Evaluation of Potassium Fertility in a Common Agricultural Soil of Arizona

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Abstract

Two field experiments were conducted during the 2001 growing season to address potassium (K) fertility response of two commonly grown varieties of cotton in Arizona. The studies were conducted near Coolidge, AZ in two separate fields and each consisted of two treatments, an untreated control and a treatment receiving a preseason side-dress application of K fertilizer. Plant growth and development estimates revealed that fruit retention (FR) and height to node ratio (HNR) levels were similar for both treatments in both fields. Lint yield data also indicated no difference between the fertilized and unfertilized treatments in both fields.

Introduction

Efficient fertility management in a cotton (Gossypium spp.) production system is critical to healthy plant growth and maintaining profitability. Nitrogen (N), phosphorus (P), and potassium (K) are the nutrients most commonly applied to Arizona soils and crops. Nutrient management is important to optimize plant response and yield and should be based upon guidelines for soil and plant tissue analysis. Guidelines have been developed through soil test and plant tissue correlation and calibration. The purpose of soil test calibration is to describe the soil test results in easily understood terminology and to simplify the process of making fertilizer recommendations by placing soils in response categories (Dahnke and Olson, 1990). For example, an NH_4-acetate extractable level of K greater than 150 ppm is usually considered sufficient for cotton production, and a level below 150 ppm is indicative of possible deficient levels of K (Silvertooth and Norton, 1989). However, fertilizer K is often applied under conditions where soils are coarse in texture where levels of K might be greater than 150 ppm. Past field experiments on cotton have shown no significant response in lint yield to the addition of a K fertilizer (Silvertooth et al., 1989, 1990, 1991; Galadima et al., 1998; and Thelander and Silvertooth, 2000).

Potassium fertility requirements for cotton have been a matter of concern due to increasing interest and emphasis on fiber quality and numerous reports of K deficiencies in various cotton producing regions to the east and west of Arizona (Unruh et al., 1993). The plant available forms of soil K are a function of soil mineralogy. Unruh et al. (1993) found that the majority of soils used for agricultural production in Arizona contain K-bearing mica and very little vermiculite known to have a tendency to fix K. Thus, we can conclude that as mineral weathering continues, K should not be deficient in most of the soils in agricultural production areas in Arizona. Recent studies in Arizona concerning K fertility evaluations with Upland (*G. hirsutum* L.) and American Pima (*G. barbadense* L.) cotton have reinforced current UA guidelines and indicated K deficient conditions in agricultural soils of Arizona are not common (Galadima et al., 1998).

Materials and Methods

Two field experiments were conducted near Coolidge in Arizona during the 2001 growing season. The K experiments were sited on a Toltec La Palma sandy loam soil on two fields designated as F4 and F8. The study involved two treatments that included a check (0 K fertilizer) and a treatment receiving a side-dress application of 2 gal./acre K fertilizer (0-0-21) having a density of 11 lbs./gal (K rate = 4.6 lbs. K_2O/acre). The control and the treated plots were arranged in an alternating configuration in both fields. A plot consisted of 6, 38-inch rows and extended the full length of the irrigation run. Total harvestable acreages were 34.5 acres and 36.5 acres for F4 and F8 respectively. Therefore, each treatment consisted of 17.25 acres (F4) and 18.25 acres (F8).

Agronomic information for this study is presented in Table 1. Rates of applied K fertilizer for the treated plots are summarized in Table 2. Preseason soil test levels are reported in Table 3.

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Basic plant measurements were collected from each field on approximately 14-day intervals from the formation of the first pinhead squares (PHS) to full maturity. These measurements included plant height, number of mainstem nodes, node of the first fruiting branch, number of aborted or missing fruit, and the number of nodes above the top white flower. This information was collected to observe the trend of crop growth and development over the season. Final lint yield for both treatments (both fields) was determined by harvesting each treatment from the entire field into separate modules by treatment. Modules were subsequently weighed and ginned lint yield for each treatment was determined as an overall average by treatment. Overall treatment means were then compared between treatments.

Results and Conclusions

Based on soil test levels (Table 3), both F4 and F8 were well above the UA K fertility critical level for cotton. Basic plant measurements indicated strong crop vigor (HNR) and high FR levels over the entire season but revealed no major differences between the fertilized plots and the check plots for both F4 and F8 (Figs. 1 - 4). There appeared to have been a slight increase in HNR for the treated plots for both F4 and F8 towards the end of the season (Figs. 2 and 4). Lint yield results indicate no differences between the untreated check and the K treated plots (Tables 4). It also appeared that added K did not influence fiber micronaire (mic) for both treatments for both fields (Table 5).

Summary

The crop growth and yield results from this study reinforce the current University of Arizona K fertilization guideline for irrigated cotton, that response to added K is unlikely if soil test K levels exceed the 150 ppm critical level (NH_4-acetate extraction). In this case, both F4 (411 ppm) and F8 (558 ppm) soil test K levels greatly exceeded the critical K level (Table 3); hence, there was no response to added K in both fields.

Acknowledgments

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Table 1. Agronomic information for the K fertility studies, Fields 4 and 8, Cockrill Farms, Coolidge, AZ, 2001.

	Field 4	Field 8
Planting Date	30 April	26 April
Variety	AP 7126	AP 9257
Termination Date	14 September	8 September
Harvest Date	30 November	29 November

Table 2. Treatments for the K fertility study, Fields 4 and 8, Coolidge, AZ, 2001.

	K Rate – lbs. K_2O/acre	
Treatment	Field 4	Field 8
1	0	0
2	4.6	4.6

Table 3. Pre-application soil test result for K fertility study (1 foot depth), Fields 4 and 8, Coolidge, AZ, 2001.

	Unit	Field 4	Field 8
pH		7.7	7.7
ECe	dS/m	1.5	1.6
K	ppm	411	558
NO_3-N	ppm	38	21
PO_4-P	ppm	5	4
Zn	ppm	0.4	0.5
Fe	ppm	6.4	6.8

pH and EC_e obtained from 1:1 water extract
Exchangeable K from using neutral molar ammonium acetate
NO_3-N and PO_4-P from Olsen bicarbonate extract
Zn and Fe from DPTA extract

Table 4. Lint yield results for K fertility study, Fields 4 and 8, Coolidge, AZ, 2001.

	Average Lint Yield (lbs. lint/acre)	
Treatment	Field 4	Field 8
Check	1393	1216
Treated	1342	1198

Table 5. Micronaire results for K fertility study, Field 4 and Field 8, Coolidge, AZ, 2001.

	Micronaire	
Treatment	Field 4	Field 8
Check	47	50
Treated	48	51

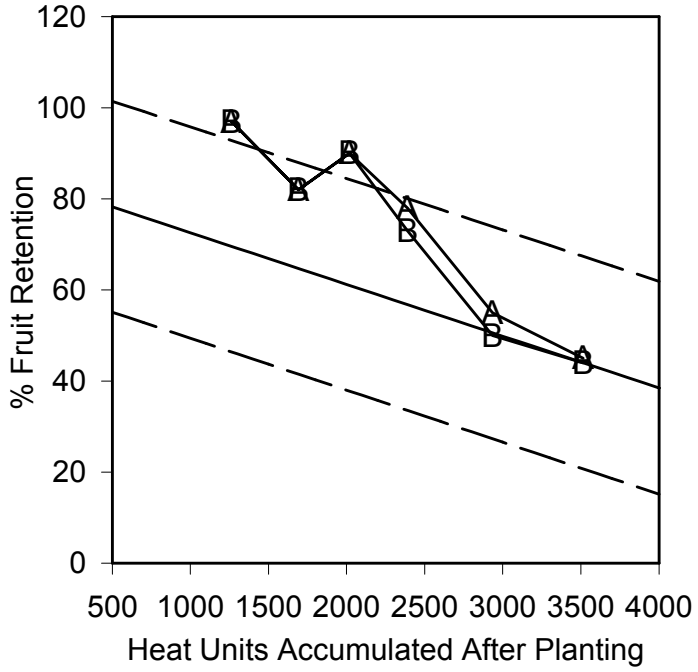

Figure 1. Fruit retention estimates for the K fertility study, Cockrill F4, Coolidge, AZ, 2001.

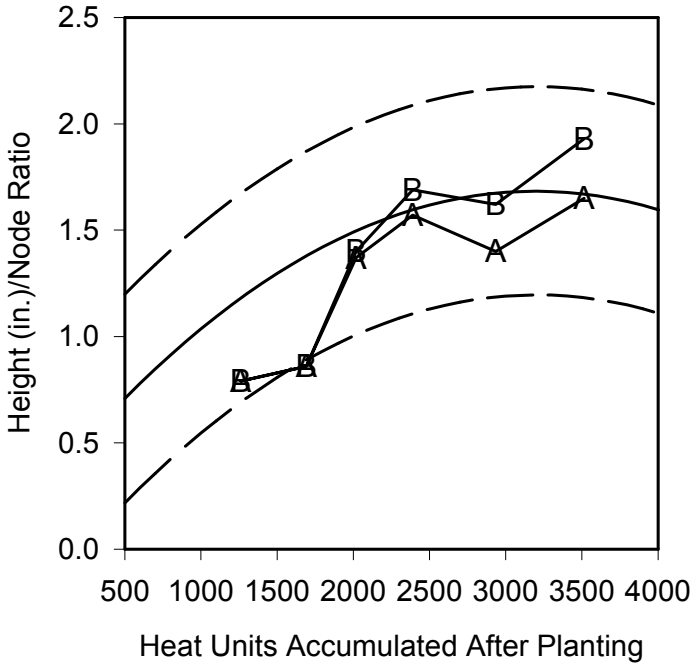

Figure 2. Height to node ratio estimates for the K fertility study, Cockrill F4, Coolidge, AZ, 2001.

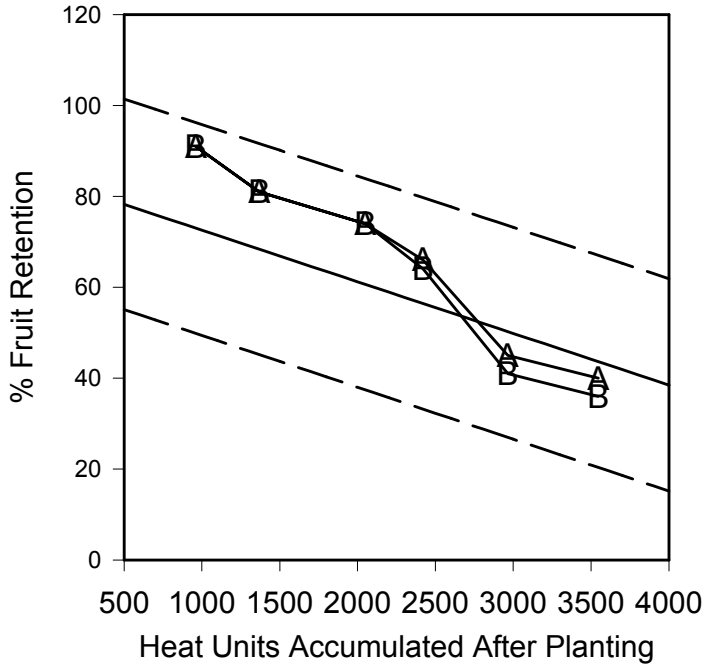

Figure 3. Fruit retention estimates for the fertility study, Cockrill F8, Coolidge, AZ, 2001.

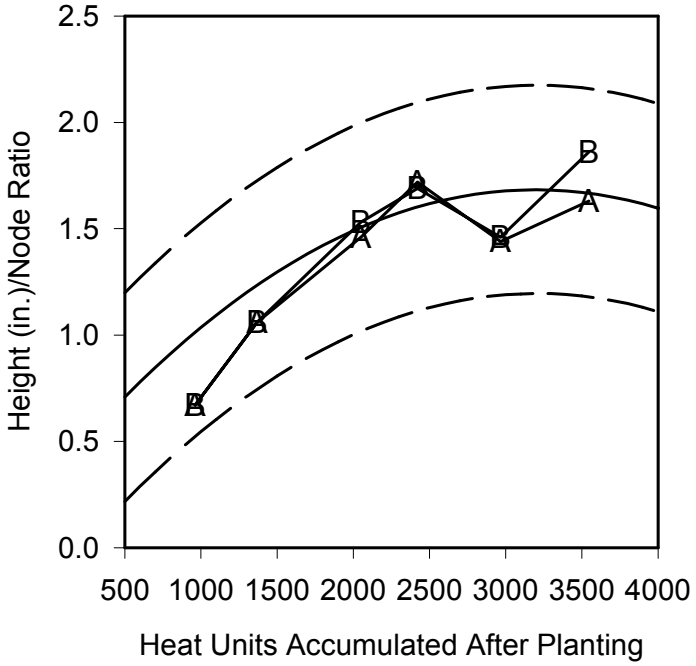

Figure 4. Height to node ratio estimates for the fertility study, Cockrill F8, Coolidge, AZ, 2001.