COTTON'S RESPONSE TO INJECTED SOIL APPLIED POTASSIUM

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Summary

The frequency and severity of potassium (K) deficiency symptoms in cotton on the highly productive clay soils in Texas have increased in recent years. Two locations with low to medium soil K levels were chosen for these trials. Four rates of injected liquid K and four rates of dry broadcast K were evaluated. Plant growth measurements, yield, and quality were recorded. Visual K deficiency symptoms were observed in the low rates of broadcast K. The injected K yields were significantly higher than the broadcast applications. Micronaire values increased with increasing injected K rates, while other fiber qualities were not impacted.

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 by crops. Additionally, under deficient K levels, cotton plants are more prone to foliar diseases that can further reduce the yield potential.

Previous research has shown an 1100 kg/ha cotton crop will remove 33 kg K/ha. While a 1100 kg/ha rainfed crop is generally considered good, increased yield potential in new varieties and better pest management have pushed cotton yields to over 2,000 kg/ha, and even exceeding 2,500 kg/ha on irrigated land. As K demand by the cotton continues to increase, deep soil profile 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.

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, 67 and 0 kg K_2O/ha were recommended for the Williamson and Wharton county sites, respectively, and soil test K (ammonium acetate) levels were 60 and 150 ppm for the sites. Treatments were 0, 22, 44, 88, 134, and 180 kg K_2O/ha applied using liquid 0-0-15 as KCl, and 44, 88, 134, and 130 kg K_2O/ha applied as a granular 0-0-60. The liquid K treatments were injected approximately 10 cm to the side of the row and at a 15 cm depth (Figure 1). 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 1100 kg/ha cotton yield goal. Both locations were non-irrigated sites and were managed for insects and with plant growth regulators according to best management practices for each region.

FIGURE 1. Liquid potassium fertilizer (0-0-15) being injected in 2013 trials.

FIGURE 2. Potassium deficiency symptoms and disease incidence on cotton leaves in untreated plot.

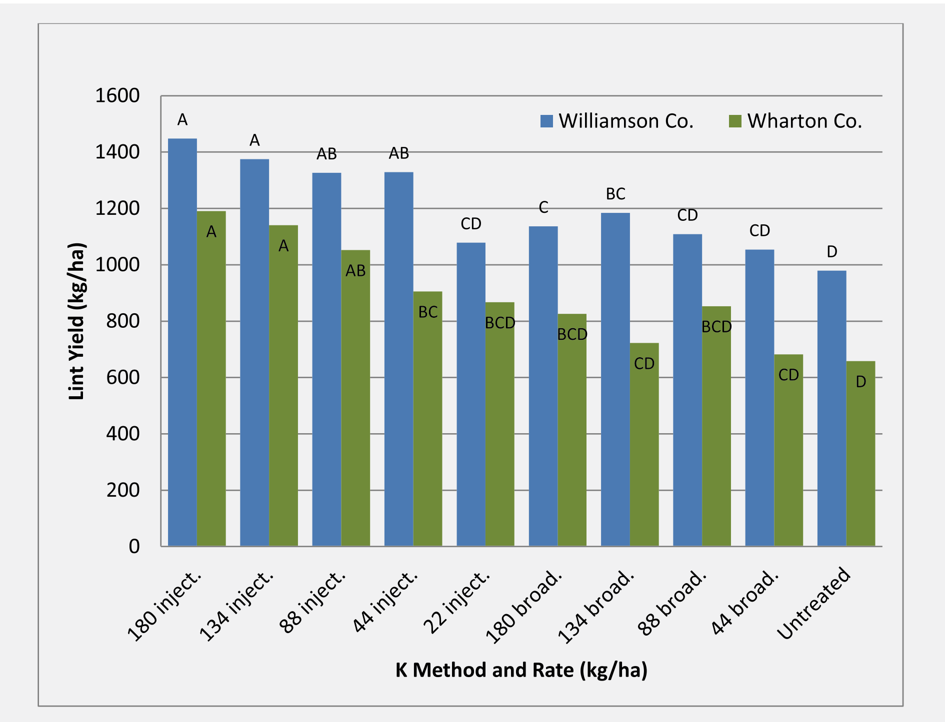

FIGURE 3. Cotton lint yield as impacted by potassium application rate and application methods (injected and broadcast incorporated) on clay soils in Texas, U.S.A.

In-season plant measurements included stand counts, plant height, nodes to first fruiting branch, and total nodes. After harvest, yield was calculated, and fiber samples sent to Cotton Inc. for HVI analysis. For return on investment calculations, a base value of 1.65 cents/kg of lint was used and then lint values calculated using the 2013 loan calculator provided by Cotton Inc. Cotton seed value was not included in the return on investment calculations. The return on investment calculations only include fertilizer costs and are presented relative to the untreated check. Fertilizer prices used were $0.57 per kg of 0-0-60 ($0.95/kg of K_2O) and $0.28 per kg of 0-0-15 ($1.88/kg of K_2O).

Discussion and Results

There was below normal in-season 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 the K treatments were the presence and severity of K deficiency symptoms in the leaves and disease incidence (Figure 2). Plots with higher rates of K, especially injected liquid K, showed few to no K deficiency symptoms. Higher rates of K had a small effect on plant height in the Wharton location but little to no effect at the Williamson location. Near the end of the season, weather conditions were conducive for some foliar disease, and disease symptoms were observed on the K deficient plants. Overall, there was a very positive response to the injected K application, on plant health and corresponding yield in the Williamson county location. The Wharton county location, with 150 ppm K, did not show foliar deficiency symptoms, but a positive yield response did occur to the injected applications. Treatments with a high rate of liquid K had higher yields compared to a similar rate of dry K at both locations (Figure 3). This is likely attributed to placement of K 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 levels in the higher injected K treatments. 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 most farmers, a significant return on investment was obtained from these rates. As with yield, the liquid treatments had a higher return on investment than the dry treatments of a similar rate.

In conclusion, applications of injected K had a positive effect on yield in soils with 150 ppm of soil K or less. Treatments with injected liquid K showed a higher K use efficiency and greater return on investment, on average, for the injected treatments versus the dry treatments. As a result of these trials, four additional trials were initiated in 2014 and the current soil test critical threshold level of 125 ppm K for Texas will likely be increased for injected applications.

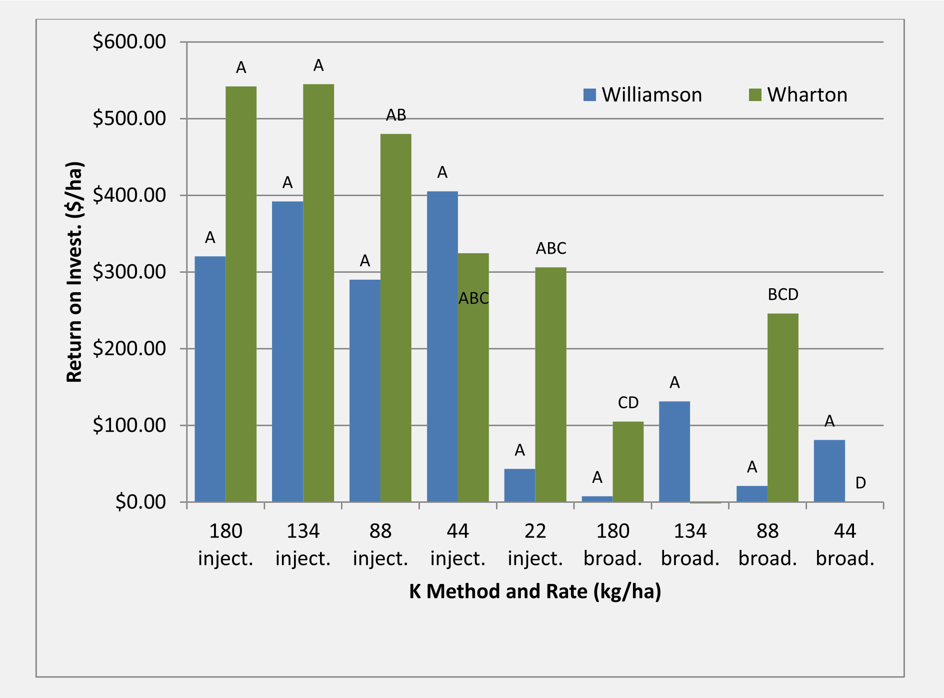

FIGURE 4. Return on investment as impacted by potassium application rate and application methods (injected and broadcast incorporated) on clay soil in Texas, U.S.A.

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