ASSESSMENT AND MANAGEMENT OF FOLIAR DISEASES AFFECTING COTTON IN GEORGIA AND TEXAS

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Abstract

Cotton grown in Georgia and Texas is affected by a number of foliar diseases which can cause variable losses to the grower. In some instances the diseases are of only cosmetic importance while in other cases severe outbreaks of disease can lead to significant pre-mature defoliation that causes significant losses in yield. In this study fungicides or a combination of fungicides and treatments with potassium fertilizer were assessed to determine their efficacy in the management of Stemphylium, Cercospora, and Corynespora leaf spot diseases in Georgia and Alternaria leaf spot in Texas. Field trials were established at research stations and in commercial cotton fields. Foliar-applied fungicides included pyraclostrobin (Headline), azoxystrobin (Quadris), tebuconazole (Folicur), thiophanate methyl (Topsin M), and fluoxastrobin (Evito). Applications were timed for early bloom and then early bloom + approximately two weeks after early bloom. In a single study in Georgia, plots were treated with muriate of potash (0-0-60) for equivalents of 0, 60, 120, or 180 units of potassium (K_2O) soon after planting followed by treatments with one or two applications of pyraclostrobin or an application of foliar-applied potassium. Neither applications of fungicides nor foliar-applied potassium reduced disease severity or improved yields over the untreated control where the predominant disease was Stemphylium leaf spot. Fungicide applications did not improve disease control or yields where Alternaria leaf spot occurred in Texas. Where the predominant disease was Corynespora leaf spot (Georgia), use of fungicides significantly reduced disease severity in two studies and significantly improved yield in one study. Based upon these finding, management of Stemphylium leaf spot and Alternaria leaf spot requires careful management of soil fertility with the use of potassium fertilizer. Based upon the results presented in this study, it appears that Corynespora leaf spot can be effectively managed with as little as a single well-timed application of an appropriate fungicide.

Introduction

Although upland cotton, *Gossypium hirsutum* L., is affected by a number of foliar diseases to include Ascochyta "wet-weather" blight, Cercospora leaf spot, and aereolate blight (*Ramularia* spp.), such diseases are typically considered to be of minimal or sporadic importance. Exceptions to this include Stemphylium and Alternaria leaf spot diseases that can cause rapid, widespread premature defoliation resulting in significant damage to cotton production in a field or in a region. Stemphylium leaf spot seems to occur primarily in the southeastern United States while the disease is replaced by the related Alternaria leaf spot in Texas and the western cotton production

regions. The fungal pathogens that cause these diseases, *Stemphylium* spp. and *Alternaria* spp., appear to be ubiquitous in the cotton production regions but do not become of consequence unless the cotton plants become deficient in potassium. When a potassium deficiency does occur, either due to inadequate soil levels or inadequate uptake of the nutrient during periods of drought, the foliage becomes increasingly susceptible to infection by the fungal pathogens. Incidence of both diseases tends to occur in the same fields over time and is often more severe in specific parts of a field than in other parts of the field. Severe symptoms of both Stemphylium leaf spot and Alternaria leaf spot can develop quickly in a field and significant areas of defoliation may occur within a few weeks after early symptom development. Management of both diseases is typically based upon recommendations leading to adequate levels of soil potassium fertilization.

Beginning in approximately 2003, consultants, growers, and county agents in southwestern Georgia began expressing concern about severe foliar disease affecting not only the cotton foliage but also apparently the cotton bolls as well. The disease was initially dismissed as outbreaks of Stemphylium leaf spot or Ascochyta blight; however consultants continued to vehemently argue that the observed disease was not tied to deficiencies in potassium and must be caused by some other pathogen. Further investigation lead to the realization that the disease in question was most likely caused by the fungal pathogen *Corynespora* spp. and that this disease had first been reported by J.P. Jones in Florida in the early 1960s and was associated with both foliar disease and boll rots in southwestern Asia. As suspected by the consultants, growers, and county agents, Corynespora leaf spot appears to be unrelated to plant nutrition and seems to progress differently than either Stemphylium or Alternaria leaf spot. Whereas Stemphylium leaf spot tends to cause general defoliation on an affected cotton plant coupled with a reddening or yellowing of the foliage, Corynespora leaf spot tends to develop initially in the lower canopy of the cotton crop and defoliates the plant progressively from bottom to top. Significant boll loss is associated with the defoliation. In severe cases, it has been observed that as much as 75% of the interior foliage may be lost to this disease leaving only the upper canopy intact.

Historically, foliar-applied fungicides have not been an important tool for management of disease in cotton. Efforts to manage Stemphylium leaf spot with fungicides in Georgia have met with, at best, mixed results. Researchers from Florida have reported success in managing "Fusarium hardlock" with foliar applications of thiophanate methyl (Topsin M); however such results have not been duplicated outside the environment of the Panhandle of Florida. Currently, pyraclostrobin (Headline), azoxystrobin (Quadris) and tebuconazole (e.g. Folicur) are labeled for use on cotton and their efficacy for management of diseases of cotton is of interest to growers.

The objective of the study presented in this paper was to assess the efficacy of foliar-applied fungicides, with or without additional applications fertilizer containing potassium, to improve management of foliar diseases affecting cotton in Georgia and Texas.

Materials and Methods

Field trials to assess strategies for management of foliar diseases of cotton were conducted at multiple locations in Georgia and in Texas in 2010. Three trials in Georgia (Bay, Colquitt County, Attapulgus, Decatur County, and RDC Pivot, Tift County) were planted to Delta and Pineland 0949B2RF. A single trial (Attapulgus, Decatur County) was planted to eight varieties from Delta and Pineland to include DPPL 0949B2RF. A fifth trial was planted in a commercial, non-irrigated field in Thomas County. Management of weeds, insects, soil fertility, and irrigation at Attapulgus and the RDC Pivot and the trial in Thomas County (with exception of irrigation) were according to guidelines from University of Georgia Cooperative Extension. The field trial in Bay, Colquitt County, was non-irrigated and plots received varying rates of fertilizer (muriate of potash) soon after planting for equivalent rates of 0, 60, 120, and 180 units of K_2O. The fertilizer was hand-spread on appropriate plots.

Fungicides to include some combination of pyraclostrobin (Headline, 6.0 and 12.0 fl oz/A), azoxystrobin (Quadris, 6.0 and 12.0 fl oz/A), tebuconazole (Folicur, 6.0 fl oz/A), fluoxastrobin (Evito, 0.5 and 1.0 fl oz/A) and thiophanate methyl (Topsin M, 16.0 fl oz/A) were applied at multiple timings beginning at "first bloom" where approximately 50% of the plants in a field had begun to flower. In Georgia, fungicides were applied with a Lee Spider Sprayer using a spray volume of 15 gal/A with 8002 flat-fan nozzles. Fungicides in Thomas County were applied by the grower using a tractor-mounted boom sprayer. Potassium was applied as potassium nitrate as a foliar treatment at the Bay, Colquitt County field trial.

A randomized complete block design with a minimum of four replications was used in all but the Bay, Colquitt County trial where a factorial design (potassium X fungicide) was used. Data were analyzed using analysis of variance (ARM, Gylling or MSTAT) and means were compared using Fisher's protected least significant difference.

Results and Discussion

Presented in the following table are results from the field trials conducted in 2010 to assess the management of foliar diseases of cotton using fungicides in Georgia and Texas.

Table 1. 2010 Stemphylium/Cercospora fungicide study, Attapulgus REC Decatur County, Georgia.[z]

Treatment	Rate (fl oz/A)	Timing[y]	Disease Severity[x] (% leaf area affect)	Seed Cotton (lb/A)
Untreated	--	--	9.0	3842
Headline	6.0	A	13.8	3456
Headline	6.0	AB	2.5	3328
Headline	6.0	ABCD	6.1	3786
Quadris	6.0	A	2.0	3340
Quadris	6.0	AB	7.9	3527
Quadris	6.0	ABCD	1.7	3848
Folicur	6.0	A	1.5	3795
Folicur	6.0	AB	12.0	3660
Folicur	6.0	ABCD	1.2	3580
Topsin M	16.0	A	6.7	3731
Topsin M	16.0	AB	8.8	3824
Topsin M	16.0	ABCD	12.9	3754
LSD≤0.05			**9.2**	**414**

[z]Trial was irrigated and planted to DPL 0949B2RF; primary diseases were Stemphylium and Cercospora leaf spots.
[y]Fungicide applications were initiated approximately two weeks after first bloom (A) and repeated as noted on a two-week interval.
[x]Rating of % leaf area affected of symptomatic leaves from a sample of 10 leaves collected on 16 August.

Table 2. Assessment of fungicides for management of Alternaria leaf spot in Texas, Trial 1, 2010.

Treatment	Rate (fl oz/A)	Timing*	Lint yield (lb/A)
Untreated	--	--	937.8
Headline	12.0	A	956.8
Headline	6.0 and 6.0	AB	985.5
Headline	6.0 and 12.0	AB	974.1
Quadris	12.0	A	929.8
Quadris	6.0 and 6.0	AB	917.9
Quadris	6.0 and 12.0	AB	922.8
LSD≤0.05			NS

* Fungicide applications were initiated soon after first bloom (A) and repeated as noted on a two-week interval.

Table 3. Assessment of fungicides for management of Alternaria leaf spot in Texas, Trial 2, 2010.

Treatment	Rate (fl oz/A)	Lint yield (lb/A)
Untreated	--	297.4
Mepiquat	8.0	273.0
Mepiquat + Evito	8.0 + 0.5	305.2
Mepiquat + Evito	8.0 + 1.0	312.5
Mepiquat	16.0	274.9
Mepiquat + Evito	16.0 + 0.5	281.4
Mepiquat + Evito	16.0 and 1.0	256.0
Evito	0.5	274.0
Evito	1.0	302.9
LSD≤0.05		**NS**

Table 4. Commercial field trial, Bay, Colquitt County, Georgia, 2010.[z]

Treatment	Rate	Timing[y]	Disease Severity[x] (% leaf area affect)	Seed Cotton (lb/A)
At-plant application of potassium				
None	0 lb/A K_2O	--	31.4	262
Low	60lb/A K_2O	Near planting	5.4	790
Middle	120 lb/A K_2O	Near planting	4.9	876
High	180 lb/A K_20	Near planting	4.3	915
LSD≤0.05			**8.5**	**206**
Fungicide Program				
Untreated	--	--	10.8	699
Headline	6.0	A	15.1	705
Headline	6.0	AB	9.3	718
Foliar Potassium	6.0	AB	11.2	721
LSD≤0.05			**8.5**	**NS**

[z]Trial was non-irrigated and planted to DPL 0949B2RF; diseases were Stemphylium and Cercospora leaf spots.
[y]Fungicide applications were initiated approximately two weeks after first bloom (A) and repeated as noted on a two-week interval.
[x]Rating of % leaf area affected from a sample of 10 leaves collected on near end of season.

Table 5. Delta and Pineland study, primarily Corynespora leaf spot, Attapulgus REC, Decatur County, Georgia.[z]

Treatment	Rate (fl oz/A)	Timing[y]	Disease Severity[x] (% leaf area affect)	Seed Cotton (lb/A)
VARIETY				
DP 09R619B2RF	--	--	4.3	
DP 09R555B2RF	--	--	1.9	
DP 09R355B2RF	--	--	8.7	
DP 1032B2RF	--	--	7.0	
DP 1034B2RF	--	--	2.7	
DP 1048B2RF	--	--	7.4	
DP 1050 B2RF	--	--	6.6	
DP 0949B2RF	--	--	8.6	
Prob(F)=			**0.4439**	
FUNGICIDE PROGRAM				
Untreated	--		9.8	3348
Headline	6.0	A	3.4	3440
Headline	12.0	A	4.4	3413
LSD≤0.05			**3.2**	**Prob(F)=0.7285**

[z]Plots were irrigated as needed throughout the study and the primary disease was Corynespora leaf spot.
[y]Appropriate plots were treated with fungicides once during the season approximately two weeks after first bloom.
[x]Rating of % leaf area affected of symptomatic leaves from a sample of 10 leaves collected near end of season.

Table 6. Commercial non-irrigated cotton fungicide trial conducted in Thomas County, Georgia; primarily Corynespora leaf spot.

Treatment	Rate (fl oz/A)	Timing[y]	Defoliation[x] (%)	Disease Severity[x] (% leaf area affect)	Lint yield (lb/A)
Untreated	--	--	72	53	1254
Headline	6.0	A	25	25	1318
Prob(F)=			**P≤0.05**	**NS**	**P≤0.1**

Stemphylium leaf spot or closely related Alternaria leaf spot was the predominant disease in a trial at Attapulgus (Table 1), the two trials from Texas (Table 2 and Table 3) and the commercial trial in Bay, Georgia (Table 4). In these trials, use of fungicides neither reduced the severity of disease nor improved yields over the untreated control. Disease severity and yields were only improved by managing soil fertility in Bay, Georgia with the use of muriate of potash. Increasing levels of potassium numerically, but not significantly, increased yields and decreased severity of disease.

Corynespora leaf spot was the primary disease observed in the DPL variety study in Attapulgus and the commercial cotton trial in Thomas County. (Note: as there were no statistical interactions between variety and fungicide treatments in the DPL study, results were pooled across varieties and also across fungicide treatments.) In studies

where Corynespora leaf spot was the primary disease, effects of disease (% leaf area affected and/or % defoliation) were significantly reduced with the single application of a fungicide and in Thomas County; yield was significantly improved over the untreated control.

Summary

In the studies presented here, use of fungicides lead to some control of Corynespora leaf spot but not Stemphylium or Alternaria leaf spot. Severity of Stemphylium leaf spot was reduced with application of adequate levels of muriate of potash near planting time but not with an application of foliar potassium nitrate. Studies will continue in the future to further assess the importance of fungicide selection, rate, and timing of application in the management of Corynespora leaf spot. Additionally, the importance of this "new" disease in Georgia will continue to be evaluated.

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