Evaluation of Surfactants in Foliar Feeding Cotton with Potassium Nitrate

By D.D. Howard, P.E. Hoskinson and P.W. Brawley

In this experiment, foliar applications of potassium (K) to cotton, at a rate of 10 lb/A potassium nitrate (KNO_3) and with a surfactant, increased petiole and leaf K concentrations. Applying KNO_3 with a surfactant to increase plant K uptake would be beneficial during periods of restricted K uptake. No yield response to foliar K was observed in 1991, the initial year of the study.

ARKANSAS RESEARCH has shown foliar K applications to a fast-fruiting cotton variety increased yield and improved fiber quality. However, many questions concerning the influence of fertilizer source, application rate and timing, soil and climatic conditions on yield and fiber quality remain. Investigations have been initiated in most of the cotton-producing states to evaluate K uptake from foliar KNO_3 applications over a wide range of soil and climatic conditions. The research reported here was initiated to evaluate the influence of surfactants on K uptake from foliar-applied KNO_3.

Procedure

A field experiment was initiated in 1991 at the West Tennessee Experiment Station on a Memphis-Loring-Calloway soil complex testing high in Mehlich I extractable K. The cultivar "DPL-50" was no-till planted on May 15. Plots were fertilized immediately after planting by broadcasting 80-60-60 lb/A of nitrogen (N), P_2O_5 and K_2O, respectively. Plots were irrigated July 18 (1.28 inches), August 6 (1.0 inch), and August 19 (0.8 inch). All recommended production practices were utilized in establishing, growing and harvesting the crop.

Six foliar treatments were initiated on July 29, two weeks after 50 percent of the plants flowered and repeated on two-week intervals for a total of four applications. These treatments were: check; 10 lb/A KNO_3 applied in water; 10 lb/A KNO_3 applied with a surfactant (Penetrator Plus or X-77); and 5 lb/A KNO_3 applied with a surfactant. Foliar treatments were applied in water at 10 gal/A rate. Surfactants were applied at labelled rates.

Cotton leaves and petioles were collected 1, 3, 7 and 14 days after each of the first three foliar applications. A defoliant was applied before the 14-day sample of the 4th application could be collected. Twenty mature leaves, generally the 4th from the terminal, were sampled for each treatment.

Results

Yield. Cotton yields were unaffected by foliar K applications. Sufficient K was supplied by the soil, making foliar applications unnecessary for increasing yields. Lint yields ranged from 840 to 1,092 lb/A.

Leaf K concentrations. Leaf K concentrations were affected by a foliar by spray period interaction. Potassium was applied each spray period. The biochemical activity of the plant probably changed with time, resulting in the interaction. Effects of foliar applications are shown in **Table 1**.

Leaf K concentrations were unaffected by treatments applied two weeks after bloom. Leaf K decreased from 1.33 to 1.19 percent three days following application and increased to 1.25 percent seven days after application, with no additional

The authors are Professor, Professor Emeritus, and Research Assistant, respectively, West Tennessee Experiment Station, Jackson, TN 38305.

Table 1. Leaf K concentrations by spray period as affected by treatment and sampling date.

Surfactant	KNO_3, lb/A	Percent K concentration Weeks after bloom: 2	4	6	8
None (Check)	0	1.31	1.25	0.97	1.15
None (Water)	10	1.14	1.32	0.99	1.20
Penetrator Plus	10	1.37	1.53	1.29	1.36
X-77	10	1.29	1.39	1.18	1.36
Penetrator Plus	5	1.25	1.42	1.11	1.16
X-77	5	1.20	1.39	1.09	1.27
L.S.D. (0.05)		NS	0.13	0.16	0.12
Days after spraying					
1		1.33	1.46	1.36	1.22
3		1.19	1.45	1.04	1.31
7		1.25	1.34	1.01	1.22
14		1.27	1.28	1.00	
L.S.D. (0.05)		0.06	0.11	0.27	NS

change by day 14. Increased leaf K concentrations seven days after application may have coincided with the 1-inch irrigation and rainfall between the 3- and 7-day sampling periods.

Applying 5 or 10 lb/A KNO_3 with a surfactant four weeks after bloom increased leaf K percentage when compared with the check. Applying 10 lb/A KNO_3 with Penetrator Plus increased leaf K when compared with 10 lb/A KNO_3 applied in water. Leaf K decreased between 3- and 14-day sample periods.

Leaf K was increased by applying 10 lb/A KNO_3 with a surfactant six weeks after bloom when compared with the check or applying 10 lb/A KNO_3 in water. Applying 5 lb/A KNO_3 with a surfactant or 10 lb/A with water did not increase leaf K when compared with the check. Leaf K decreased after the first sampling date with no additional change after the 3-day sample period.

Applying 10 lb/A KNO_3 with surfactant eight weeks after bloom increased leaf K when compared with the check or applying 10 lb/A KNO_3 in water. Applying 10 lb/A KNO_3 in water did not affect leaf K when compared with the check.

Petiole K concentrations. Petiole K concentrations were affected by a treatment by spray period interaction (**Table 2**). Applying 10 lb/A KNO_3 with Penetrator Plus two weeks after bloom increased petiole K percentage when compared with applying 10 lb/A KNO_3 in water. Petiole K levels were not increased by other treatments when compared with the check.

Table 2. Petiole K concentrations by spray period as affected by treatment and sampling date.

Surfactant	KNO_3, lb/A	Percent K concentration Weeks after bloom: 2	4	6	8
None (Check)	0	2.86	2.56	2.38	2.52
None (Water)	10	2.55	2.49	2.37	2.33
Penetrator Plus	10	3.17	3.24	3.02	3.02
X-77	10	2.82	2.73	2.82	2.90
Penetrator Plus	5	2.79	2.81	2.65	2.63
X-77	5	2.60	2.78	2.77	2.69
L.S.D. (0.05)		0.34	0.28	0.34	0.33
Days after spraying					
1		2.86	2.68	2.73	2.76
3		2.80	2.99	2.74	2.69
7		2.76	2.58	2.57	2.60
14		2.77	2.83	2.63	
L.S.D. (0.05)		NS	0.22	NS	NS

Petiole K was increased by applying 10 lb/A KNO_3 with Penetrator Plus four weeks after bloom when compared with other treatments. Petiole K was unaffected by applying 5 lb/A KNO_3 with a surfactant or applying 10 lb/A KNO_3 in water.

Petiole K levels were higher six weeks after bloom from applying 10 lb/A KNO_3 with surfactant or 5 lb/A KNO_3 with X-77 when compared with either the check or 10 lb/A KNO_3 applied in water.

Petiole K concentrations were greater eight weeks after bloom for applying 10 lb/A KNO_3 with Penetrator Plus when compared with other treatments, except applying 10 lb/A KNO_3 with X-77. Applying 10 lb/A KNO_3 with X-77 increased petiole K concentrations when compared with the check or 10 lb/A KNO_3 in water.

Discussion

Caution must be exerted when interpreting one-year foliar treatment data

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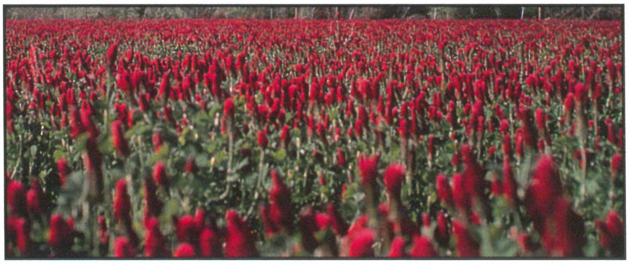

CRIMSON CLOVER is a popular legume among cattlemen in the southeastern U.S., although many do not give adequate attention to its nutritional requirements for economic production.

Table 3. Lime and P increase total N production by crimson and arrowleaf clovers.

P_2O_5 rate, lb/A	Total N production, lb/A			
	Crimson clover		Arrowleaf clover	
	No lime	Lime	No lime	Lime
0	40	26	16	40
250	61	100	136	136
500	66	78	110	142

maturity was multiplied by total dry matter production to arrive at the values shown in the table. Nitrogen production for each species increased slightly with liming, but was dramatically increased by P fertilization. Again, the best treatment was the 250 lb/A P_2O_5 rate. Differences in N production were due to effects of yield and Rhizobia nodulation, not N tissue concentration.

The results of these two Alabama studies show the critical importance of good fertilizer management and liming practices on the economic production of forage legumes. They illustrate the point that there is no 'free ride' for the farmer who is looking for ways to save on his or her fertilizer N bill by including legumes in the crop rotation. Legumes require sound management, just as do other crops. Anything less will result in uneconomical production and can increase the potential for damage to the environment. ■

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that did not increase yield. However, it would appear that increasing leaf and petiole K concentrations in a non-deficient situation would make these observations even more notable. Petiole K concentrations determined 4 and 6 weeks after bloom were 2.56 and 2.38 percent, respectively, which are higher than levels reported to be critical in the Arkansas research.

Potassium moves from the leaves through the petioles to points of demand within the plant, thus allowing leaf K concentrations to change more than the petiole. Petiole K concentrations were about double the leaf K concentrations. Petiole K decreased from 2.2 to 2.0 times leaf K as the number of weeks after bloom increased from two to six. But after eight weeks the ratio of petiole to leaf increased to 2.4. Leaf K concentrations decreased rather sharply six weeks after bloom, indicating a greater demand by the plant than the previous sample period. This decrease was also reflected by the petiole data.

Apparently, the critical time for applying K to these plots was six weeks after bloom. By August 26, six weeks after bloom, the cotton plant enters the maturation stage. During this time, increases in seed size, micronaire, and probably fiber strength also occur. In addition, drought conditions that are common during this period may have restricted root uptake of K since plots had not received irrigation or rainfall since August 19 and many leaves were approaching senescence.

Foliar application of 10 lb/A KNO_3 with either Penetrator Plus or X-77 increased leaf and petiole K concentrations. Applying 10 lb/A KNO_3 with Penetrator Plus consistently resulted in the highest leaf and petiole K concentrations. Applying KNO_3 with a surfactant to increase plant K uptake would be beneficial during periods of restricted soil uptake. Applying lower KNO_3 rates could reduce the possibility of leaf burn during drought stress. ■