Proposal to International Plant Nutrition Institute

Title: Evaluation of Cotton Yield, Quality, and Plant Growth Response to Soil-Applied Potassium

Locations: Various Cotton Belt States including Texas, Louisiana, Arkansas, Mississippi, Missouri, North Carolina, South Carolina, Alabama, Arizona, Oklahoma, Tennessee, and Virginia**.**

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Justification

The frequency and severity of potassium (K) deficiency symptoms in cotton have increased in some soils in the US Cotton Belt over the past decade or so. Insufficient levels plant available K in these regions are likely decreasing yields and fiber quality and leading to decrease profits for cotton producers. Deficiency symptoms may be observed beginning at first flower but increase in severity as the boll load and boll fill period progress (Reddy et al., 2000). Potassium plays a major role in several critical process, including photosynthesis and activation of protein enzymes. It also 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 lb/acre K annually (Oosterhuis, 2001). Increased yield potential in new varieties and better insect management have pushed cotton yields to 3-4 bales and can exceed 5 bales on irrigated land. These high yields put a substantial demand on the roots' ability to uptake sufficient K and other nutrients to meet the physiological demand of the plant, seed, and lint. As K demand continues to increase, deep profile soil samples indicate a reduced level of plant available K in some production areas. According to the Nutrient Use Geographic Information System (NuGIS) webpage, K_2O balance is negative (-11 to -50lbs/a) for the majority of the cotton production regions (IPNI, 2010).

It is well documented that cotton is more sensitive to low K availability than most other major field crops, and often shows symptoms of K deficiency on soils not considered deficient (Cassman et al, 1989). Hence cotton may be the first crop to reach the tipping point for low K levels and may serve as a "miner's canary" for K deficiencies to come in other row crops.

Objectives

The first objective is to quantify the soil K levels, surface and with depth, from several major cotton production regions in the Cotton Belt experiencing K deficiencies. The second objective is to evaluate the impact of application methods and rates of K on cotton yield, quality, and return on investment. Based on these finding, soil K recommendations will be re-evaluated and modified as appropriate to optimize yields.

Previous Findings

The 2012 and 2013 studies were initiated at six field sites with a previous history of visual K deficiencies in the Blacklands (Williamson Co.) and the Upper Gulf Coast region (Wharton Co.) of Texas. Based on soil test results 0- 65 lb K_2O/A were recommended for the six site years. In 2013, the treatments were 0, 40, 80, 120, and 160 lb of K_2O/A applied shortly after planting using liquid 0-0-15 (KCl) placed in a band in a 4x6 configuration, and as granular 0-0-60 preplant incorporated. Phosphorous and nitrogen were applied at the same rate across all treatments. Monthly rainfall during the season was below normal at both study sites. Lint yield significantly responded to rates of applied K equal to and less than 150 ppm at all sites. Liquid K applied in a subsurface band had a greater positive effect on lint yield compared to granular K surface applied and incorporated. Applied K improved length, strength and uniformity at the Williamson site. These trials are being repeated in 2014 to better assess the influence of seasonal differences in rainfall, crop rotation and soil properties on the results. Additionally, fall incorporated treatments were added to the trials. Figures at the end of this document summarize the impact of the K application on cotton lint yields, quality, and net returns from these initial efforts.

2015 Proposed Methodology

Small plot replicated trials will be initiated on various soil types across the Cotton Belt. Soil samples will be collected to a two foot depth and macronutrients will be quantified for the 0-6", 6-12", and 12-24"depth. The K application rates will encompass the recommended rate of K to accomplish a respectable yield for each region and will be identical for all locations. The application methods will include both a broadcast incorporated application in the fall and a deep banded application arranged in a randomized complete block design prior to planting cotton. The sites will have a minimum of four replications. The broadcast treatments will be applied using a granular product with an analysis of 0-0-60 and will be incorporated 2-4 inches deep following application. The liquid treatments of 0-0-15 will be knifed (injected) at a depth of approximately six inches below the seed and six inches to the side (6x6). Basic K treatments are shown in **Table 1**. Nitrogen and phosphorus will be applied using 32-0-0 and 11-37-0 according to soil sample recommendations.

Table 1. Potassium application method and rates for 2015 trials

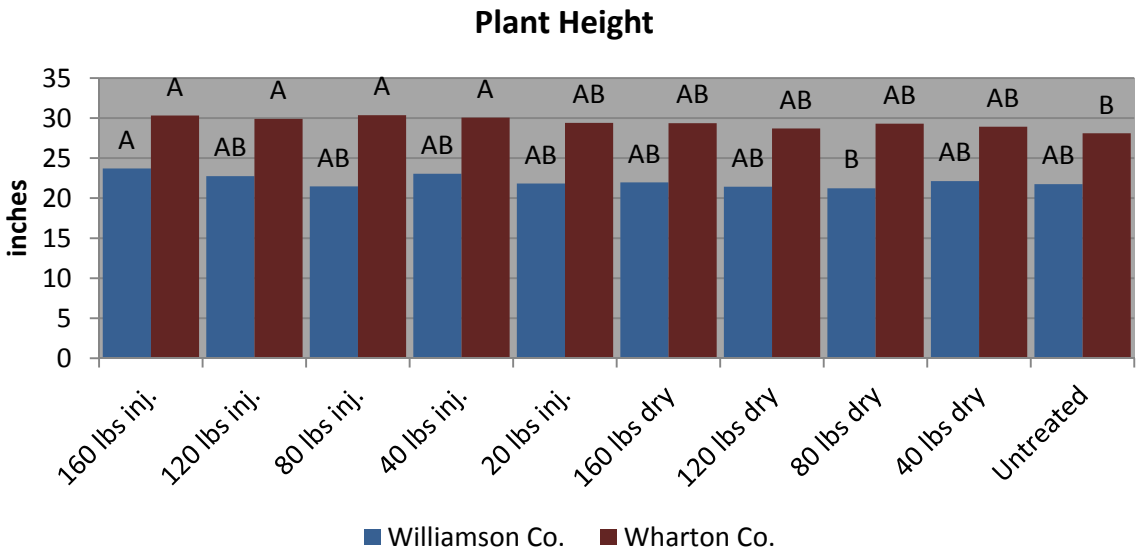
Application method	**Rate (lb K_2O/A)**
Broadcast	0, 40, 80, 120, and 160
Deep banded	0, 40, 80, 120, and 160

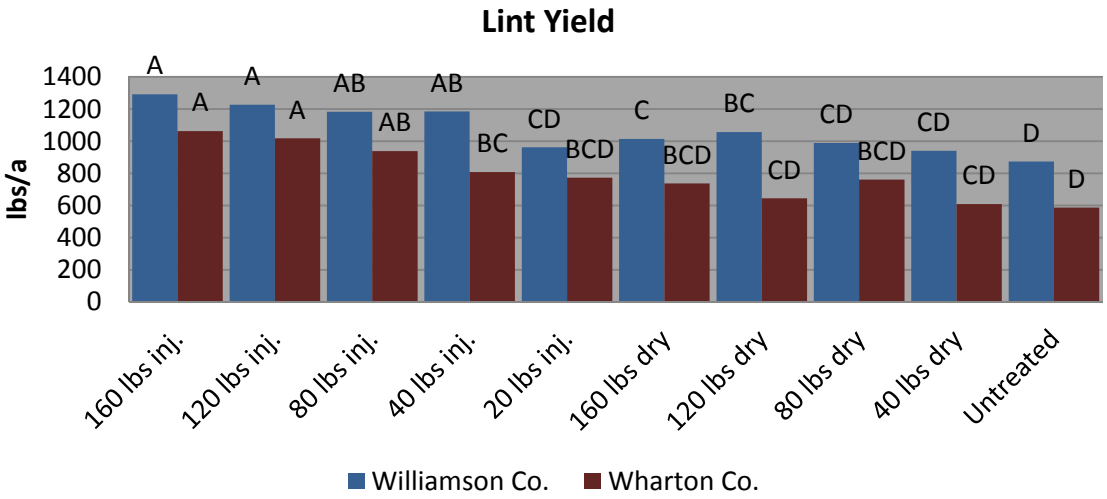
In-season plant measurements will include stand counts, early season vigor, and physiological measurements (first fruiting branch, boll distribution, crop maturity). Leaf tissue samples will be collected at first bloom and mid bloom growth stage and will be sent to the common laboratory to quantify the K uptake. The leaf sampling method and handling will be based on an agreed upon

methodology previously published. End of season visual ratings of K deficiencies and disease severity will be recorded. A minimum of 40 feet of row will be machine harvested from each plot. Cotton samples will be ginned and fiber quality samples will be sent to Cotton Incorporated for fiber testing (AFIS). All the data will be compiled from all the locations. Data will be analyzed in SAS using the most appropriate statistical procedures. Results will be summarized and presented at local producer meetings and regional and national professional meetings.

Project duration and funding

The majority of funding for this multistate project will come from Cotton Incorporated (CI), with partial support requested from both the International Plant Nutrition Institute (IPNI) and the Fluid Fertilizer Foundation (FFF). The project is planned for a total of three years.





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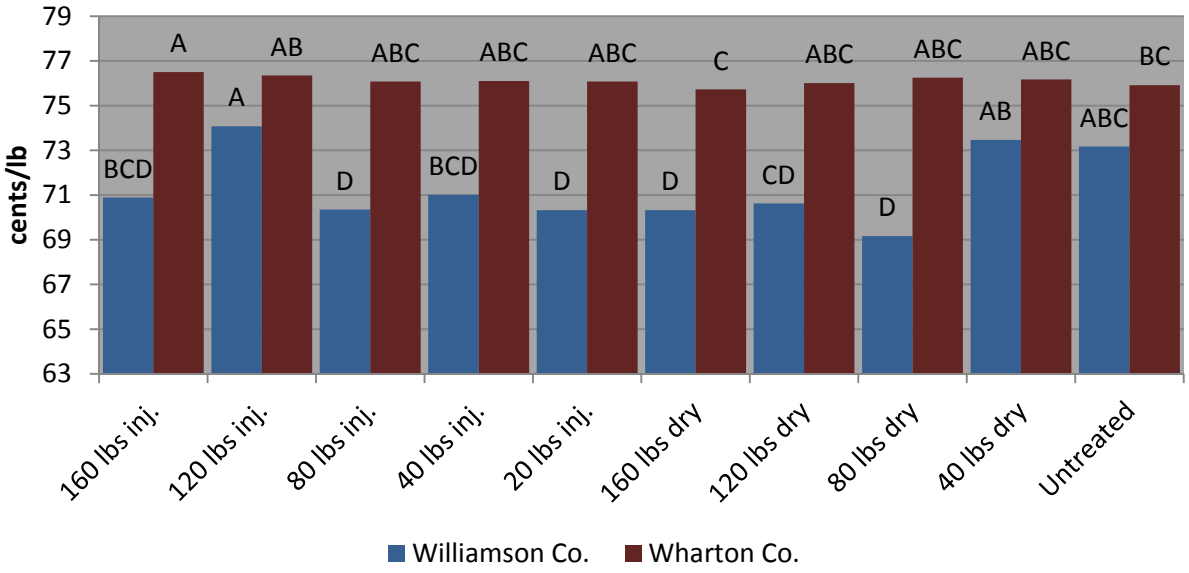

Return on Investment