FUNGICIDE PLACEMENT AND CONTROL OF TARGET SPOT IN COTTON

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Abstract

With over-the top broadcast fungicide applications, much of the fungicide is intercepted by the upper leaf canopy and fails to reach the lower leaves in the inner canopy where *Corynespora cassiicola* infections often begin. Improved disease control may be obtained with a combination of over the top plus drop nozzles that would improve coverage in the inner leaf canopy. At the Brewton Agricultural Research Unit (BARU), better season long target spot control was obtained with Headline 2.09SC and Quadris 2.08SC applied with a combination over the top and drop nozzle arrangement than with the standard over-the-top broadcast nozzle arrangement on Phytogen 499 and Deltapine 1252, while final disease ratings and yields for the both nozzle arrangements were similar. While full season AUDPC and final target spot ratings were lower for Headline 2.09SC than Quadris 2.08SC, both fungicides reduced target spot damage compared to the non-treated control. Yield response with Headline 2.09SC and Quadris 2.08SC at BARU did not differ from the non-treated control. In a similar study at the E. V. Smith Research Center, similar disease control and yields were obtained with the broadcast and drop nozzle spray rigs. Although similar final disease ratings were noted, superior season long disease control was provided by the drop as compared with broadcast nozzle arrangement. Nozzle arrangement had no impact on seed cotton yield. Lower season-long target spot ratings and higher yields were noted for Headline 2.09SC and Quadris 2.08SC than for the non-fungicide treated control. At both locations 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.

Introduction

As previously noted by Hagan et al. (2013a), Hagan et al. (2013b), Kemeriat et al. (2011), and Walls et al. (2013), registered fungicides such as Headline 2.09SC and Quadris 2.08SC, regardless of application number, often do not provide a high level of target spot control. Even with five applications of 9 fl oz/A Headline 2.09SC, defoliation on Phytogen 499 exceeded 30% as compared with 80% defoliation for the non-fungicide treated control (Hagan et al,. 2013a). In contrast, multiple applications of the above fungicides gave excellent target spot control on tomato (Pernezny et al. 2002, Schlub et al. 2009). Effective target spot control may be due in part to improved coverage obtained with the combination of over the top and drop nozzles plus an elevated spray volume. While unlikely, the other option that may account for the relatively poor performance of strobilurin fungicides such as Headline 2.09SC and Quadris 2.08SC is a decline in sensitivity in the causal fungus *Corynespora cassiicola*. Recently, catastrophic declines in the efficacy of these strobilurin fungicides against *C. cassiicola*-incited diseases on cucumber (Miyamoto et al., 2009) and tomato (Adkison et al., 2012) have been reported.

The objective of this study was to assess the impact of fungicide selection and placement on the efficacy of recommended fungicides for the control of target spot on Phytogen 499 and Deltapine 1252 cotton varieties at two locations in Alabama.

Material and Methods

Brewton Agricultural Research Unit (BARU) Study Site

The study site was prepared for planting with a KMC ripper bedder. On 29 Mar, 400 lb/A of 15-0-15 analysis fertilizer was broadcast and incorporated. On 15 May, Phytogen 499 and Deltapine (DPL) 1252 cotton varieties were hill dropped at a rate of 3 seed/row ft. Layby applications of 200 lb/A of 15-0-15 analysis fertilizer on 6 June was followed by an application of 400 lb/A of 15-0-15 analysis fertilizer on 18 June. Weed control was obtained with a pre-emergent incorporated application of 1 pt/A Prowl H_20 followed by a 7 June broadcast application of 1

qt/A Roundup Weathermax. Cotton was prepared for harvest with an application of 1.5 pt/A Finish defoliant on 2 October. Plots received with 1.0, 0.5, and 0.5 acre inches of water delivered by a lateral irrigation system on 29 May, 29 August, and 11 September, respectively. 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 18 July (1st week of bloom) and 1 August (3rd week of bloom) with TX-12 nozzles on 20 inch spacing at 20 gal/A of spray volume at 60 psi or with a drop nozzle arrangement with a single TX-12 nozzles 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.

E.V. Smith Study Site

The study site was prepared for planting with a KMC strip till rig. On 16 May, Phytogen 499 and DPL 1252 cotton varieties were hill dropped at a rate of 2 seed/row ft. A 17 May broadcast application of 91 lb/A of 33-0-0 analysis fertilizer was followed by a 12 June layby application of 100 lb/A of murate of potash (0-0-60) and a 28 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 16 May pre-emergent incorporated application of 2 pt/A Prowl H_20 + 1 pt/A Reflex followed by a 12 June broadcast application of 22 fl oz/A Roundup Weathermax + 1 pt/A Dual Magnum II and a 1 July layby application of 40 fl oz/A MSMA + 2 pt/A Caparol with a hooded sprayer. Cotton was prepared for harvest with an 11 October application of 1 pt/A Folex + 6 fl oz/A Takedown + 8 fl oz/A Boll Buster + 1.5 fl oz/A Aim. Bidrin at 4 fl oz/A was broadcast on 26 July and 22 August for stink bug control. Plots received 0.35 and 0.5 acre inches of water via a lateral irrigation system on 15 May and 29 May, respectively. Headline 2.09SC at 9 fl oz/A and Quadris 2.08SC at 9 fl oz/A were applied with a 'spider' sprayer on 19 Jul (1st week of bloom) and 5 Aug (3rd week of bloom) as 1) a broadcast application with AITTJ60-11002VP nozzles on 18 in. 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 20 gal/A at 40 psi. A non-fungicide treated control was included.

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 split split-plots consisted of four 30–ft rows spaced 3 ft apart. Four replications of treatments were included. Target spot intensity was visually assessed at BARU on 24 July, 15 August, 27August, 10 September, and 20 September and E.V. Smith on 6 August,13 August, 27 August, 31 August, 6 September, and 15 September using the 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 $\leq$ 10% defoliation, 5 = lesions noticeable and $\leq$ 25% defoliation, 6 = lesions numerous and $\leq$ 50% defoliation, 7 = lesions very numerous and $\leq$ 75% defoliation, 8 = numerous lesions on few remaining leaves and $\leq$ 90% defoliation, 9 = very few remaining leaves covered with lesions and $\leq$ 95% defoliation, and 10 = plants defoliated (Chiteka et al., 1988). Data collected at BARU and E.V. Smith on 20 September and 15 September, respectively, are displayed in the table. Cotton was mechanically harvested on 14 October. Significance of interactions was determined using the PROC GLIMMIX procedure in SAS. Statistical analysis on target spot intensity was done on rank transformations of data, which were back transformed for presentation. Means were separated using least significant difference (LSD) test ($P \leq 0.05$).

Environmental conditions

Temperatures during the study period were below to near the 30-year historical average. Rainfall totals for May through August were above to well above normal but were relatively dry in September and October.

Results

BARU Site

Since the cotton variety x fungicide interaction on final target spot intensity, season-long target spot AUDPC values, and seed cotton yield are not significant, pooled data are presented. While final target spot intensity and season-long disease AUDPC values were significantly lower for DPL 1252 than Phytogen 499, yield of the two varieties were similar (Table 1). Higher target spot intensity and AUDPC values were recorded for the non-treated control compared with Headline 2.09SC and Quadris 2.08SC, with the former fungicide providing superior target spot control. Although similar final target spot ratings were recorded with the broadcast and drop nozzle arrangements, better season-long disease control as indicated by lower AUDPC values was obtained with the latter nozzle arrangement. Superior yield response was obtained with Headline 2.09SC than Quadris 2.09SC but neither

fungicide improved yields when compared with the non-treated control. Seed cotton yield also was not impacted by nozzle arrangement.

Table 1. Impact of cotton variety, fungicide selection, and nozzle arrangement on the control of target spot and yield at BARU in 2013.

Split plot analysis (*F* values)	Final target spot intensity[z]	AUDPC[y]	Seed cotton yield lb/A[x]
Cotton variety	200.43***[w]	200.85***	0.02
Fungicide	8.91**	13.22**	10.39**
Cotton variety × Fungicide	0.51	0.60	0.66
Placement	2.41	28.24***	1.92
Cotton variety × Nozzle arrangement	2.79	2.76	0.13
Fungicide × Nozzle arrangement	2.79	0.94	0.05
Cotton variety × Fungicide × Nozzle arrangement	0.36	0.55	0.51
Cotton varieties			
Phytogen 499	5.8 a[v]	168 a	2821 a
Deltapine 1252	4.5 b	118 b	2827 a
Fungicide and rate/A			
Non-treated control	5.7 a	170 a	2828 ab
Headline 2.09SC 9 fl oz	4.8 c	129 c	2927 a
Quadris 2.08SC 9 fl oz	5.2 b	143 b	2720 b
Nozzle arrangement			
Broadcast	5.0 a	143 a	2790 a
Drops	5.0 a	128 b	2892 a

[z]Target spot intensity was rated using a leaf spot scoring system (1 to 10 scale) on 20 September.
[y]AUDPC = area under the disease progress curve during the study period.
[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 least significant difference (LSD) test ($P \leq 0.05$).

E.V. Smith Site

Since all interactions for AUDPC and yield are not significant, data presented for each variable are pooled (Table 2). Due to a significant variety x nozzle arrangement interaction for target spot intensity, data are presented by cotton variety. Despite higher final target spot ratings and AUDPC values, yield was higher for Phytogen 499 than DPL 1252. Final disease ratings were similar for non-treated control, Quadris 2.08SC and Headline 2.09SC, however, the latter fungicide treatment gave better season-long target spot control, as indicated by a lower AUDPC value. Superior season-long disease control obtained with both fungicide treatments as compared with the non-treated control was reflected in higher seed cotton yields. Target spot ratings on Phytogen 499 and DPL 1252, along with the AUDPC values, and yield obtained with the drop and over-the-top broadcast nozzle arrangements did not significantly differ.

Table 2. Yield response and control of target spot as influenced by cotton variety, fungicide selection, and nozzle arrangement at E.V. Smith Research Center in 2013.

Split plot analysis (*F* values)	Final target spot intensity[z]		AUDPC[y]	Seed cotton yield lb/A[x]
Cotton variety	25.77**		42.15**	12.60**
Fungicide	3.88		19.98***	0.11
Cotton variety × Fungicide	1.55		0.93	0.42
Placement	0.69		0.01	2.73
Cotton variety × Nozzle arrangement	4.74*		0.01	0.17
Fungicide × Nozzle arrangement	1.55		0.09	0.11
Cotton variety × Fungicide × Nozzle arrangement	0.01		0.01	0.14
Cotton varieties				
Phytogen 499	6.1 a		197 a	4974 a
Deltapine 1252	4.8 b		163 b	4570 b
Fungicide and rate/A				
Non-treated control	6.2 a		197 a	4568 b
Headline 2.09SC 9 fl oz	5.1 a		168 c	4842 a
Quadris 2.08SC 9 fl oz	5.4 a		183 b	4805 a
Nozzle arrangement	**Phytogen 499**	**DPL 1252**		
Broadcast	5.7 a	4.7 b	176 a	4731 a
Drops	6.1 a	4.6 b	175 a	4916 a

[z]Target spot intensity was rated using a leaf spot scoring system (scale = 1 to 10) on 15 Sep.
[y]AUDPC = area under the disease progress curve during the study period.
[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 ($P \leq 0.05$).

Discussion

Nozzle arrangement had limited impact on target spot intensity in cotton. At one of two sites, season-long disease intensity was reduced with the drop and top nozzle arrangement compared with over the top broadcast nozzle arrangement. By the final September rating date at both sites, similar target spot intensity ratings for both nozzle arrangements were also reflected in the absence of yield differences. Fungicide selection significantly impacted target spot intensity and seed cotton yield. Final target spot ratings at BARU but not E. V. Smith were also lower for Headline 2.09SC compared with Quadris 2.08SC. When compared with the non-treated controls, Headline 2.09SC gave better season-long target spot control as indicated by lower AUDPC values at both study sites than Quadris 2.08SC. Significant yield gains were obtained with Headline 2.09SC and Quadris 2.08SC compared with the non-treated control at the E. V. Smith but not BARU sites, where yields were higher for the former than latter fungicide treatments. While few differences in target spot were observed in 2012 trials between 9 fl oz/A rates of Headline 2.09SC and Quadris 2.08SC, higher yields were obtained with the former and not the latter fungicide when compared with the non-treated control (Hagan et al. 2013a). Despite higher final and season-long target spot ratings, Phytogen 499 had similar and higher seed cotton yields at BARU and E. V. Smith sites, respectively, than DPL 1252. As noted previously by Hagan et al. (2013c), Phytogen 499 often produces superior seed cotton yields, despite severe target spot-incited defoliation, while DPL 1252 has, as noted here, suffered less premature defoliation and produced competitive yields.

While drop nozzle arrangement failed to consistently produce the anticipated improvement in target spot control and subsequent yield gains over the standard over the top broadcast nozzle arrangement, additional studies will need to be conducted to confirm results of the present studies as well as assess the effect of increased spray volume on the control of target spot in cotton with fungicides.

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