. Additionally, under deficient K levels, cotton plants are more prone to foliar diseases that can further reduce the yield potential.

Previous research has shown a two bale cotton crop will remove 30 lbs K/acre. While a 2 bale rainfed crop is generally considered strong, increased yield potential in new varieties and better pest management have pushed cotton yields to 3-4 bales, and even exceeding 5 bales on irrigated land. As K demand continues to increase, deep profile soil samples indicate a reduced level of plant available K in some production areas. The objective of the research was to evaluate the effect of K application rates and methods on cotton growth, development, yield, and fiber quality.

Materials and Methods

Studies were initiated at two field sites with a previous history of K deficiency, one in Williamson County in the Blacklands region and one in Wharton County in the Upper Gulf Coast region. Based on soil test results, 0 and 60 lbs K_2O/acre were recommended for the Wharton and Williamson sites, respectively, and soil test K (ammonium acetate) levels were 150 and 60 for the sites. Treatments were 0, 20, 40, 80, 120, and 160 lbs K_2O/acre applied using liquid 0-0-15 as KCl, and 40, 80, 120, and 160 lbs of K_2O/acre applied as a granular 0-0-60. The liquid K treatments were injected approximately four inches to the side of the row at a 6 inch depth. The dry treatments were broadcast by hand and incorporated with light tillage. Both K application methods occurred 2 - 3 weeks prior to planting. In early April, cotton cv. DP 0935B2RF was planted into a Lake Charles clay loam at the Wharton site. In mid-April, cv. Phytogen 499WRF was planted into a Burleson clay at the Williamson county site. Phosphorous and nitrogen were applied according to soil test recommendations for 2 bale/acre cotton yield goal.

In-season plant measurements included stand counts, plant height, nodes to first fruiting branch, and total nodes. After harvest, yield was calculated, and samples sent to Cotton Inc. for HVI analysis. For return on investment calculations, a base value of 75 cents/lb of lint was used and then lint values calculated using the 2013 loan calculator provided by Cotton Inc. The return on investment calculations only include fertilizer costs and are presented relative to the untreated check. Fertilizer prices used were $520 per ton of 0-0-60 and $275 per ton of 0-0-15.

Results and Discussion

Yield and other significant data for the 2013 crop are presented in Figures 1-4. There was below normal rainfall for most of the growing season at both locations, but good yields were obtained due to the timeliness of the rain. Visually, the biggest differences between treatments were the presence and severity of K deficiency symptoms in the leaves. Plots with higher rates of K, especially injected liquid K, showed fewer K deficiency symptoms. Higher rates of K had a small effect on plant height in the Wharton location but seemingly no effect at the Williamson location (Figure 1). Near the end of the season, weather conditions were conducive for some foliar disease, and disease symptoms were observed in the K deficient treatments. Overall, there appears to be a positive correlation with amount of K applied, and the impact on yield and plant health. Treatments with a high rate of liquid K had higher yields compared to a similar rate of dry K at both locations (Figure 2). This could be attributed to placement and mobility of K in the soil. The liquid K was placed in the active root zone while the dry K was less plant available due to dry soil surface conditions.

The highest rates of injected K had a slight positive effect on lint loan price at the Wharton location, while the dry K had no significant effect. At the Williamson location, there were mixed effects on loan price due to high micronaire (Figure 3). When the K rate and price factors are used to calculate the net return on investment, fewer significant differences were observed for both sites (Figure 4). Despite the highest injected rates being considered unrealistic for farmers, a significant return on investment was obtained from the higher injected rates. As with yield, the liquid treatments had a higher return on investment than the dry treatments of a similar rate.

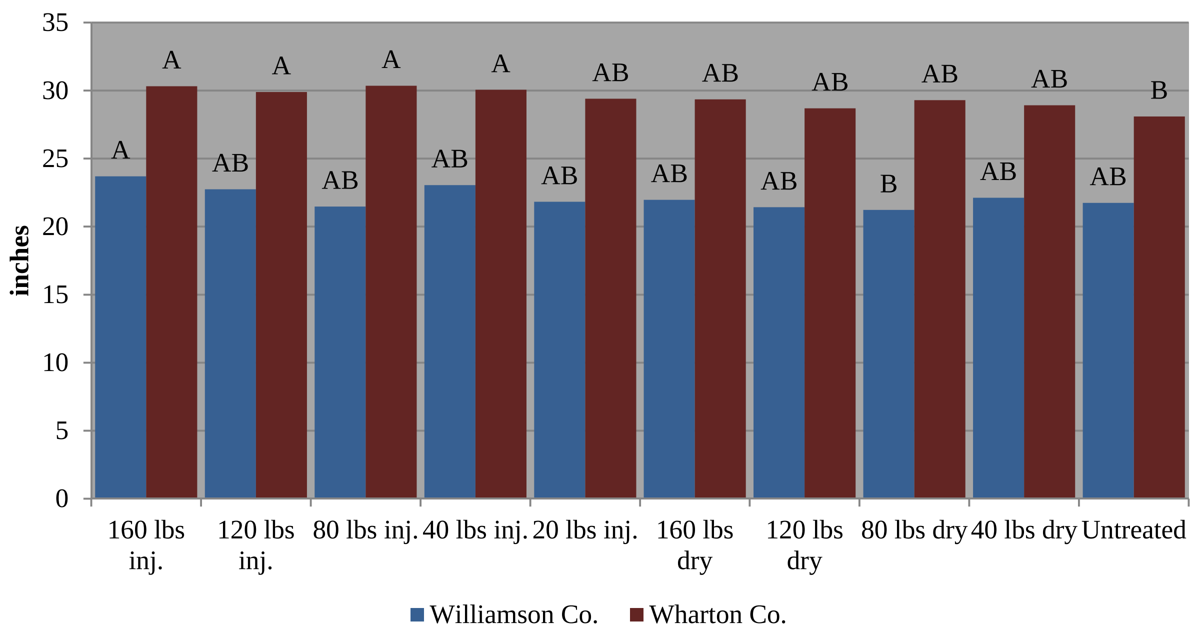

Figure 1: Plant Height

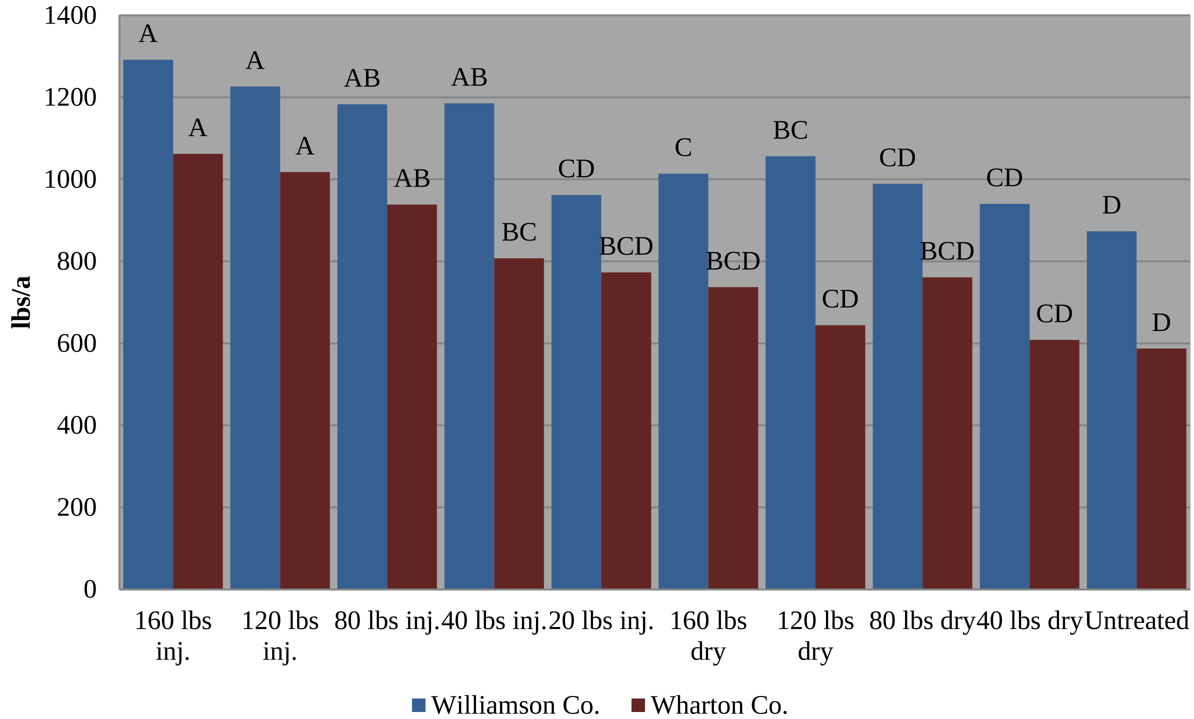

Figure 2: Yield

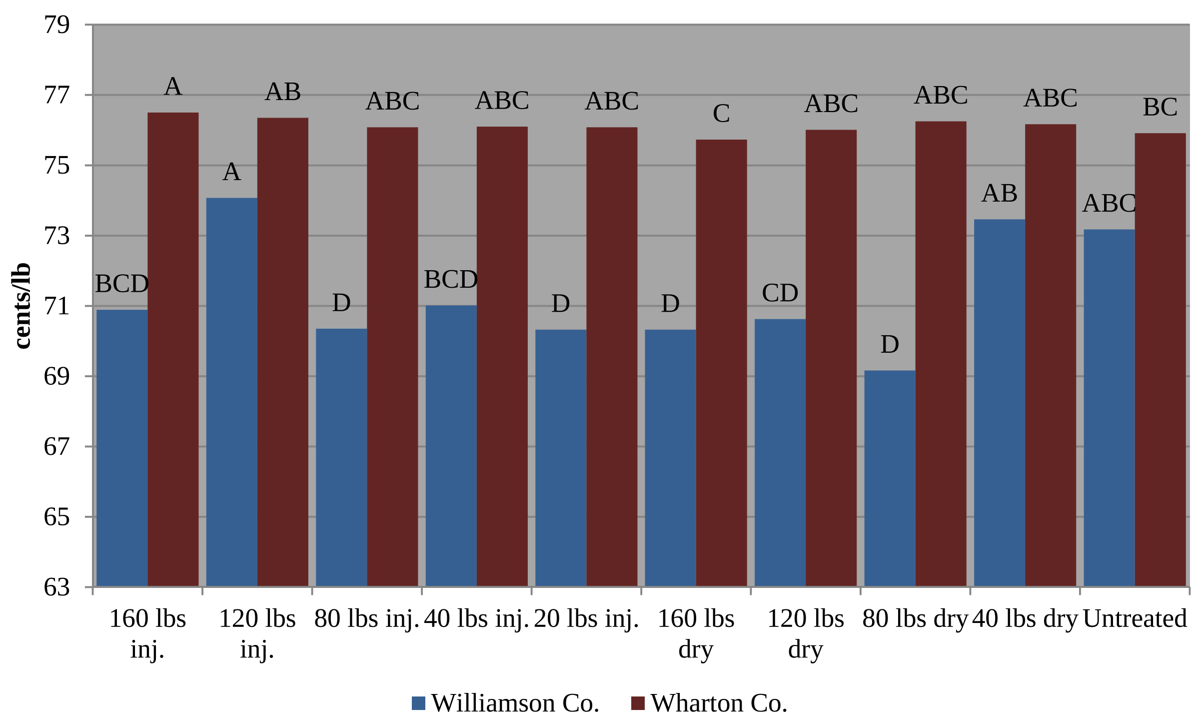

Figure 3: Net Loan Price

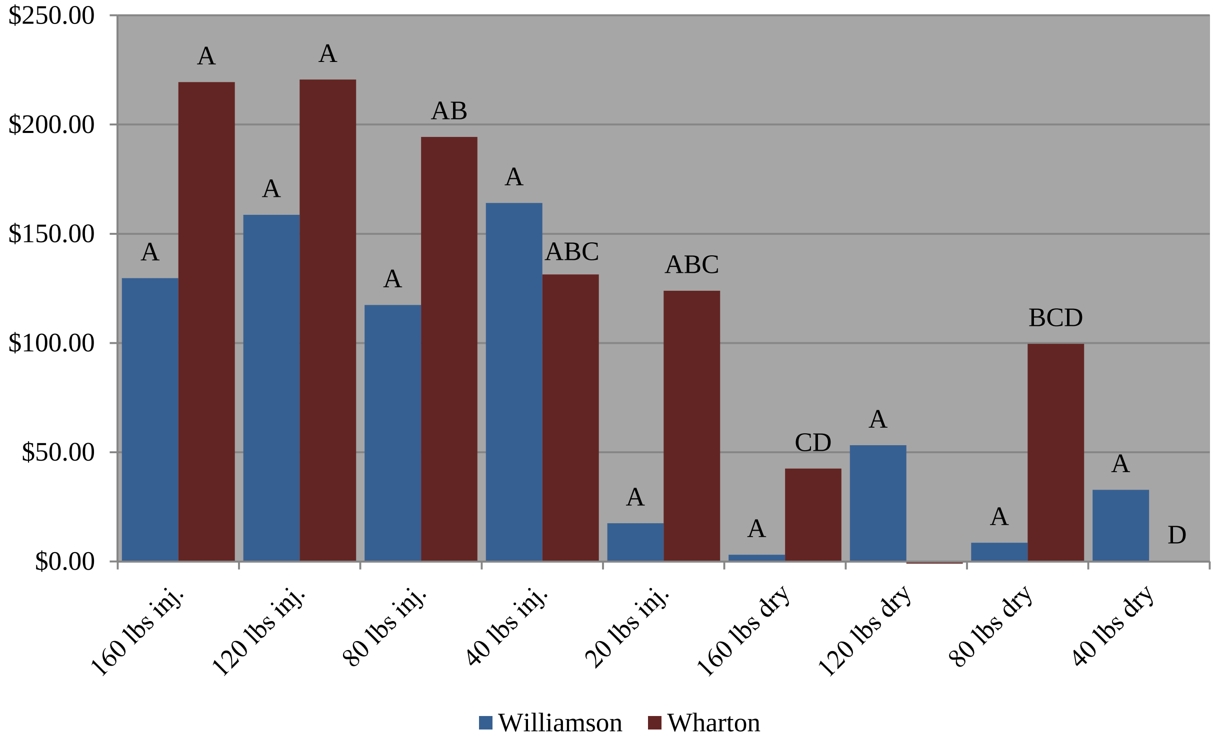

Figure 4: Return on Investment

Conclusions

Applications of K had a positive effect on yield and fiber quality in soils with 150 ppm of soil K or less. Treatments with injected liquid K showed greater plant response than treatments with dry K and therefore a higher K use efficiency. Return on investment was higher, on average, for the injected treatments versus the dry treatments.

Acknowledgements

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