EFFECT OF FUNGICIDE AND APPLICATION TIMING ON TARGET SPOT IN LOUISIANA

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Introduction

Target spot, caused by the fungus *Corynespora cassiicola*, is an emerging issue in cotton (*Gossypium hirsutum* L.) in the Mid-South. The disease has been a significant disease of cotton in the southeastern United States since 2005 (Kemerait et al 2011). Since 2011, the disease has been observed in Arkansas, Mississippi, and Louisiana (Allen 2011, Faske 2013, Price 2014). In severe cases target spot has been estimated to cause losses of approximately 60 to 280 lb lint/A (Kemerait et al 2011, Fulmer et al 2012, Hagan et al 2013a, 2013b). In 2014, target spot was widespread throughout cotton producing areas in Louisiana with moderate to heavy disease severity in Franklin, Madison, Rapides, Richland, and Tensas Parishes. Prior to disease epidemics in cotton, target spot was observed with low incidence in maturing soybeans. In cotton symptoms first appeared in the lower canopy with lesions exhibiting a target-like appearance, and concentric rings were evident within lesions. Microscopic examination confirmed the presence of *C. cassiicola* conidia. In some cases, the disease progressed upwards through the canopy and caused rapid premature defoliation. Rainfall, wind, and/or overhead irrigation may aid in spreading the pathogen resulting in new infections, and the pathogen overwinters in plant debris. In Louisiana in 2014, producer fields were observed with up to 60% defoliation, and in research station field plots, up to 90% defoliation was observed. Differences in varietal susceptibility, presumably because of plant height and/or structure, have been noted throughout the southeastern United States (Kemerait et al 2011; Hagan et al 2013a, 2013b, multiple reports in 2012 and 2013 Plant Disease Management Reports [PDMR]). There are no completely resistant varieties, and any cotton line that becomes rank may develop symptoms, as observed in northeast Louisiana in 2014. Applications of Quadris, Headline, or Twinline (the only products currently labeled for target spot in cotton), from the first through eighth week of bloom (or at the first appearance of symptoms) have been shown to effectively reduce disease incidence and severity (Kemerait et al 2011, Hagan et al 2013b, multiple PDMRs 2013). In some cases fungicide applications may be economical depending on disease severity and crop stage; however, consistent trial results are elusive. More information concerning the effect of fungicides and application timings on target spot and yield is needed in the Mid-South.

Materials and Methods

In 2014, two trials were conducted at the Dean Lee Research Station (DLRS) in Alexandria, LA, and one trial was conducted at the Macon Ridge Research Station (MRRS) near Winnsboro, LA. At DLRS one trial was planted to a Coushatta silt loam with Delta & Pine Land (D&PL) 1133, while the other was planted with Phytogen (PHY) 499 on 20 May. Both trials at DLRS had the exact same treatments: Headline (6 fl oz/A), Priaxor (4 fl oz/A), Quadris (6 fl oz/A), or Topguard (7 fl oz/A) applied at the 1st (22 Jul) or 3rd (8 Aug) week of bloom. Rainfall amounts during the trial period at DLRS totaled 29.5 inches, with temperature and relative humidity averaging 79.2°F and 71.8%, respectively. Plots at DLRS were harvested on 17 Oct.

The trial at MRRS was planted to a Gigger-Gilbert silt loam with Phytogen 499 on 2 Jun, and treatments consisted of Headline (6 fl oz/A), Priaxor (4 fl oz/A), or Quadris (6 fl oz/A) applied at the 1st week of bloom (4 Aug); Headline (6 fl oz/A) or Priaxor (4 fl oz/A) applied the 1st and 3rd week (20 Aug) of bloom; or Headline (6 fl oz/A) at the 1st week of bloom followed by Priaxor (4 fl oz/A) at the 3rd week of bloom or *vice versa*. Rainfall amounts during the trial period at MRRS totaled 21.3 inches, and supplemental overhead irrigation was provided as needed. Average temperature during the trial period was 77.7°F, and minimum relative humidity averaged 48%. Plots were harvested on 27 Oct.

Trials were arranged in randomized complete block designs with 4 replicates at DLRS and 6 replicates at MRRS, and plots were rated by visually estimating disease incidence and defoliation as percentages at both locations. Lint cotton yields were calculated at 40% turnout for both locations. Data were analyzed using analysis of variance, and treatment means were compared using Tukey's Honest Significant Difference Test at the 90% confidence level (P=0.10). All

other production practices and pest management events were conducted adhering to the recommendations of LSU AgCenter.

Results

At DLRS (Alexandria) in D&PL 1133, disease incidence and defoliation ranged from 18 to 49% and 7 to 22%, respectively, on 19 Aug (Table 1). No significant differences among treatments were observed on 19 Aug. On 26 Aug, disease incidence and defoliation ranged from 28 to 70% and 15 to 43%, respectively. Plots treated with Priaxor during the 3rd week of bloom had significantly lower disease incidence than plots treated with Headline, Topguard, and Quadris during the 1st week of bloom. There were no significant differences in defoliation among treatments on 26 Aug. Plots treated with Priaxor during the 3rd week of bloom had significantly lower area under the disease progress curve (AUDPC) values for disease incidence than plots treated with Quadris during the 1st week of bloom. There were no significant differences in yield among treatments.

Table 1. Effect of fungicide application and timing on target spot incidence, defoliation due to target spot, and yield of cotton (Delta & Pine Land 1133) in Alexandria, Louisiana.

Treatment and rate/A (timing)[z]	Inc[y]. % 19 Aug	Def[x]. % 19 Aug	Inc. % 26 Aug	Def. % 26 Aug	AUDPC[w] (Inc.)	AUDPC (Def.)	17-Oct lb/A (lint yield)
Non-treated check	29 a[v]	11 a	54 ab	33 a	290 ab	160 a	1670 a
Headline 6 fl oz (A)	39 a	17 a	70 a	43 a	380 ab	210 a	1700 a
Topguard 7 fl oz (A)	28 a	10 a	66 a	39 a	330 ab	170 a	1502 a
Priaxor 4 fl oz (A)	30 a	12 a	64 ab	39 a	330 ab	180 a	1682 a
Quadris 6 fl oz (A)	49 a	22 a	70 a	41 a	420 a	230 a	1453 a
Non-treated check	33 a	10 a	53 ab	29 a	300 ab	140 a	1563 a
Headline 6 fl oz (B)	33 a	15 a	40 ab	23 a	250 ab	130 a	1816 a
Topguard 7 fl oz (B)	26 a	12 a	58 ab	33 a	290 ab	160 a	1622 a
Priaxor 4 fl oz (B)	18 a	7 a	28 b	15 a	160 b	80 a	1677 a
Quadris 6 fl oz (B)	30 a	10 a	59 ab	33 a	310 ab	150 a	1542 a
Tukey's HSD (P = 0.10)	38	2.7t[u]	37	28	250	160	459

[z]A=1st week of bloom; B=3rd week of bloom.
[y]Incidence.
[x]Defoliation.
[w]Area Under the Disease Progress Curve.
[v]Means followed by the same letter are not significantly different at P=0.10 as determined by Tukey's honest significant difference test.
[u]Data log-transformed during analysis to correct for heterogeneity of variance.

At DLRS (Alexandria) in PHY 499, disease incidence and defoliation ranged from 31 to 65% and 15 to 36%, respectively, on 19 Aug (Table 2). No significant differences among treatments were observed on 19 Aug. On 26 Aug, disease incidence and defoliation ranged from 35 to 85% and 19 to 60%, respectively. Plots treated with Headline or Priaxor during the 3rd week of bloom had significantly less disease incidence than at least one non-treated control. Plots treated with Priaxor at the second timing also had significantly less defoliation than the non-treated control and all other treatments with the exception of Headline and Quadris applied during the 3rd week of bloom. AUDPC incidence and defoliation values for plots treated with Priaxor at the later application timing were significantly lower

than at least one non-treated control. Although there were trends towards yield preservation in some treated plots, there were no significant differences in yield among treatments.

At MRRS (Winnsboro) in PHY 499, disease incidence and defoliation ranged from 13 to 28% and 6 to 14%, respectively, on 22 Aug (Table 3). Plots treated with Priaxor during the 1st week of bloom had significantly lower disease incidence and defoliation than the non-treated control. On 3 Sep, disease incidence and defoliation ranged from 19 to 50% and 9 to 26%, respectively. Plots treated with Priaxor during the 1st week of bloom had significantly lower disease incidence and defoliation than the non-treated control. Plots treated with two applications of Headline, two applications of Priaxor, or either product followed by the other had significantly less disease incidence and defoliation than the non-treated control. On 18 Sep, all plots that received an application of Headline or Priaxor during the third week of bloom had significantly lower disease incidence and defoliation than the non-treated control and plots only treated once at 1st bloom. AUDPC values for disease incidence and defoliation were significantly lower than the non-treated control for plots receiving only Priaxor at 1st bloom. Plots receiving two applications of Headline, two applications of Priaxor, or either product followed by the other during the 3rd week of bloom had significantly lower AUDPC values for incidence and defoliation than the non-treated control. Although there were trends towards yield preservation in some treated plots, there were no significant differences in yield among treatments.

Table 2. Effect of fungicide application and timing on target spot incidence, defoliation due to target spot, and yield of cotton (Phytogen 499) in Alexandria, Louisiana.

Treatment and rate/A (timing)[z]	Inc[y]. % 19 Aug[y]	Def[x]. % 19 Aug	Inc. % 26 Aug	Def. % 26 Aug	AUDPC[w] (Inc.)	AUDPC (Def.)	17-Oct lb/A (lint yield)
Non-treated check	56 a[v]	31 a	74 ab	48 a	460 a	280 ab	1450 a
Headline 6 fl oz (A)	54 a	30 a	85 a	59 a	490 a	310 a	1354 a
Topguard 7 fl oz (A)	58 a	30 a	81 a	54 a	490 a	290 ab	1363 a
Priaxor 4 fl oz (A)	45 a	25 a	79 ab	53 a	430 ab	270 ab	1437 a
Quadris 6 fl oz (A)	65 a	36 a	85 a	60 a	530 a	340 a	1229 a
Non-treated check	54 a	34 a	85 a	60 a	490 a	330 a	1262 a
Headline 6 fl oz (B)	48 a	26 a	58 bc	38 ab	370 ab	220 ab	1585 a
Topguard 7 fl oz (B)	60 a	36 a	81 a	54 a	490 a	320 a	1422 a
Priaxor 4 fl oz (B)	31 a	15 a	35 c	19 b	230 b	120 b	1568 a
Quadris 6 fl oz (B)	53 a	29 a	71 ab	40 ab	430 ab	240 ab	1332 a
Tukey's HSD (P = 0.10)	40	32	23	25	210	190	474

[z]A=1st week of bloom; B=3rd week of bloom.
[y]Incidence.
[x]Defoliation.
[w]Area Under the Disease Progress Curve.
[v]Means followed by the same letter are not significantly different at P=0.10 as determined by Tukey's honest significant difference test.

Table 3. Effect of fungicide application and timing on target spot incidence, defoliation due to target spot, and yield of cotton (Phytogen 499) near Winnsboro, Louisiana.

Treatment and rate/A (timing)[z]	Inc[y]. % 22 Aug	Def[x]. % 22 Aug	Inc. % 3 Sep	Def. % 3 Sep	Inc. % 18 Sep	Def. % 18 Sep	AUDPC[w] (Inc.)	AUDPC (Def.)	27-Oct lb/A (lint yield)
Nontreated	28 a[v]	14 a	50 a	26 a	77 a	51 a	1420 a	840 a	826 a
Headline 6 fl oz (A)	28 a	12 ab	42 ab	20 abc	73 a	45 ab	1280 a	680 a	870 a
Priaxor 4 fl oz (A)	13 b	6 b	19 c	9 d	68 ab	38 abc	840 bc	450 b	933 a
Quadris 6 fl oz (A)	23 ab	10 ab	47 a	22 ab	80 a	53 a	1370 a	760 a	818 a
Headline 6 fl oz (AB)	22 ab	9 ab	30 bc	15 bcd	54 b	28 bcd	940 b	470 b	801 a
Priaxor 4 fl oz (AB)	27 a	11 ab	20 c	10 d	34 c	26 cd	690 bc	415 b	796 a
Headline 6 fl oz (A) fb Priaxor (B)	24 ab	12 ab	24 c	12 cd	35 c	18 d	730 bc	380 b	815 a
Priaxor 4 fl oz (A) fb Headline 6 fl oz (B)	16 ab	8 ab	21 c	10 d	34 c	17 d	630 c	310 b	951 a
Tukey's HSD (P = 0.10)	13	1t[u]	13	1t	16	19	270	210	166

[z]A=1st week of bloom; B=3rd week of bloom.
[y]Incidence.
[x]Defoliation.
[w]Area Under the Disease Progress Curve.
[v]Means followed by the same letter are not significantly different at P=0.10 as determined by Tukey's honest significant difference test.
[u]Data log-transformed during analysis to correct for heterogeneity of variance.

Discussion

Results from all three field trials indicate that fungicide applications, particularly Headline and Priaxor, are efficacious on reducing incidence of target spot and defoliation as a result of infection. There were some trends towards preserved yield with some treatments; however, there were no significant impacts on yield, which was unexpected due to high rates of defoliation in some plots. This may be due to variable field conditions, compensation by cotton plants, or other unknown factors that occurred during the growing season. Current recommendations in Louisiana do not call for prophylactic applications of fungicides to cotton for target spot management. Instead, consultants and producers are encouraged to thoroughly scout for target spot beginning at blooming paying close attention to areas with a history of target spot. Conveniently, scouting for target spot may be conducted while looking for insect pests low within the canopy using the shake sheet method. Target spot infections in maturing soybeans also may serve as a warning of impending problems in cotton. If target spot is encountered within the first eight weeks of blooming, a fungicide application may be warranted depending on disease severity and prevailing environmental conditions. Currently, it is unclear if late-season applications or "revenge sprays" are efficacious or economically feasible. Ideally, ground applications with maximum total water volume, high pressure, appropriate nozzles, and labeled rates should be used to maximize coverage. More research on the effects of fungicide application type, timing, and rate on target spot is needed. Additionally, basic information (optimal infection parameters) concerning the pathogen would be useful in predicting outbreaks. More information concerning cotton defoliation as related to yield loss would be helpful in making management decisions as well.

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