CALIFORNIA

Foliar Applied Potassium Benefits Cotton in the San Joaquin Valley

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California produces about 20 percent of U.S. upland cotton annually on 1.25 million acres. There are currently 11 different varieties available for growers to choose from. They are grown on a wide variety of soil types and with diverse management practices.

Along with new varieties have come new technologies and changes in cultural practices. Plant growth regulators such as PIX (mepiquat chloride) and PGR IV (gibberellic acid and indobuteric acid) may improve yields by aiding in setting and retaining more bolls. Earlier application of the first irrigation to avoid moisture stress has also been beneficial to yields and has enhanced the positive response derived from the plant growth regulators. Intensive crop monitoring has become standardized and is used extensively for pest management and for monitoring progression of the crop.

Studies in California indicate that mid-season potassium (K) deficiency in cotton can be avoided with foliar sprays. Rates of less than 10 lb/A of K_2O can produce a highly economical return.

The application of foliar nitrogen (N) and K at or near the early bloom stage of growth, when these nutrients are in peak demand, is a recent practice that is gaining in popularity. Since 1983, such innovations in fertilization and other inputs, cultural practices, and overall management have resulted in an average annual cotton yield increase of 32 lb lint/A in California.

Cotton plants require K at a rate of 1.9 to 3.0 lb/A/day during boll fill. Previous studies by University of California researchers (Dr. Ken Cassman and others) have demonstrated that these levels of K uptake can be difficult to maintain, especially on vermiculitic soils in the San Joaquin Valley. After years of K depletion (inadequate fertilization), the high K buffering capacity of these soils results in conditions in which very large amounts of soil applied K are fixed.

Growers of the San Joaquin Valley are aware of the need to be efficient with fertilizer in the sense of minimizing K fixation by the soil as well as preventing losses of nutrients, primarily N, to the groundwater and to the atmosphere. Innovative methods of fertilizer applications such as split sidedress, water run, and

TABLE 1. *Test site characteristics.*

Test	Variety	Exchangeable K[1], ppm	Release rate[2], ppm/day
Merced 1992	Royale	160	2
Kings 1992	Pima S-6	159	–
Merced 1993	Maxxa	145	2

[1] In ammonium acetate.
[2] Unocal procedure.

foliar applications are becoming common. The increasing interest in supplemental applications of N and K by foliar applications is creating many questions that must be answered by researchers.

San Joaquin Valley Studies

Field tests were conducted in 1992 and 1993 in Merced and Kings counties in which K was applied in foliar sprays at various times during the growing season. All treatments were replicated four times. In Merced County, one test was conducted with potassium sulfate (K_2SO_4) and two with potassium nitrate (KNO_3).

Treatments were applied by a tractor sprayer set up for foliar plot work. Plots were eight rows wide (30-inch centers) by one-fourth mile long. Five treatments consisted of foliar applications initiated after first flower at timings of: 1 and 2 weeks; 3 and 4 weeks; 5 and 6 weeks; 7 and 8 weeks; and a control. Each of the two applications consisted of materials applied at the rate of 4.5 lb/A of K_2O, so that each treatment received a total of 9 lb/A. Acala Royale and Acala Maxxa were evaluated in the study. Plots were harvested with the grower's straddle row 30-inch picker and weighed with a research scale.

Similarly, the Kings County trials tested the yield response of Pima S-6 to foliar KNO_3 applied after first bloom at: 1, 3, 5, and 7 weeks; 3 and 4 weeks; and 5 and 6 weeks. A fourth treatment consisted of foliar K applied at 3 and 4 weeks to plants growing on soil fertilized preplant at the rate of 360 lb/A of K_2O using potassium chloride (KCl). Foliar applications went on as KNO_3 at the rate of 4.5 lb/A of K_2O which totaled 9 lb/A after two applications and 18 lb/A after four applications. This test was conducted by hand spraying plots four rows wide (38-inch centers) and hand harvesting 13-foot lengths from the center two rows for yields.

The cotton varieties used and the available soil K values for each experimental site are presented in **Table 1**. All sites were adequate in exchangeable K according to present University of California guidelines. The K release test also suggests adequate release potential.

Results

The Merced and Kings counties tests in 1992 evaluated the importance of timing of foliar KNO_3 (unbuffered solution) on both upland and Pima varieties (**Table 2**). Data in **Figure 1** show that applica-

Table 2. *Foliar KNO_3 application effects on yields of Acala and Pima cottons, 1992.*

Application, weeks after first flower	7/1	7/7	7/16	7/22	7/28	8/4	8/12	8/20	Lint yield, lb/A
	Treatments dates								
Acala (Merced)									
Control	–	–	–	–	–	–	–	–	1,291
1 & 2	+	+	–	–	–	–	–	–	1,360
3 & 4	–	–	+	+	–	–	–	–	1,411
5 & 6	–	–	–	–	+	+	–	–	1,367
7 & 8	–	–	–	–	–	–	+	+	1,313
Pima (Kings)									
Control	–	–	–	–	–	–	–	–	1,310
1-7	–	+	–	+	–	+	–	+	1,371
4 & 6	–	–	–	–	+	–	+	–	1,332
5 & 7	–	–	–	–	–	+	–	+	1,255
360 lb K_2O/A soil	–	–	–	–	+	–	+	–	1,397

tions of KNO_3 at about three weeks after bloom resulted in greater yields than either earlier or later applications. The highest yield in the Pima test when there was no soil applied K treatment occurred with four sequential applications at 1, 3, 5, and 7 weeks after first bloom. The yields were not significantly different, but the trend supports the results from the upland tests.

The 1993 tests employed both KNO_3 and K_2SO_4 applied foliarly (unbuffered solutions) to Acala Maxxa cotton in Merced County and KNO_3 applied to Pima S-7 in Kings County. Results from these tests were very similar to those of the previous year. The greatest yield responses were measured from plots receiving foliar K at 2 to 3 weeks after bloom initiation. Yield response was less as foliar applications were made later in the season. The effect was similar whether the K fertilizer source was KNO_3 or K_2SO_4.

NEW COTTON *varieties which set a heavy boll load over a short period of time require larger amounts of K. High yield management of these varieties has led to widespread occurrence of K deficiency symptoms during mid and late season in the San Joaquin Valley.*

Summary

The results of these tests show that benefits can be obtained from foliar applications of K. New, more determinant cotton varieties which set the crop over a short period of time require larger amounts of some nutrients, such as K and N, during this critical stage of development. These varieties coupled with cultural practices aimed at obtaining high yields and which push the crop toward earlier termination also intensify nutrient demand. One result has been the widespread occurrence of K deficiency symptoms in cotton fields during mid- and late-season. Even though soil K levels are "adequate" according to present guidelines, foliar applications at 2 to 3 weeks after first bloom produce a positive yield response. BC

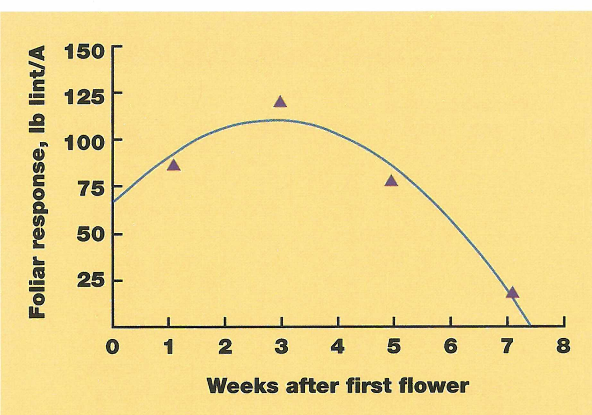

FIGURE 1. *Cotton response to foliar-applied K at various times after first flower.*

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