IMPACT OF SOIL APPLIED POTASSIUM ON COTTON YIELD, QUTALITY, AND PLANT GROWTH IN TEXAS

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Abstract

In recent years, various areas in the Texas Blacklands and Gulf Coast agricultural production regions have reported increased incidence of potassium (K) deficiencies in cotton. Cotton, specifically, is sensitive to low potassium levels reducing yields and fiber quality, as well as making the cotton plant more susceptible to some foliar diseases. In 2013 and 2014, eight locations were chosen to conduct trials on the rate of potassium applied to cotton, as well as the application methods. These sites ranged from low (60 ppm) to high (350 ppm) potassium levels in the soil. Treatments included four rates of granular (0-0-60) broadcasted and incorporated and five rates of liquid (0-0-15) injected fertilizer, as well as, untreated plots. In-season data collection included: plant height, nodes to first fruiting branch, total nodes, and leaf tissue sampling. The plots were harvested by various means, depending on the location. After harvesting was completed, samples were weighed and ginned. Lint samples were sent to Cotton Inc. to test fiber properties by HVI and AFIS analysis. The 2014 trials were non-responsive to the treatments at these two locations, unlike the 2013 trials which had a positive correlation between the amount of fertilizer and application method and yield.

Introduction

For the past decade, Texas has continued to become a larger percentage of the total U.S. cotton production. Much of the cotton production in Texas occurs on clay soils in the Blacklands of Texas and Gulf Coast production regions and potassium deficiencies have been reported in these regions in various years over the past 20 years. However, the frequency of the potassium deficiency symptoms seems to be on the rise, and the geographic occurrence seems to be increasing also as more potassium is mined from the soils. Additionally, under deficient potassium levels, cotton plants are more prone to foliar diseases that can further reduce the yield potential. Potassium is required in large amounts by cotton for normal growth and fiber development. Potassium plays a major role in photosynthesis, activation of protein enzymes, increases disease and drought resistance, and positively affects cotton fiber yield and quality. Previous research has shown a two bale cotton crop will remove 30 lbs/acre of potassium annually. However, increased yield potential in new varieties and better pest management have pushed cotton yields to 3-4 bales and can exceed 5 bales on irrigated land. As potassium demand continues to increase, deep profile soil samples indicate a reduced level of plant available potassium in some production areas.

Objective

To evaluate the effect of K application rates and methods on cotton growth, development, yield, and fiber quality.

Materials and Methods

The 2013 and 2014 trials were carried out in two regions in the Blacklands region including Williamson County at the Torres, Poncho, and Gin sites, as well as, Hill County. Wharton County, in the Upper Gulf Coast, was also included in the trails in both years. The plots were arranged in a Randomized Complete Block Design with five replications. Plot dimensions at the Williamson, Hill, and Wharton sites were 4-6 rows wide and 50 feet long with an in-row spacing of 38, 30, and 40 inches, respectively. Soil samples were collected to a total depth of 48 inches from these locations and were analyzed at depth increments by the Texas A&M Soil Testing Laboratory. The soil analysis results from a Mehlich III extraction method and cotton varieties used in these trials are presented in Table 1. Table 2, shows the treatment data used for the trials. This data were analyzed in SAS using Fisher's LSD means separation formula.

Table 1. Soil recommendations and cotton varieties

Site Year	Recommended lbs K_2o/A	Cotton Variety
Wharton 13	0	DP 0935B2RF
Wharton 14	0	ST 6448GLB2
Williamson- Torres 13	60	Phytogen 499WRF
Williamson- Torres 14	20	Phytogen 499WRF
Williamson- Poncho 13	0	Phytogen 499WRF
Williamson- Gin 14	0	Phytogen 499WRF
Hill 13	0	DP 2570B2RF
Hill 14	0	DP 2570B2RF

Table 2. Treatments used

Fertilizer	Formulation	Rates (lbs K_20/A)				
0-0-60	Granular	untreated	40	80	120	160
0-0-15	Liquid	20	40	80	120	160

The granular treatments were broadcasted by hand and incorporated to an approximate depth of 2 inches with tillage. The liquid potassium fertilizer was injected approximately 6 inches deep and 4 inches to the side of the row. Approximately 2 weeks before planting the granular and liquid fertilizer treatments were applied to the plots. The recommended amount of nitrogen and phosphorous from the soil analysis were also applied to the plots to obtain 2 bale/acre yields. The Williamson and Hill County sites were planted in early April and the Wharton county site was planted in mid- April. In-season plant measurements included stand counts, plant height, nodes to first fruiting branch, and total nodes. After harvest the cotton was ginned with a table-top gin and fiber samples sent to Cotton Inc. for HVI and AFIS analysis.

<u>Results and Discussion</u>

Figure 1 represents soil potassium levels from 0- 48 inches over eight site years. The Williamson- Torres site was the only location where potassium levels were below the current soil test threshold of 125 ppm and in both years stayed relatively consistent throughout the profile. The Wharton site soil test in 2013 shows an increase in potassium with depth, while the 2014 soil test show a higher level of potassium in the shallow and deep ranges of soil with the lowest levels at 12-24". The Hill county site in 2013 showed the highest levels of potassium in 0-6" at 390 ppm and tappers off throughout the profile, while in 2014 it drops down and remains at a consistent level in the profile. This is likely due to natural soil potassium variation and not soil mining. The Williamson- Gin location in 2014 shows high levels at 0-6", but drops below the soil test threshold throughout the profile. The Williamson- Poncho site in 2013 remains consistent from 0-48", ranging from 260 ppm to 300 ppm.

In 2013 the only locations to show a response to the potassium treatments were the Williamson- Torres, figure 2, and Wharton County sites, figure 3. Timely precipitation in 2013, along with response to applied treatments, allowed for good yields at the Williamson- Torres location. Williamson- Torres was unresponsive in 2014, with much lower yields than in 2013 likely due to unfavorable growing conditions. In the 2014 Wharton trial, cotton yield exceeded that of 2013 trial, but with no response to applied treatments. The Hill County locations, figure 4, in 2013 and 2014 yielded relatively well with a slight drop in yield from 2013 to 2014, but did not respond to the applied potassium. Figure 5 and 6 represent the yields at the Williamson- Gin and Poncho locations. The

Williamson- Poncho site received adequate precipitation, which allowed it to yield well, but the Williamson-Gin site in 2014 suffered a loss in yields due to poorly timed rainfall throughout the growing season.

In 2013, treatments in soils containing less than 150 ppm showed a positive correlation in yield to the increasing rates of fertilizer, especially liquid injected treatments. In all cases in the 2014 trials, the yields varied little across treatments with no difference between high rates of fertilizer and the untreated check. Wharton county site had a higher soil potassium levels throughout the soil profile and was not responsive to the K rates or application method. Additionally, the ST 6448GLB2 is a later maturing variety with an extended fruiting period and thus placed less K demand from the soil.

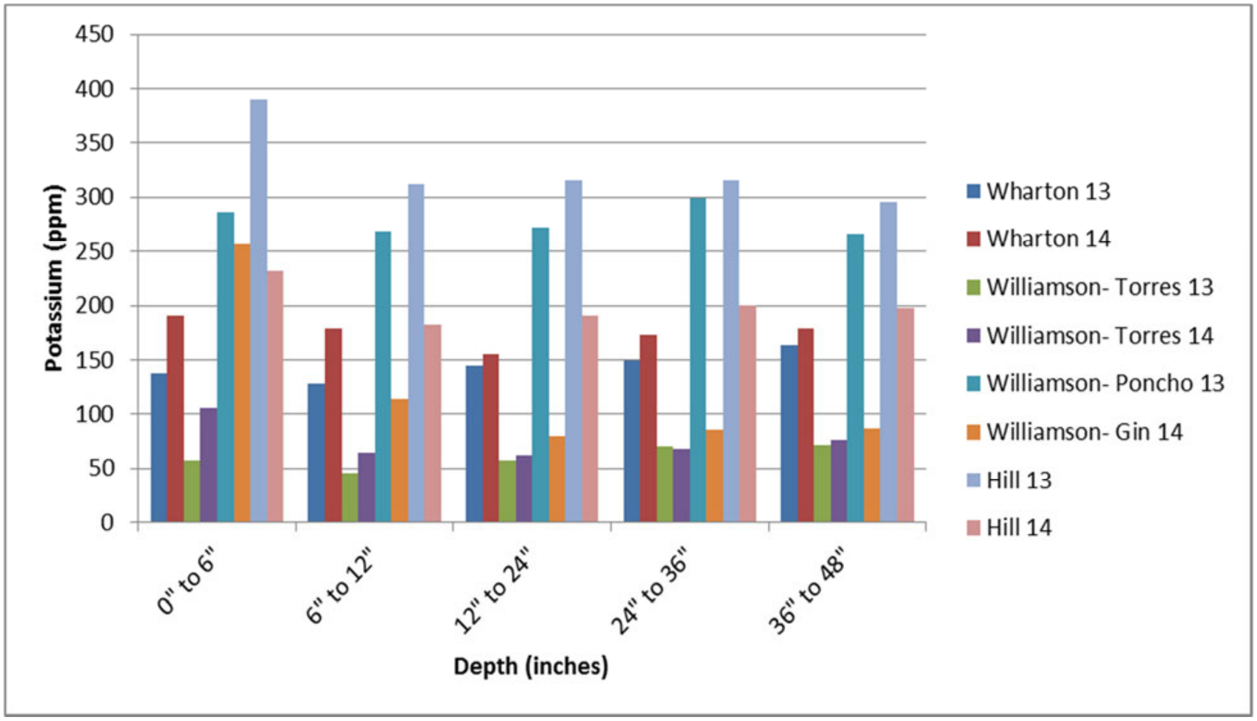

Figure 1.Soil Potassium at Depth

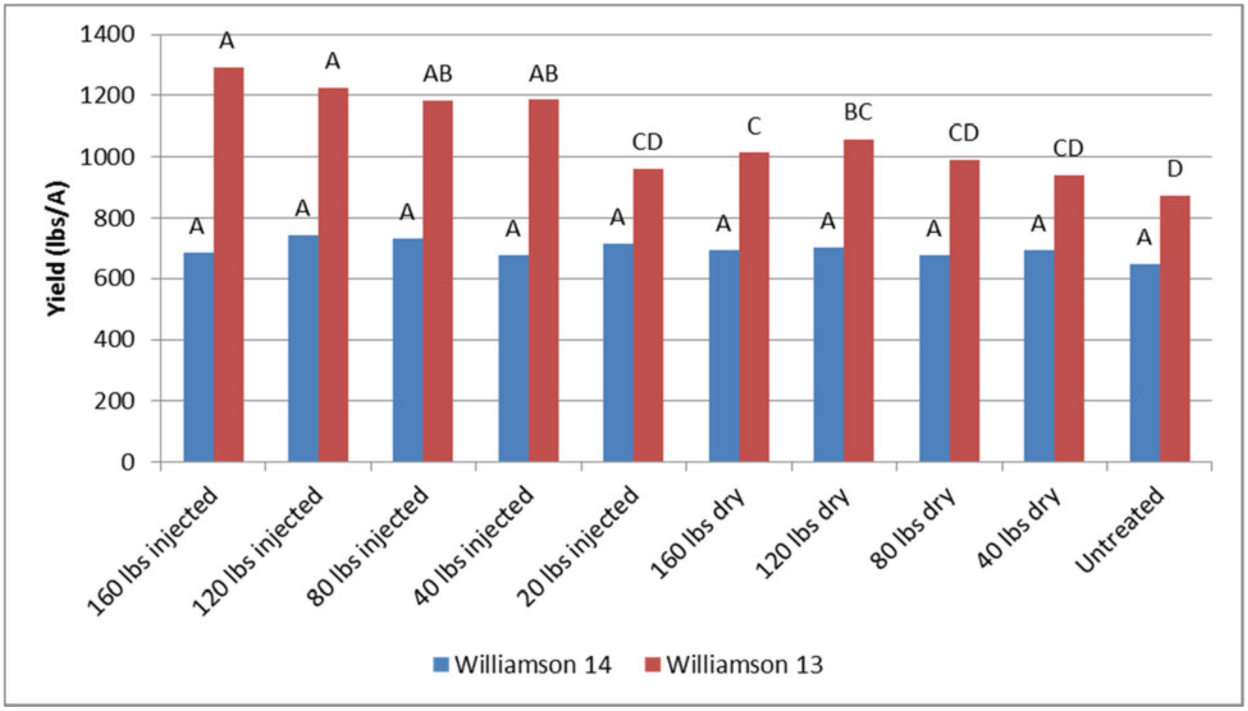

Figure 2.Williamson- Torres yield 2013 and 2014

Figure 3.Wharton county yield 2013 and 2014

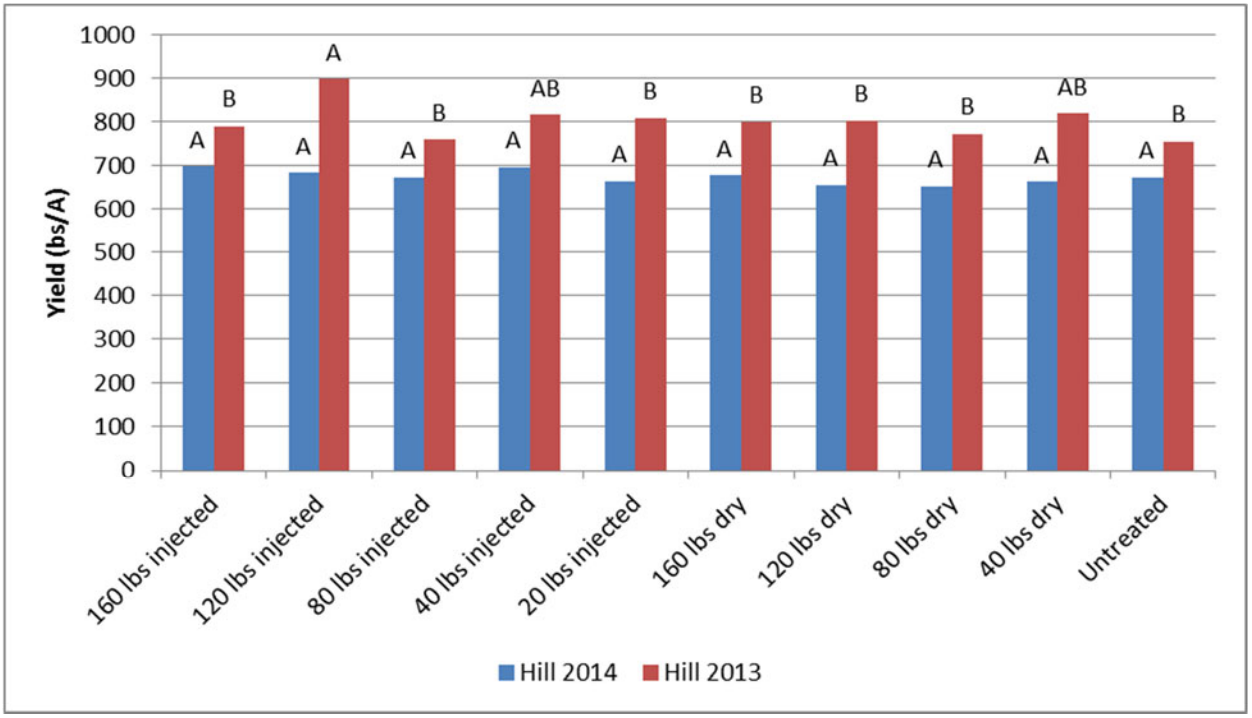

Figure 4.Hill county yield 2013 and 2014

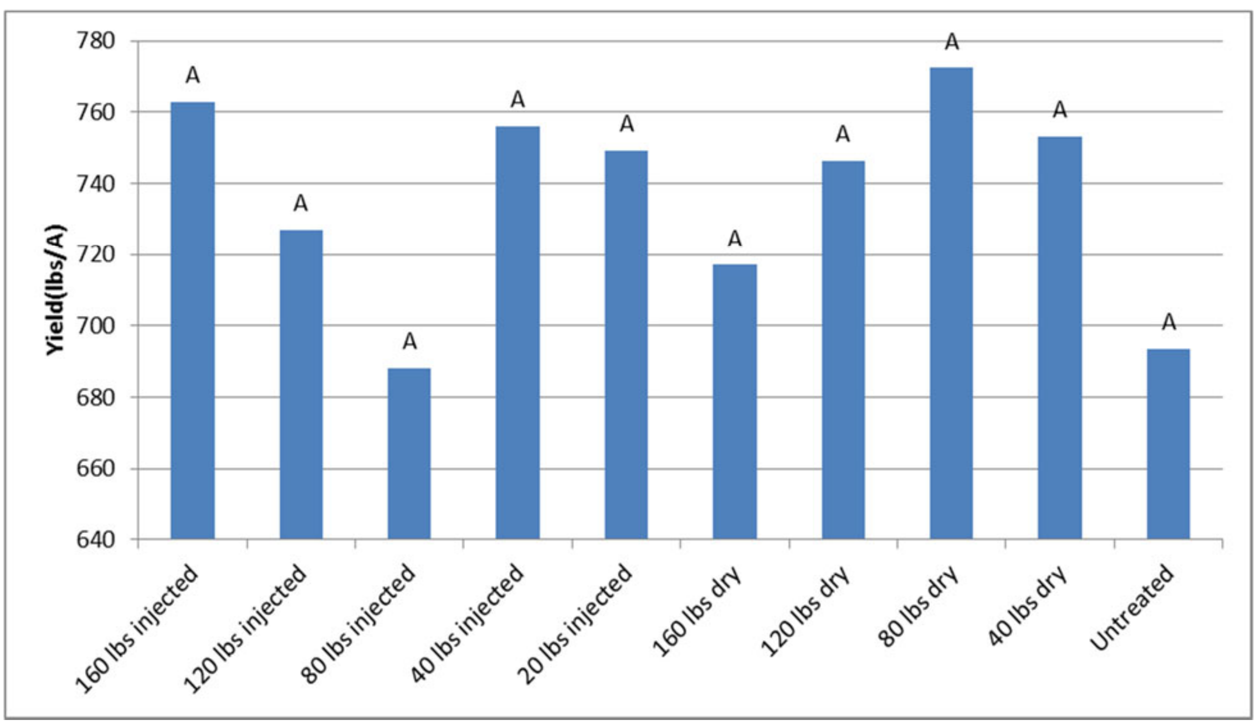

Figure 5.Williamson- Gin yield 2014

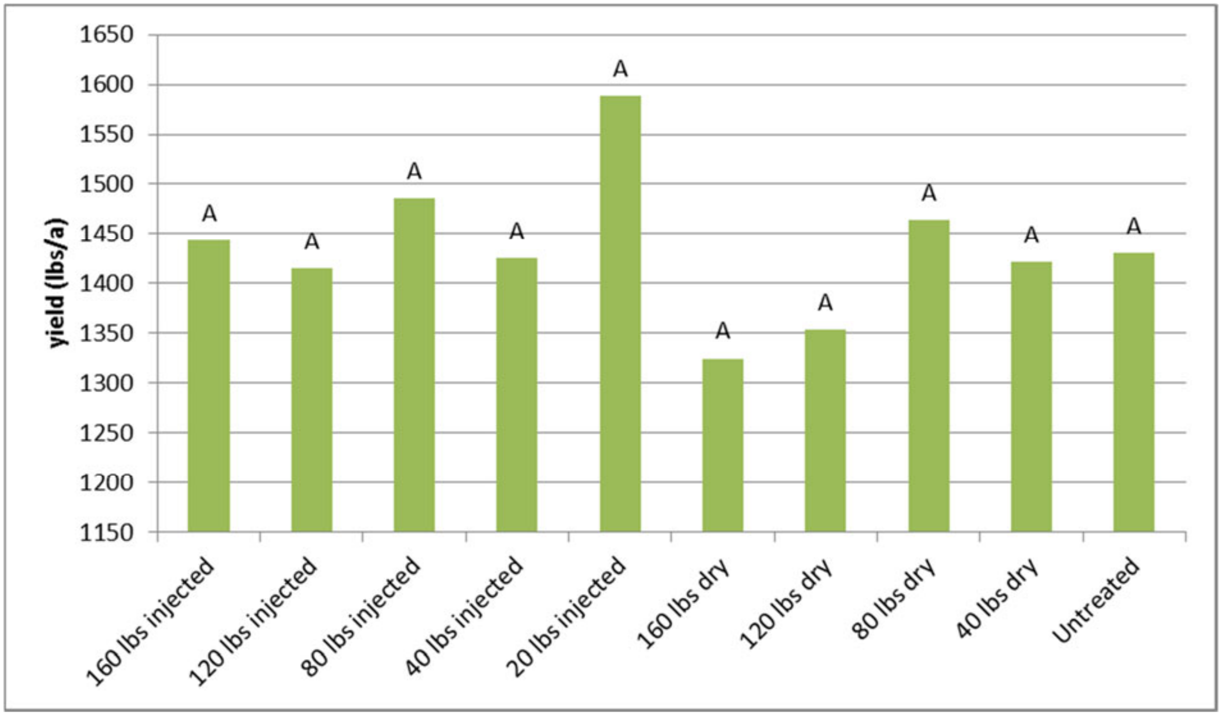

Figure 6.Williamson- Poncho yield 2013