FUNGICIDE PLACEMENT AND SELECTION IMPACT TARGET SPOT CONTROL AND COTTON YIELD IN 2014

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Abstract

In 2014, efficacy of Headline 2.09SC and Quadris 2.08SC when applied with broadcast and drop nozzle spray equipment was evaluated at two irrigated Alabama sites for the control of target spot caused by *Corynespora cassiicola* on the cotton varieties Phytogen 499 and Deltapine (DPL) 1252. At the SW AL site, the level of target spot control observed with each fungicide at the final rating date differed by cotton variety. Overall, defoliation levels were higher on Phytogen 499 than Deltapine 1252. When compared with the non-fungicide treated control, Quadris 2.08SC failed to reduce target spot-related defoliation on Phytogen 499 but proved as efficacious as Headline 2.09SC on Deltapine 1252 in controlling this disease. Defoliation levels for the Headline 2.09SC-treated Phytogen 499 and non-fungicide treated Deltapine 1252 were similar. At the Central AL site, target spot control was influenced by cotton variety and fungicide selection but not fungicide placement. Higher defoliation ratings were recorded for Phytogen 499 than Deltapine 1252. While the non-fungicide treated control suffered the highest level of defoliation, lower ratings were noted for Headline 2.09SC compared with Quadris 2.09SC. Similar disease control was obtained with broadcast and drop nozzle spray equipment. At the SW AL study site, seed cotton yields for both varieties were not impacted by fungicide program, including the non-fungicide-treated control. Fungicide placement did not impact yield at either study site.

Introduction

The performance and yield response to fungicide inputs for target spot control in cotton has been mixed (Hagan *et al*., 2014b, Kemeriat *et al.* 2011, Wall *et al.* 2013). Yield gains with fungicides, which are most likely to be seen on target spot susceptible varieties where defoliation levels in early to mid-September exceed 50%, typically range between 100 to 200 lb lint/A on 2.5+ bale/A cotton (Hagan 2014). Fungicide efficacy could be improved by delivering fungicides in to the lower and mid-canopy to improve leaf coverage and delay early disease development. In fungicide placement studies conducted in 2013, similar final target spot ratings were obtained with broadcast and drop nozzle arrangements at two Alabama study locations (Hagan et al, 2014a). Yields also were not impacted by fungicide placement. Significant yield gains were obtained at one of two study sites with Headline 2.09SC and Quadris 2.08SC. At both study locations in 2013, final and season-long target spot ratings were lower for Deltapine 1252 than Phytogen 499 but the latter variety had higher seed cotton at one of two study sites.

The objective of this study was to continue to assess the impact of fungicide selection and placement on the efficacy of Headline 2.09SC and Quadris 2.08SC for the control of target spot and yield response of the cotton varieties Phytogen 499 and Deltapine 1252 at two locations in Alabama.

Material and Methods

Southwest AL (Brewton Agricultural Research Unit [BARU]) Study Site - The study site was prepared for planting with a KMC ripper bedder. On 11 March, 256 lb/A of 20-60-60 analysis fertilizer was broadcast and incorporated. On 8 May, Phytogen 499 WRF and Deltapine 1252 B2RF cotton varieties were hill dropped at a rate of 3 seed/row foot into a Benndale sandy loam soil (≤ 1% organic material) at the Brewton Agricultural Research Unit (USDA Hardiness Zone 8a) in Brewton, AL. Layby applications of 100 lb/A of 34-0-0 analysis fertilizer on 6 June

was followed by an application of 400 lb/A of 15-0-15 analysis fertilizer on 19 June. Weed control was obtained with a pre-emergent incorporated application of 1.5 pt/A Prowl H_20 followed by a 7 June application of 1 qt/A Roundup WeatherMax. Cotton was prepared for harvest with an application of 1.5 pt/A Finish defoliant on 30 September. Plots received 0.5, 0.6, 0.6, 0.7 and 0.7 acre inches of water on 2 July, 8 July, 5 August, 11 August, and 4 September, respectively. The experimental design was factorial arranged as a split split-plot with cotton variety as the whole plot, fungicide as the split plot, and fungicide placement as the split split-plot treatment. Individual subplots consisted of four 30–foot rows spaced 3 feet apart. Four replications were included. Headline 2.09SC at 9 fl oz/A and Quadris 2.08SC at 9 fl oz/A were applied with a 'high-boy' sprayer as a broadcast application on 11 July (1st week of bloom) and 23 July (3rd week of bloom) with TX-12 nozzles on a 20 inch spacing at 20 gal/A of spray volume at 60 psi or with a drop nozzle arrangement with a single TX-12 nozzle over the top of the row for top coverage and one TX-12 nozzle on a drop on each side of the row to deliver the fungicide into the cotton canopy at a spray volume of 20 gal/A at 60 psi. A non-fungicide treated control was included. Counts of open, unopened, and locked bolls were made in a 3.2 ft of a border row on 5 November. Cotton was mechanically harvested on 4 November.

Central AL (Field Crops Unit, E.V. Smith Research Center) Study Site - The study site was prepared for planting with a KMC strip till rig. On 19 May, Phytogen 499 WFR and Deltapine 1252 B2RF cotton varieties were hill dropped at 2 seed/row foot in a Marvyn loamy sand (organic matter < 1%) at the Field Crops in Milstead, AL. A 13 May broadcast application of 88 lb/A of 34-0-0 analysis fertilizer was followed by a 27 June layby application of 67 lb/A of murate of potash (0-0-60) and a 26 June layby application of 19.4 gal/A of 28-0-0 liquid fertilizer (60 lb actual N/A). Weed control was obtained with a pre-emergent incorporated application of 1 pt/A Diuron + 1 pt/A Reflex on 8 May followed by a 20 June broadcast application of 22 fl oz/A Roundup Weathermax + 1 pt/A Dual Magnum II, and a 26 June layby application of 2.5 pt/A MSMA + 1 pt/A Diuron with a hooded sprayer. Cotton was prepared for harvest with a 24 September application of 1 pt/A Folex + 6 fl oz/A Daze followed by a 1 October application of 8 fl oz Folex + 3 fl oz Daze + 12 fl oz Boll'd. Plots received 0.6, 0.75, 0.9, and 1.1 acre inches of water on 2 July, 31 July, 12 August, and 10 September, respectively. The experimental design was a factorial arranged in a split split-plot with cotton variety as the whole plot, fungicide treatments as the split plot, and fungicide placement as the split split-plot treatment. Individual split split-plots consisted of four 30-foot rows spaced 3 feet apart. Four replications of treatments were included. Headline 2.09SC at 9 fl oz/A and Quadris 2.08SC at 9 fl oz/A were applied with a Spider sprayer on 23 July (1st week of bloom) and 8 August (3rd week of bloom) as 1) a broadcast application with AITTJ60-11002VP nozzles on 18 inch centers at 15 gal/A of spray volume at 40 psi and 2) with a drop nozzle arrangement consisting of a single AITTJ60-11002VP nozzle over the top of the row and one AITTJ60-11002VP nozzle on a drop on each side of each row at a spray volume of 32 gal/A at 40 psi. A non-fungicide treated control was included. On 7 October, counts of open bolls were made on 3.2 foot of row of one of two border rows. Cotton was mechanically harvested on 6 October.

Disease assessment – Final target spot intensity was assessed on 17 September and18 September at the Central and SW AL sites, respectively, using a 1 to 10 leaf spot scoring system where 1 = no disease, 2 = very few lesions in canopy, 3 = few lesions noticed in lower and upper canopy, 4 = some lesions seen and < 10% defoliation, 5 = lesions noticeable and < 25% defoliation, 6 = lesions numerous and < 50% defoliation, 7 = lesions very numerous and < 75% defoliation, 8 = numerous lesions on few remaining leaves and <90% defoliation, 9 = very few remaining leaves covered with lesions and < 95% defoliation, and 10 = plants defoliated (Chiteka, *et al.* 1988). Defoliation values were calculated using the formula [% Defoliation = 100/ (1+e (- (disease score-6.0672)/0.7975)] (Liu *et al.* 2012). Significance of interactions was determined using PROC GLIMMIX procedure in SAS. Statistical analysis on target spot defoliation was done on rank transformations of data, which were back transformed for presentation. Means were separated using Fisher's protected least significant difference (LSD) test ($P \leq 0.05$).

Weather Conditions – At the Central AL site, temperatures during the study period were at or above 30-year historical average while rainfall totals above to well above normal for May and Jun but were below normal for Jul, Aug, and Sep. At the SW AL site, monthly rainfall and temperatures were at or above the 30-year average during the study period.

Results

Southwest AL Site

Since the cotton variety x fungicide interaction for target spot intensity and yield at the SW AL site are significant, data were segregated by cotton variety and fungicide treatment for both variables (Table 1). Defoliation levels were higher for Phytogen 499 than Deltapine 1252. When compared with the non-fungicide treated control, Quadris 2.08SC failed to reduce target spot-related defoliation on Phytogen 499 but proved as efficacious as Headline 2.09SC on Deltapine 1252 (Fig. 1). Defoliation levels for the Headline 2.09SC-treated Phytogen 499 and non-fungicide treated Deltapine 1252 were similar. Fungicide efficacy was not impacted by fungicide placement. For both varieties, seed cotton yields were not impacted by fungicide program, including the non-fungicide-treated control (Fig. 2). Non-fungicide treated and Quadris 2.08SC-treated Phytogen 499 had lower yields than Deltapine 1252, regardless of the fungicide program. Only the Headline 2.09SC-Phytogen 499 yields were similar to Deltapine 1252. Fungicide placement did not impact seed cotton yield.

Table 1. Impact of cotton variety, fungicide selection, and fungicide placement on the control of target spot and yield in Southwest AL (BARU) in 2014.

Split plot analysis (F)	Target spot % defoliation[z]	Seed cotton yield lb/A[y]
Cotton variety	189.96***[x]	3.50
Fungicide	22.82***	3.79
Cotton variety x Fungicide	17.11***	4.62*
Nozzle arrangement	5.05*	2.03
Cotton variety x Nozzle arrangement	2.20	2.17
Fungicide x Nozzle arrangement	0.01	0.18
Cotton variety x Fungicide x Nozzle arrangement	0.33	0.91
Nozzle arrangement		
Broadcast	33.1 a	4144 a
Drop	26.8 a	4007 a

[z]Target spot intensity was rated using a leaf spot scoring system (1 to 10 scale) on 18 Sep and converted to % defoliation values.
[y]Seed cotton yield = total weight of seed + lint.
[x]Significance of *F* values at the 0.05, 0.01, and 0.001 levels is indicated by *, **, or ***, respectively.
[w]Means in each column followed by the same letter are not significantly different according to Fisher's protected least significant difference (LSD) test ($P \leq 0.05$).

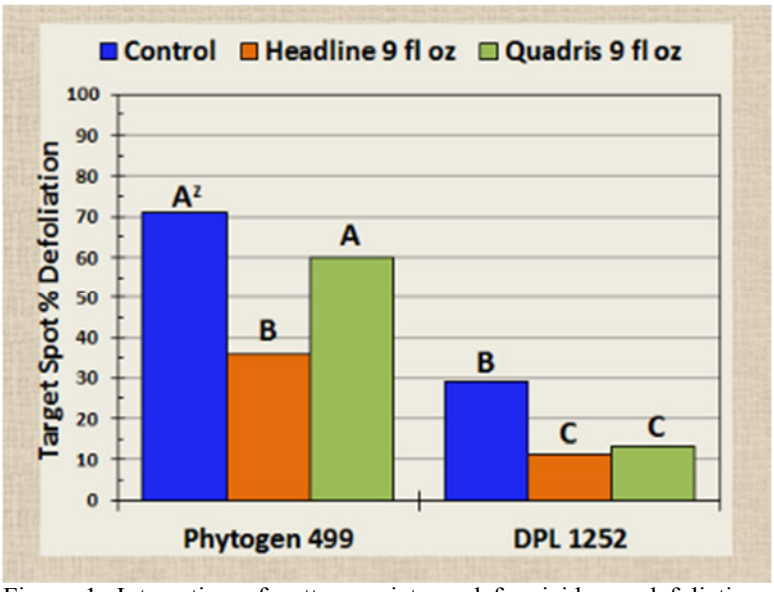

Figure 1. Interaction of cotton variety and fungicide on defoliation attributed to target spot on two cotton varieties in SW AL in 2014. Means in each column followed by the same letter are not significantly different according to Fisher's protected least significant difference (LSD) test ($P \leq 0.05$).

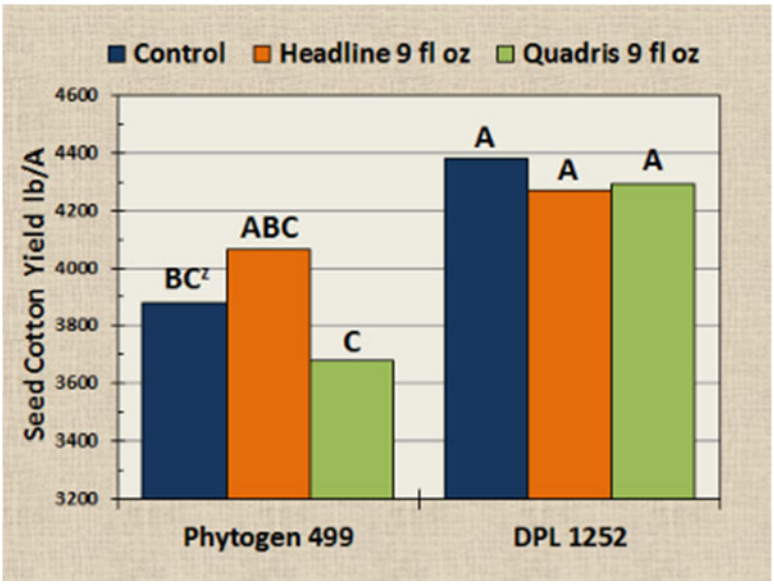

Figure 2. Yield of two cotton varieties as impacted by fungicide selection in SW AL in 2014. Means in each column followed by the same letter are not significantly different according to Fisher's protected least significant difference (LSD) test ($P \leq 0.05$).

Table 2. Counts of open, unopened locked and total bolls as impacted by cotton variety, fungicide, and nozzle arrangement.

Source of variation (*F* values)	Boll count[z]			
	Open	Unopened	Locked	Total
Variety	3.55^[y]	11.76*	12.74**	4.13*
Fungicide	0.62	0.22	1.36	0.22
Variety x Fungicide	0.84	0.12	0.12	1.03
Placement	2.22	2.53	0.08	3.78^
Variety x Nozzle arrangement	0.39	2.53	1.21	2.19
Fungicide x Nozzle arrangement	0.04	0.00	0.00	0.03
Variety x Fungicide x Nozzle arrangement	0.30	0.03	1.70	0.00
Cotton variety				
Phytogen 499	63.6 b	8.9 b	16.5 a	88.9 b
Deltapine 1252	71.9 a	17.6 a	9.8 b	99.3 a
Fungicide and rate /A				
Headline 2.09SC 9 fl oz	70.8 a	13.3 a	11.3 b	95.4 a
Quadris 2.08SC 9 fl oz	67.1 a	12.3 a	13.4 ab	92.8 a
Non-fungicide treated control	62.9 a	15.0 a	16.3 a	94.1 a
Nozzle arrangement				
Broadcast	72.5 a	14.4 a	12.6 a	99.6 a
Drop	65.4 a	11.1 a	12.1 a	88.6 a

[z]Numbers of open, unopened, locked, and total bolls per 3.2 ft of row.
[y]Significance of *F* values at the 0.10, 0.05, 0.01, and 0.001 levels is indicated by ^, *, **, or ***, respectively.
[x]Means in each column followed by the same letter are not significantly different according to Fisher's protected least significant difference (LSD) test ($P \leq 0.05$).

While locked boll counts were lower, counts of open, unopened, and total bolls were higher for Deltapine 1252 than Phytogen 499 (Table 1). Similar open, unopened, and total boll counts were recorded for the non-fungicide treated control as well as the Headline 2.09SC- and Abound 2.08SC-treated cotton. Fewer locked bolls were reported for the Headline 2.09SC-treated cotton than for the non-fungicide treated control. Nozzle arrangement had no impact on open, unopened, locked, or total boll counts.

Central AL Site

Since interactions for target spot defoliation and yield are not significant, data presented for each variable are pooled (Table 1). Data for the significant fungicide x placement interaction are segregated by variety and nozzle arrangement. While target spot defoliation levels were lower for Deltapine 1252 than Phytogen 499, open boll counts and yield of the latter variety were significantly higher. When compared with the non-fungicide treated control, significant reductions in target spot-incited defoliation were obtained with Quadris 2.08SC and Headline 2.09SC with the latter fungicide giving better disease control. While the open boll counts for the non-treated control and for both nozzle arrangements with Headline 2.09SC and Quadris 2.08SC did not significantly differ, higher open boll counts were noted with Headline 2.09SC applied with the drop compared with broadcast nozzle arrangement. Reductions in target spot defoliation obtained with the above fungicides did not translate into significant yield gains when compared with the non-fungicide treated control. Nozzle arrangement had no impact on target spot control or seed cotton yield.

Table 3. Impact of cotton variety, fungicide selection, and fungicide placement on the control of target spot and yield in Central AL in 2014.

Factorial analysis (*F* values)	Target spot % defoliation[z]	Open boll count[y]	Seed cotton yield lb/A[x]
Cotton Variety	27.54*	9.54**	50.51***
Fungicide	7.05*	0.03	1.51
Cotton Variety x Fungicide	1.92	0.13	0.01
Placement	1.95	4.72*	0.01
Cotton Variety x Placement	3.61	0.00	2.32
Fungicide x Placement	2.80	5.43*	1.42
Cotton Variety x Fungicide x Placement	0.34	2.39	0.00
Cotton variety			
Phytogen 499 WRF	41.9 a	83 a	3897 a
Deltapine 1252 B2RF	7.1 b	68 b	3375 b
Fungicide and rate/A		Broadcast Drop	
Non-treated control	35.1 a	74.1 ab	3600 a
Headline 2.09SC 9 fl oz	18.9 c	64.5 b 86.7 a	3700 a
Quadris 2.08SC 9 fl oz	24.7 b	74.3 ab 75.8 ab	3582 a
Nozzle arrangement			
Broadcast	23.4 a	--	3653 a
Drop	20.3 a	--	3647 a

[z]Target spot defoliation was assessed on 17 Sep.
[y]Counts of open bolls were made on 3.2 contiguous row ft on Oct 7 from a border row.
[x]Seed cotton yield = total weight of seed + lint.
[w]Significance of *F* values at the 0.05, 0.01, and 0.001 levels is indicated by *, **, or ***, respectively.
[v]Means in each column followed by the same letter are not significantly different according to the least significant difference (LSD) test ($P \leq 0.05$).

Summary

As previously noted in 2013 by Hagan *et al.* (2014a), no improvement in target spot control with the fungicides Headline 2.09SC and Quadris 2.08SC or yield gains was obtained with a drop nozzle compared with the standard broadcast nozzle arrangement on the cotton varieties Phytogen 499 and Deltapine 1252 under irrigation at two widely separated study sites in Alabama. With the exception of Deltapine 1252 at the Southwest AL location, Headline 2.09SC gave better target spot control than Quadris 2.08SC, which confirms results from previous Alabama field trials (Hagan *et al.* 2014b). At both study sites, defoliation levels were consistently higher for the non-fungicide treated control than for the Headline 2.09SC but not Quadris 2.08SC treated cotton. Despite sizable reductions in defoliation levels, particularly with Headline 2.09SC, yields for the fungicide-treated cotton and the non-fungicide treated controls at both study sites were similar. Kemeriat *et al.* (2011) and Wall *et al.* (2013) also reported significant reductions in target spot damage but failed to obtain consistent yield gains with fungicide inputs. Significantly lower defoliation levels recorded at both sites for Deltapine 1252 translated in higher seed cotton yields when compared with Phytogen 499 at the SW but not Central AL study site where yields were lower for the former cotton variety. Open, unopened, locked and total boll counts at the Southwest AL study site were impacted by variety selection. A reduction in the number of locked bolls was also obtained with Headline 2.09SC but not Quadris 2.08SC at this same study site.

References

Chiteka, Z. A., D. W. Gorbet, F. M. Shokes, T. A. Kucharek, and D. A. Knauft. 1988. Components of resistance to late leaf spot in peanut. 1. Levels of variability-implications for selection. Peanut Sci.15:25-30.

Hagan, A. K. 2014. Target spot management options in Alabama. 2014 Beltwide Cotton Conference. 45-48. http://www.cotton.org/beltwide/proceedings/2005-2014/index.htm.

Hagan, A. K., K. L. Bowen, M. Pegues, and J. Jones. 2013. An estimate of yield loss to target spot (Corynespora leaf spot) on cotton. 2013 Proc. Beltwide Cotton Conference: 33-38. http://www.cotton.org/beltwide/proceedings/2005-2013/index.htm.

Hagan, A. K., J. R. Akridge, and S. Scott. 2014a. Fungicide placement and control of target spot in cotton. 2014 Beltwide Cotton Conference. 276-280. http://www.cotton.org/beltwide/proceedings/2005-2014/index.htm.

Hagan, A. K., M. Pegues, and J. Jones. 2014b. Further studies on the control of target spot with fungicides. 2014 Beltwide Cotton Conference. 281-285. http://www.cotton.org/beltwide/proceedings/2005-2014/index.htm

Jones, J. P. 1961. A leaf spot of cotton caused by *Corynespora cassiicola*. Phytopathology 51:305-306.

Kemerait, R. C., Jr., F. H. Sanders, G. H. Harris, J. E. Woodward, S. N. Brown, and R. J. Byrne. 2011. Assessment and management of foliar diseases affecting cotton in Georgia and Texas. 2011 Proc. Beltwide Cotton Conferences: 287-292.

Li, Y., A. K. Culbreath, C. Y. Chen, S. J. Knapp, C. C. Holbrook, and B. Guo. 2012. Variability in field response of peanut genotypes from the U.S. and China to tomato spotted wilt virus and leaf spots. Peanut Sci. 39:30–37.

Walls, J. T, A. M. Fulmer, R. C. Kemeriat, Jr., F. H. Sanders, C. Perry, S. Newell, L. Newsom, R. J. Byrne, and P. Phipps. 2013. Impact of application timing of fungicides on the management of target spot. 2013 Proc. Beltwide Cotton Conference: 12-19. http://www.cotton.org/beltwide/proceedings/2005-2014/index.htm.