Potassium Fertilization of Upland and Pima Cotton

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Abstract

In a continuing effort to assess the agronomic necessity of potassium (K) fertilization in Arizona cotton (Gossypium spp.) production, one new and two on-going (Maricopa and Safford Ag. Centers), K fertility studies were conducted in 1993. They included locations ranging from western (Yuma) to eastern (Safford) Arizona, with both Upland (G. hirsutum L.) and American Pima (G. barbadense L.) cotton, using soil and foliar applications of K. The results indicated that there was no response to the added K at any of the locations by either Upland or Pima cotton.

Introduction

Potassium fertility of cotton continues to be a hot topic all across the cotton belt as indicated by numerous papers devoted to this issue at both the national American Society of Agronomy meetings last November and the Beltwide Cotton Conferences at the beginning of this year. Producers in the state of Arizona are also highly aware of the importance of K fertility in cotton production as indicated by many reports from across the cotton-belt of yield responses to added K. For these reasons, there has been an ongoing effort on the part of researchers at the University of Arizona to provide quantitative measurements of yield responses to the additions of K under common Arizona cotton production conditions, which can differ substantially from other areas. It is especially important to consider the experimental results from Arizona rather than results from other areas since the regional specificity of the soils and their properties are responsible for the inherent K status and response to added K (Unruh et al., 1993b).

Beginning in 1991 a single field experiment was initiated to evaluate the effects of both soil- and foliar-applied K (Silvertooth et al., 1992). In 1992 three different K fertility studies were conducted with the objective of evaluating the response of cotton crop growth, in-season fertility status, lint yield and lint quality to soil and/or foliar applications of K fertilizer (Unruh et al., 1993a). With the same objectives in mind, in 1993 two of the three previous experiments were continued at Maricopa and Safford Ag. Centers, and a third new experiment was initiated in the Yuma Valley.

Materials and Methods

Three K fertility trials were conducted in 1993 which included the Safford Ag. Center (Pima clay loam), Maricopa Ag. Center (Casa Grande sandy loam), and the Yuma valley (Gadsden clay). All irrigation, pest management, and fertilization inputs (other than K) were provided on an as-needed basis throughout the season. Routine plant measurements consisting of plant height, number of mainstem nodes, bloom counts per unit area (75 ft^2), number of nodes from the top white bloom to the terminal (NAWB), percent canopy closure, and complete plant mapping analyses were carried out at each location on regular intervals throughout the season. All fertilization and plant mapping was carried out on a heat unit (HU) basis using 86/55° F thresholds, and expressed commonly as HU accumulated after planting (HUAP).

At the Safford Ag. Center both Upland (var. DPL 90) and Pima (var. S-7) cotton were planted 26 April (525 HU after 1 January). Plots consisted of eight 40 in. rows, each 34 ft. in length. Treatments included both soil and foliar K applications. All soil K application were broadcast and preplant incorporated using K_2SO_4 as the K source. Three foliar applications of KNO_3 were applied over the growing season, the date, HUAP, and rate of each foliar application is given in Table 1. All foliar applications were made using a ground-rig applicator with 25 gal/acre carrier. The soil and foliar K applications were combined to form a factorial arrangement of treatments with five replications as shown in Table 2. The Upland and Pima cotton had a final irrigation on 2 August and yield estimates were made by mechanically picking the center four rows of each plot on 11 November 1993.

The fertility trial at the Maricopa Ag. Center included only foliar K applications over the growing season applied to American Pima cotton (var. S-7). Cotton was planted on 5 April (471 HU after 1 January) in plots consisting of four 40 in rows which were 40 ft long. Foliar treatment rates and dates (HUAP) are given in Table 3. The six foliar treatments were arranged over the experimental area in a randomized complete block design with five replications. The experimental area had a final irrigation on 17 August and the center two rows of each plot were mechanically picked on 18 October.

In the Yuma Valley, Upland (var. DPL 5409) cotton received aerial applications (10 gal carrier/acre) of foliar-K over the course of the growing season. Plots were 24 (40 in) rows that extended the full length of the 640-ft irrigation run. The K source was KNO_3 and the rate and timing of applications are shown in Table 4. Cotton was planted and watered-up on 11 April (773 HU after 1 January) and treatments were applied in four replications in a randomized complete block design. The final irrigation was on 15 August prior to mechanical picking of the center eight rows on 21 September.

Results and Discussion

The results of each of these studies have a common result, there were no statistical differences among any of the treatments. In Tables 2, 3, and 4 the observed significance level (OSL) is at least an order of magnitude larger (slightly less for Safford Upland cotton) than the traditional α value ($\alpha = 0.05$) used to declare differences in hypothesis testing. In other words, the unfertilized treatment resulted in the same lint yield response as all the fertilized treatments.

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Table 1. Dates of foliar K applications, Safford Agricultural Center, AZ, 1993.

Date	HUAP†	Rate
		lb K_2O/acre
23 July	1910	4.6
17 August	2539	4.6
24 September	3406	4.6

† HUAP, Heat Units (86/55°F thresholds) accumulated after planting on 19 May (586 HU after 1 January).

Table 3. Lint yield means for all soil and foliar K treatments at the Safford Ag. Center, AZ, 1993.

Treatment			Lint Yield	
Soil†	Foliar‡		Upland (DPL 90)	Pima (S-7)
lb K_2O/acre			lb/acre	
0	0		1101	405
0	13.8		1117	466
200	0		1015	386
200	13.8		751	351
400	0		982	450
400	13.8		935	477
		OSL§	0.2	0.5
		$LSD_{0.05}$	317	158
		CV (%)	24.5	28.4

† Potassium source K_2SO_4 was broadcast-applied and incorporated preplant.
‡ 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 the treatments.

Table 4. Foliar K application dates, rates and lint yields of Pima cotton (var. S-7) at Maricopa Ag. Center in 1993.

22 June (1595)‡	8 July (2042)	23 July (2446)	4 August (2779)		Lint Yield
lb K_2O/acre					lb/acre
0	0	0	0		1322
4.6	4.6	4.6	4.6		1276
9.2	9.2	9.2	9.2		1288
0	4.6	4.6	0		1355
0	9.2	9.2	0		1336
0	9.2	0	0		1389
				OSL§	0.6
				$LSD_{0.05}$	141
				CV (%)	8.1

† 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 (5 April, 471 HU after 1 January) associated with the fertilization dates.

§ Observed significance level for the treatment differences, or the probability that there are no differences among the treatments.

Table 5. Foliar K application dates, rates and lint yields of Upland cotton (var. DPL 5409) at Yuma in 1993.

30 June (1809)‡	14 July (2206)	28 July (2548)	10 August (2975)		Lint Yield
lb K_2O/acre					lb/acre
0	0	0	0		1301
0	0	4.6	4.6		1187
4.6	4.6	4.6	4.6		1283
				OSL§	0.6
				$LSD_{0.05}$	299
				CV (%)	13.8

† All foliar treatments were aerial-applied using KNO_3 as the K source.

‡ Values in parentheses are the heat units (86/55°F thresholds) accumulated after planting (11 April, 773 HU after 1 January) associated with the fertilization dates.

§ Observed significance level for the treatment differences, or the probability that there are no differences among the treatments.