Effect of Soil and Foliar Applied Potassium on Pima and Upland Cotton at Two Arizona Locations

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Abstract

Due to increasing emphasis and interest being placed on cotton (Gossypium spp.) fiber quality as well as yield benefits associated with potassium (K) fertilization, two studies were conducted in 1994. These studies with those before them were aimed at assessing the agronomic necessity of K fertilization in Arizona cotton production. The locations of the trials included Maricopa Agricultural Center (Casa Grande sandy loam) and Safford Agricultural Center (Pima clay loam). At the Safford location, both Upland (G. hirsutum L., var. DPL 90) and Pima (G. barbadense L., var. S-7) cotton were planted with treatments that included both soil and foliar K applications. The trials at Maricopa Agricultural Center included four foliar K applications over the growing season on Pima (G barbadense L., var. S-7) cotton. The results of the experiments at both locations indicated no lint yield responses to K fertilization by either Upland or Pima cotton.

Introduction

Interest, propelled by indications of increased cotton yield as well as lint quality found in various parts of U.S. (Mullins et al.,1991, Oosterhuis et al.,1991, and Tupper et al.,1991) led to the beginning of a single field experiment conducted in 1991 (Silvertooth et al.,1992) to determine the benefits of both soil and foliar K fertilization in Sonoran desert soils of Arizona. In 1992, three similar studies were conducted with the same objective of assessing the benefits of cotton productivity, in-season fertility status, lint yield and fiber quality to soil and/or foliar K fertilization (Unruh et al. ,1993). With the same objectives in mind, three studies were conducted in 1993 (Unruh et al., 1994). Two of the three experiments were continued at Safford and Maricopa Ag. Centers and a third was a new experiment located in the Yuma Valley (Unruh et al., 1994). The 1994 experiments were carried out with the same objectives of evaluating the agronomic necessity and benefits which may be realized from K fertilization.

The ongoing effort is intended to provide information which describes the response of common varieties of cotton grown in Arizona to foliar and/or soil applied K. This effort includes in-season plant measurements and yield analyses to provide quantitative measures of response to K fertilization under Arizona cotton production conditions, which may differ significantly from other parts of the country. It is hoped that the experimental results from Arizona rather than those from elsewhere will provide producers in the state of Arizona with sufficient information regarding the use of K fertilizer. This is especially important since variation in inherent soil properties (responsible for soil K level) determine response to the added K. These soil properties vary within the state and other regions of the cotton belt.

Materials and Methods

Two K fertility studies were undertaken in 1994. The locations included Maricopa Ag. Center (Casa Grande sandy loam) and Safford Ag. Center (Pima clay loam). All agronomic inputs which included irrigation, pest control, and nitrogen (N) fertilization were applied as needed throughout the season. Routine in-season plant measurements were obtained every two weeks and these included measurement of the plant height, number of mainstem nodes, bloom counts, number of nodes above the topmost white bloom to the terminal (NAWB), and percent canopy closure. Heat unit data was collected from AZMET weather stations at each location and heat units accumulated after plant planting (HUAP) was determined using 86/55 °F maximum and minimum thresholds, respectively.

At the Maricopa Ag. Center the fertility trial involved only foliar K applications over the growing season applied to Pima cotton (S-7). Cotton was planted on 29 March (428 HU accumulated after January 1) in plots which were four 40-in rows that were 40 ft long. The six foliar treatments were arranged over the experimental area in a randomized complete block design with five replications. Foliar treatments, rates and dates (HUAP) are given in Table 1. Plots were mechanically picked on 29 October from which yield estimates were made.

The K fertility trial at Safford Ag. Center included both Pima (S-7) planted on April 7 (411 HU accumulated after January 1) and replanted on 27 April (659 HU accumulated after January 1) due to an irregular plant stand which resulted; and Upland (DLP 90) planted on 7 April (411 HU accumulated after January 1). Plots consisted of eight 40-in rows, each 32 ft long. Treatments included both soil and foliar K applications. All soil K was side band incorporated using K_2SO_4 as the source. Four foliar KNO_3 applications were made over the growing season. The date, HUAP, and the rate of each foliar application are given in Table 2. The foliar applications were made using a ground-rig applicator with 25 gal/acre carrier. Both soil and foliar treatments were combined to form a factorial arrangement of treatments with five replications as shown in Table 3. Plots were mechanically picked on 22 November from which yields were determined.

Results and Discussions

There were no apparent symptoms which would indicate any K nutritional problems in the two study sites. None of the plant measurements collected over the study period revealed any differences due to the treatments. Fruit retention levels were favorable for all treatments, as was the vegetative/reproductive balance maintained by the crop (data not shown in this report). The observed significance level (OSL) for the Maricopa (Table 1) study indicated there were no differences among treatments. The OSL is about an order of magnitude greater than alpha value ($\alpha=0.05$) used for declaring differences in testing hypotheses. The general reduction in yield observed for all Pima (S-7) treatments in Safford (Table 3) compared to the previous years may be attributed to the late replanting of this crop. This late planting resulted in bolls that did not reach physiological maturity. The OSL for the soil/foliar interaction studies at Safford revealed no differences among K fertilization treatments for both Pima (S-7) and Upland (DPL 90). Generally, the 1994 K studies for both locations showed a common result with previous K fertility studies in Arizona. There were no statistical differences among any of the treatments, hence, the unfertilized treatment resulted in the same lint yield response as all the fertilized treatments.

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Table 1. Foliar K application dates, rates and lint yields of Pima cotton (var. S-7) at Maricopa Ag. center in 1994.

16 June ‡(1448)	6 July (2021)	21 July (2432)	10 August (3015)		Yield
lbs K_2O / Acre					lbs lint/acre
0	0	0	0		1040
4.6	4.6	4.6	4.6		895
9.2	9.2	9.2	9.2		986
0	4.6	4.6	0		933
0	9.2	9.2	0		962
0	4.6	0	0		900
				OSL§	0.100
				$LSD_{0.05}$	NS
				C.V.(%)	8.3

All foliar treatments were applied with a ground-rig applicator using KNO_3 as the K source.
‡ Values in parentheses are the heat units (86/55°F thresholds) accumulated after planting.
§ observed significance level for the treatment differences, or the probability that there no differences among treatments.

Table 2. Dates of foliar K applications, Safford Ag. center, AZ, 1994.

Date	HUAP†		Rate
	DPL 90	Pima S-7	lbs K_2O/acre
8 July	1784	1536	4.6
21 July	2108	1860	4.6
4 August	2477	2229	4.6
15 August	2758	2510	4.6

†Heat Units (86/55 thresholds) accumulated after planting on 7 April = 411 HU after 1 January;(Pima was replanted 27 April, 659 HU after 1 January).

Table 3. Lint yields for all soil and foliar K treatments at the Safford Ag. center, AZ, 1994.

Treatment			Lint Yield	
Soil†	Foliar‡		DPL 90	Pima S-7
lbs of K_2O / Acre			lbs / acre	
0	0		813	382
0	13.8		836	363
200	0		784	407
200	13.8		809	357
400	0		818	302
400	13.8		788	355
		OSL§	0.900	1.000
		$LSD_{0.05}$	NS	NS
		C.V.(%)	11	20

† Potassium source was soil incorporated by banding after planting.
‡ Sum of three 4.6 lb K_2O/acre foliar applications using KNO_3 as the K source.
§ observed significance level for the treatment differences, or the probability that there are no differences among treatments.