Soil and Foliar Potassium Effects on Alternaria Leaf Spot Disease in Cotton

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The severity of the cotton disease Alternaria leaf spot (*Alternaria macrospora* Zimm.) varies with location, year, fertility level, and other factors. In general, damage has been small, but if premature plant defoliation resulting from the disease is extensive, yields may be reduced. Researchers are continuing to evaluate new and improved disease control measures.

Research in Tennessee was established in 1991 to evaluate soil and foliar potassium (K) effects on cotton produced on low and high extractable K soils under conventional tillage (CT) and no-tillage (NT) systems. A second objective was to evaluate CT and NT systems for Alternaria leaf spot and plant defoliation.

Field investigations were conducted in 1991 and 1992 on a Memphis silt loam soil (fine-silty, mixed, thermic, Typic Hapludalf) located on the Ames Plantation at Grand Junction, Tennessee, and on a Loring silt loam soil (fine-silty, mixed, thermic, Typic Fragiudalf,) located on the Milan Experiment Station. Mehlich I extractable K for the Memphis soil was 90 and 80 lb/A (low) for the CT and NT systems, respectively. Extractable K for the Loring soil was 197 and 168 lb/A (high).

The experimental design was a split-plot arrangement of treatments in a randomized complete block. Main plot treatments were 0, 30, 60, and 120 lb broadcast K_2O/A. The K source was potassium chloride (KCl). Subplot treatments consisted of foliar applications of potassium nitrate (KNO_3) and calcium nitrate [$Ca(NO_3)_2$] and an untreated check. The KNO_3 was applied at 4.4 lb K_2O/A/application using a spray volume of 10 gal/A. The $Ca(NO_3)_2$ was applied at a rate to supply 1.4 lb/A nitrogen (N), which is equal to the N applied in the foliar KNO_3 treatments. A total of four foliar applications were applied during the year. The first application was 14 days after mid-bloom and was repeated on 14-day intervals.

The cotton cultivar Deltapine 50 was planted by mid-May on both soils in 40-inch rows. Plots were fertilized annually with 80 lb N/A using ammonium nitrate (NH_4NO_3) and 60 lb P_2O_5/A using triple superphosphate. The CT site on the Memphis soil was bedded in 1991, reshaped each fall, and the tops shaped in the spring. The NT cotton was planted on a flat seedbed.

Two separate visual evaluations were made for Alternaria leaf spot severity and for plant defoliation on September 2 on the Memphis silt loam and September 24 on the Loring silt loam. The rating scale for both evaluations ranged from 0 to 10, in which 0 indicates no symptoms and 10 is total disease coverage or total plant defoliation. Lint yields were determined by mechanically picking the two center

TABLE 1. Soil- and foliar-K effects on Alternaria leaf spot, defoliation ratings, and cotton lint yields on Memphis silt loam and Loring silt loam soils with a tillage variable.

	Memphis silt loam (low soil K)			Loring silt loam (high soil K)		
	Alternaria[1]	Defoliation[1]	Yield, lb/A	Alternaria[1]	Defoliation[1]	Yield, lb/A
K_2O, lb/A[2]			Conventional tillage			
0	7.7 A[3]	6.9 A	350 C	3.7 A	0.8 A	1,036 A
30	5.8 B	4.5 B	556 B	4.4 A	1.1 A	1,057 A
60	5.5 B	2.9 BC	621 B	3.6 A	1.2 A	894 A
120	4.7 B	1.3 C	760 A	3.7 A	1.3 A	987 A
Foliar treatment[4]						
Check	6.4 a	4.5 a	551 b	3.8 b	1.0 ab	972 a
KNO_3	5.4 b	3.1 b	612 a	3.3 c	0.9 b	1,015 a
$Ca(NO_3)_2$	6.0 a	4.2 a	552 b	4.4 a	1.4 a	994 a
K_2O, lb/A[2]			No-tillage			
0	7.5 A	5.8 A	360 C	4.8 A	4.5 A	1,294 B
30	6.1 AB	4.2 AB	531 B	4.7 A	4.3 A	1,312 B
60	5.1 BC	1.6 BC	528 B	4.6 A	4.3 A	1,391 A
120	4.5 C	0.6 C	669 A	5.7 A	4.5 A	1,313 B
Foliar treatment[4]						
Check	5.8 ab	3.1 ab	483 b	5.1 a	4.9 a	1,322 ab
KNO_3	5.5 b	2.6 b	567 a	4.5 b	3.8 b	1,365 a
$Ca(NO_3)_2$	6.2 a	3.5 a	516 b	5.2 a	4.6 ab	1,296 b

[1]Alternaria leaf spot and leaf defoliation ratings – 0 (none) to 10 (highest).
[2]Averaged across foliar treatments.
[3]Within tillage system, within soil, soil applied K, and foliar treatments, means followed by the same letter are not significantly different at the 0.05 probability level.
[4]Averaged across soil K rates.

rows of each plot twice each year. Percent lint was determined by combining samples of seed cotton from individual treatments across replications and ginning on a 20-saw gin with dual lint cleaners.

Results

Alternaria leaf spot severity and premature plant defoliation associated with the leaf disease, as well as lint yields from both tillage systems on the Memphis silt loam, were affected by broadcast and foliar K (**Table 1**). Alternaria leaf spot severity was reduced in the CT system from applying 30 lb K_2O/A. Severity was not further reduced by higher rates. For the NT system, Alternaria leaf spot severity was reduced with rates up to 120 lb K_2O/A.

Premature plant defoliation also decreased with increased broadcast K rates in both tillage systems. Defoliation was greatest in the unfertilized plots and lowest after broadcasting 120 lb K_2O/A.

Yields from both tillage systems were increased by broadcast K and corresponded well with premature defoliation data. The highest yield and the least amount of premature plant defoliation in both tillage systems occurred with the highest K rate. Plants that were 40 to 70 percent defoliated by early September produced less yield.

Applying foliar K reduced Alternaria leaf spot severity and premature plant defoliation in the CT system relative to the

non-foliar and $Ca(NO_3)_2$ treatments. Different results were obtained for the NT cotton. Foliar K reduced Alternaria leaf spot and premature defoliation when compared with foliar $Ca(NO_3)_2$, but the non-foliar check was intermediate. Foliar K increased both CT and NT yields relative to the other foliar treatments.

Broadcasting K for the Loring silt loam did not affect Alternaria leaf spot or premature plant defoliation for either tillage system. Conventional tillage yields were not affected by soil applied K, but NT yields were increased by the 60 lb/A rate. Foliar-applying K reduced Alternaria leaf spot and premature plant defoliation in both tillage systems when compared with the other two foliar treatments. Conventional tillage yields were unaffected by the foliar treatments, but NT yields were greater for the foliar K relative to the $Ca(NO_3)_2$ foliar treatment.

Conclusions

Reduction of Alternaria leaf spot severity and premature leaf drop of cotton produced on soils low in extractable K can be accomplished by applying K to the soil or to the leaves. Yields were also increased by both soil- and foliar-applied K. Early identification of Alternaria leaf spot within a cotton field may indicate a low level of extractable soil K. On soils testing high in extractable K, Alternaria leaf spot severity and premature leaf drop were not factors affecting cotton yields. BC

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detecting large differences within extremely small areas (10 sq. ft.) in an entire field. Instead of applying a fixed rate to a 100 acre field, this technology allows us to apply the prescribed amount to 435,600 individual 10 sq. ft. areas within the 100-acre field at N rates that range from 0 to 100 lb/A.

It is important to note that there will be many interfering factors affecting fertilizer recommendations when using sensor based systems. While formal field experiments can remove all other factors excluding those being evaluated, the real world poses many additional problems. If a weed is present, and the sensor responds to it, one agronomic decision could be to not fertilize that area (decreased potential for weed seed). Not fertilizing this area will ultimately lead to increased field variability for that fertilizer nutrient. Alternatively, fertilizer could be applied as normal, and a point injector could be used to 'spot' treat for weeds as they are detected in the field. Added problems include the presence of clouds, time of day, plant variety, stage of growth, percent coverage, weed interference, nutrient interactions, and many others. BC

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