TENNESSEE

Foliar Potassium on Cotton – A Profitable Supplement to Broadcast Potassium Application on Low Testing Soils

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Supplementing soil applied K with foliar applied K can increase cotton lint yields for fast-fruiting cotton cultivars. Our research shows that foliar K can be profitable on a low extractable K soil for at least two years even when relatively high rates of K (as high as 120 lb K_2O/A) are soil applied each year.

Foliar applied potassium (K) for cotton was profitable in Tennessee studies on low K soil with fast-fruiting, high yielding cultivars. However, the benefits with foliar K did not continue after high rates of soil applied K built up soil test levels over a period of two years. Tests included conventional and no-tillage.

Procedures

Field experiments were conducted from 1991 through 1994 on a Memphis silt loam soil at the Ames Plantation Experiment Station of the University of Tennessee. Conventional and no-tillage, non-irrigated systems were evaluated. Initial extractable K levels in the 0-6 inch soil layer were 90 and 80 lb/A (low) for conventional and no-tillage, respectively. The cultivar "D&PL 50" was planted in 40-inch rows by mid-May. Potassium chloride (KCl) rates of 0, 30, 60, and 120 lb K_20/A were soil applied to the same plots each year. In addition, foliar fertilization provided 40 lb/A potassium nitrate (KNO_3) in four applications of 10 lb/A, starting at or shortly after bloom and applied on a 9- to 14-day interval. Similarly, the foliar calcium nitrate [$Ca(NO_3)_2$] treatment provided 36 lb/A $Ca(NO_3)_2$ in four applications of 9 lb/A, applied at a rate equal to nitrogen (N) in the foliar KNO_3 treatment (5.6 lb N/A). All foliar treatments were applied in 10 gal/A of water without a surfactant. The check received soil applied K only. All plots received 80 lb/A of N as ammonium nitrate and 60 lb/A of P_2O_5 as triple superphosphate each year. Pix (8 oz/A) was applied in mid-July each year. Conventional tillage plots were planted on fresh beds in 1991 and on stale beds the other years. No-tillage plots were planted on flat seedbeds. Cultural practices observed in the area were used.

Yield response models developed from regression were used to estimate yield gains/A from the foliar treatments compared with the check for five levels of soil applied K (0, 30, 60, 90, and 120 lb K_2O/A) each year. The net revenue gain/A for each level of soil applied K was calculated by subtracting the cost of the fertilizer and its foliar application from the total revenue gain/A. The total revenue gain/A was estimated by multiplying the Tennessee average cotton lint price for 1985 to 1994 by the yield gain/A resulting from foliar KNO_3 predicted from the yield response models. The cost of KNO_3/A was calculated by multiplying the 1994 26¢/lb price of KNO_3 by 40 lb of KNO_3/A. Machinery cost/A to foliar apply KNO_3 was estimated

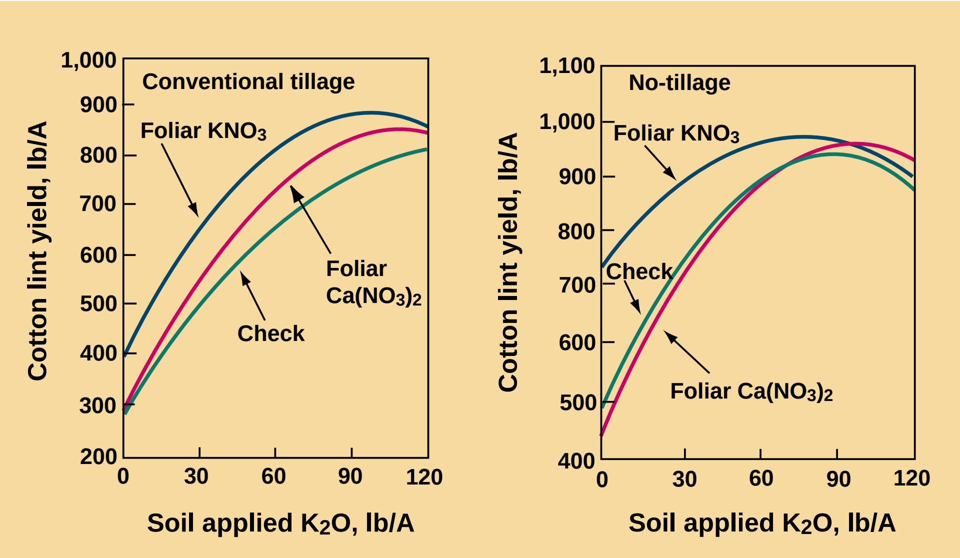

FIGURE 1. Conventional and no-tillage cotton lint yield response models, 1994.

as the sum of fuel, oil, repair, depreciation, insurance, storage, and interest costs for a 90-horsepower, self-propelled sprayer with a 60-ft. boom, \$50,000 purchase price, 15-year useful life, and the ability to cover an acre in 1.7 minutes. Operator labor was valued at \$5.25/ hour and labor hours were assumed to be 1.25 times machine hours. Net revenue gains/A for foliar $Ca(NO_3)_2$ were determined in the same manner, except the 1994 price and amount of $Ca(NO_3)_2$ applied were 25¢/lb and 36 lb/A of $Ca(NO_3)_2$, respectively. Break-even levels of soil applied K that equate net revenue gains/A from foliar KNO_3 with the cost of KNO_3 and its foliar application were calculated.

Results

Machinery and labor costs/A for foliar KNO_3 and $Ca(NO_3)_2$ application were estimated to be about \$9/A. Adding this cost to the costs of KNO_3 and $Ca(NO_3)_2$ gave costs of fertilizers and application of

TABLE 1. Estimated net revenue gains/A from foliar KNO_3 and $Ca(NO_3)_2$ treatments compared to the check, non-irrigated, conventional tillage cotton, 1991 to 1994.

	Net revenue gained (\$/A) from foliar application at various soil applied K rates[1]				
	K_2O, lb/A				
Year, foliar treatment	0	30	60	90	120
1991					
KNO_3	-3	27	41	39	21
$Ca(NO_3)_2$	-15	-8	-6	-9	-17
1992					
KNO_3	21	18	14	8	2
$Ca(NO_3)_2$	-4	-23	-31	-29	-16
1993					
KNO_3	15	13	3	-14	-39
$Ca(NO_3)_2$	-51	-33	-22	-18	-21
1994					
KNO_3	40	76	82	58	6
$Ca(NO_3)_2$	-22	17	34	29	2

[1]Evaluated at the average Tennessee cotton lint price for 1985 through 1994 of \$0.584/lb.

about \$20 and \$18/A for foliar KNO_3 and $Ca(NO_3)_2$, respectively.

Net revenue gains/A from foliar KNO_3 and $Ca(NO_3)_2$ estimated from the yield response models (**Figure 1** for 1994 example) for five levels of soil applied K are presented in **Table 1** for non-irrigated, conventional tillage cotton. Net revenue gains/A from foliar KNO_3 were mostly positive (profitable) except in 1993. Break-even analysis for that year suggested foliar KNO_3 was profitable for lower levels of soil applied K, but unprofitable for soil applied levels greater than 66 lb/A. Relatively low rainfall in 1993, which reduced yields, may have been responsible for the lack of yield response to foliar KNO_3 at the higher soil applied levels because lower yields are not as K-demanding as higher yields. Positive net revenue gains/A for 1994 suggest that foliar KNO_3 on this non-irrigated, conventional tillage cotton, produced on a low K soil, may be profitable when soil applied K rates are high, depending on the weather. Net revenue gains/A from foliar $Ca(NO_3)_2$ were negative except for 1994 when they were mostly positive. Nevertheless, for that year, net revenue gains/A from foliar KNO_3 were about twice as large as from foliar $Ca(NO_3)_2$, suggesting the increased revenue from foliar KNO_3 resulted mostly from K, although some increased revenue could have come from N.

Net revenue gains/A from foliar KNO_3 and $Ca(NO_3)_2$ estimated from the yield response models (**Figure 1** for 1994 example) for non-irrigated, no-tillage cotton are presented in **Table 2**. They were positive for foliar KNO_3 in 1991 and 1992, but the effects of extractable K accumulations in the soil became evident in 1993 and 1994. In those years, net revenue gains/A from foliar KNO_3 became negative with the higher soil applied K rates. In both 1993 and 1994, the break-even rate was 76 lb K_2O/A. These findings suggest that foliar KNO_3 may not profitably supplement soil applied K for more than two years when high (120 lb K_2O/A) levels of K are being applied to a soil initially testing low in K. Net revenue gains/A from foliar $Ca(NO_3)_2$ were negative in 1991 and 1994, but were positive for some levels of soil applied K for 1992 and 1993. These results suggest N might have been important in increasing lint yields for some rates of soil applied K in those years.

Conclusions

Economic analysis suggests that foliar KNO_3 on this loess-derived, low K soil in western Tennessee provides higher

TABLE 2. Estimated net revenue gains/A from foliar KNO_3 and $Ca(NO_3)_2$ treatments compared to the check, non-irrigated, no-tillage cotton, 1991 to 1994.

	Net revenue gained (\$/A) from foliar application at various soil applied K rates[1]				
	K_2O, lb/A				
Year, foliar treatment	0	30	60	90	120
1991					
KNO_3	16	35	46	49	43
$Ca(NO_3)_2$	-17	-15	-17	-22	-31
1992					
KNO_3	46	27	18	20	33
$Ca(NO_3)_2$	-22	5	20	20	7
1993					
KNO_3	66	31	7	-6	-9
$Ca(NO_3)_2$	-35	-11	6	17	21
1994					
KNO_3	123	66	20	-14	-36
$Ca(NO_3)_2$	-52	-29	-20	-27	-48

[1]Evaluated at the average Tennessee cotton lint price for 1985 through 1994 of \$0.584/lb.

net revenues/A than not applying it to cotton, even when relatively high rates of K are applied to the soil for up to two years. However, high K rates for three or more years may substantially reduce the profitability of foliar KNO_3. Alternatively stated, K deficiencies that can be corrected by foliar KNO_3 may be eliminated after about two years of high soil applied K rates. This finding is more certain for no-tillage than conventional tillage cotton. The conventional tillage cotton produced negative net revenue gains/A from foliar KNO_3 for high soil applied K rates in 1993, but net revenue gains/A were positive for all K rates in 1994. However, no-tillage cotton had negative net revenue gains/A for high K rates in both 1993 and 1994.

Cotton lint yields were generally unresponsive to foliar $Ca(NO_3)_2$. These results suggest that lint yields responded to the K in foliar KNO_3 rather than the N. Exceptions were 1994 conventional tillage cotton and no-tillage in 1992 and 1993, when yields appeared to be somewhat responsive to foliar N. Earlier research has shown that other K sources may also result in responses, provided spray solutions are buffered to pH levels between 4 and 6. BC

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Information Agriculture Conference Scheduled for August 6-8, 1997

Dates for the 1997 Information Agriculture Conference are now set for Wednesday, August 6 through Friday, August 8, at the Krannert Center for the Performing Arts, University of Illinois, Urbana-Champaign. Plans were announced by Dr. David W. Dibb, President of the Potash & Phosphate Institute (PPI).

"This will be the third Information Agriculture Conference, following highly successful events in 1995 and 1996," he noted. "The program content and focus continues on precision farming, with site-specific management of nutrients and other crop inputs emphasized even more this year."

The Conference brings together a unique cross section of farmers, industry representatives, university and Extension specialists, consultants and others interested in new technology, equipment, and information for more efficient crop production.

The program this year will include workshop sessions analyzing real case studies of farms using site-specific systems. Analytical and mapping software will be demonstrated.

An exhibit area will include displays by a wide variety of companies and organizations offering products and services related to the program topics.

Registration fee for the 1997 Information Agriculture Conference is $250 per individual before July 8 and $350 after that date. Student registration fee is $100. Exhibitor fee is $300 for a standard booth area.

Additional details will be available on the Information Agriculture Home Page on the Internet at:
http://w3.ag.uiuc.edu/INFOAG/
and on the PPI Home Page at:
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For conference registration,
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