EFFICACY AND YIELD PROTECTION FROM DEVELOPMENTAL FUNGICIDES COMPARED FOR THE CONTROL OF TARGET SPOT IN COTTON

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Abstract

Studies were conducted in 2019 to determine the yield protection and efficacy of developmental fungicides for the control of target spot on Stoneville 6182 GLT and Deltapine 1646 B2XF cotton at the Brewton Agricultural Research Unit (BARU). The experimental design for both studies was a randomized complete block with four (4) replications. The study utilizing Stoneville 6182 GLT but not Deltapine 1646 B2XF was irrigated and both were managed to maximize yield. With the exception of the Priaxor + Bravo WeatherStik umbrella program, the remaining fungicide treatments were applied at the third and fifth week of bloom. Target spot intensity was assessed on a 1 to 10 intensity scale at 7 to 14 day intervals. On Stoneville 6182 GLT, target spot symptoms, first noted on 28 July, intensified into mid-September. Significant differences in defoliation were noted among fungicide programs with the non-fungicide control having the greatest leaf loss. When compared with the non-fungicide control, defoliation levels were lower for the all rates of Revytek (BAS 75302F) along with Priaxor, Miravis Top alone or tank mixed with Quadris and the Priaxor + Bravo positive control. In contrast, Propulse, Provost Silver, along with both Aproach programs failed to reduce defoliation when compared with the non-fungicide control. On rainfed Deltapine 1646 B2XF, fungicide applications were initiated after target spot onset. When compared with the non-fungicide control, significant reductions in premature defoliation were obtained with all fungicides except for the Aproach programs and Provost Silver. The low level of defoliation recorded for Revytek was equaled by the Priaxor + Bravo WeatherStik positive control and Priaxor standard. Superior disease control was provided by the two higher compared with lowest rate of Revytek. Despite significant differences in disease-incited defoliation, similar seed cotton yields were recorded for all fungicide programs on Deltapine 1646 B2XF.

Introduction

Target spot, which is caused by the fungus *Corynespora cassiicola* Berk. & M.A. Curtis) C.T. Wei, is linked with significant yield losses in cotton (Bowen et al, 2018; Hagan et al, 2018). Mehl et al. (2019) has also reported a negative correlation between target spot-incited defoliation and yield. Disease distribution in the U.S. includes all cotton producing states except for Arizona and California (Butler et al. 2016; Conner et al. 2013; Donahue 2012; Edmisten 2012; Fulmer et al. 2012; Price et al. 2015a, Damicone, personal communication; Woodruff, personal communication). Target spot outbreaks have also been reported in Brazil (Galbieri et al. 2014) and China (Wei et al. 2014).

Strong-growing cotton with early canopy closure and a yield potential of 1500 lb./acre is most vulnerable to target spot, particularly when irrigated and/or close proximity to the Gulf Coast where frequent afternoon summer showers favor early disease onset and development (Hagan 2014). As was previously demonstrated in 2017, absence of a closed canopy after first bloom minimizes target spot development, regardless of rainfall or irrigation patterns (Hagan, personal observation).

While cultivars with partial resistance to target spot continue to dominate the cotton seed market in Alabama (USDA-AMS 2019), fungicides are an effective tool for limiting premature defoliation and disease-incited yield loss, particularly in intensively managed target spot susceptible cultivars (Hagan, 2014). Yield protection obtained with registered fungicides may range up to 250 lb. lint/A (Hagan et al, 2014; Hagan et al, 2016). However, Mehl et al (2019) also reported inconsistent yield gains from the Headline, Quadris, and the more efficacious Priaxor Xemium Brand Fungicide on PhytoGen 499 WRF and Deltapine 1137 B2RF despite reductions in premature defoliation.

The study objective was to assess the efficacy of selected established and developmental fungicides for the control of target spot as well as their impact on yield parameters in a high disease pressure setting in Southwest Alabama.

Methods

For both studies conducted at the BARU, the experimental design was a randomized complete block with four replications. Individual plots consisted of four 25 ft rows spaced 3 ft apart. The cotton cultivars 'Deltapine 1646 B2XF' and 'Stoneville 6182 GLT' was hill dropped at a rate of 3 seed/row ft in a Benndale fine sandy loam on 8 May and 22 May, respectively. Alleys between replications were cut with a bush hog several days prior to harvest. Recommendations of the Alabama Cooperative Extension System for fertility along with insect and weed control, canopy management, and harvest preparation were followed. The block of Stoneville 6182 GLT was irrigated as needed with a lateral irrigation system. Fungicides were broadcast with a high clearance sprayer on 25 Jul (3th week of bloom) and 7 Aug (5th week of bloom) on Stoneville 6182 and on the same dates at the 3rd and 5th week of bloom to the Deltapine 1646 B2RF with TX-12 nozzles on 18-in. spacing at 20 gal/A of spray volume at 60 psi.

Target spot intensity was assessed at cut-out 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 $\leq$ 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). Defoliation values were calculated using the formula [% Defoliation = 100/(1+e(-(leaf spot scoring system -6.0672)/0.7975)] (Li et al, 2012). Cotton was mechanically harvested and samples collected for grading. Significance of cultivar × fungicide interactions were determined using PROC GLIMMIX in SAS. Statistical analyses were done on rank transformations for non-normal values. Non-transformed data are reported. Means were separated using Fisher's protected least significant difference (LSD) test ($P \leq 0.05$) unless otherwise indicated.

Results

Despite late summer dry weather patterns, significant differences in the level of target spot-incited defoliation were noted among the fungicide programs with the non-fungicide control having the greatest premature leaf loss at 73% at the final 11 Sep rating date. When compared with the no fungicide control, significantly lower defoliation levels were noted for all rates of Revytek along with Priaxor, Miravis Top alone or tank mixed with Quadris and the Priaxor + Bravo WeatherStik positive control, all of which gave equally effective target spot control. In contrast, Propulse, Provost Silver, along with both Aproach programs failed to significantly reduce target spot-incited defoliation compared with the no fungicide control. Significant yield gains ($P \leq 0.10$) were obtained with Miravis Top, 12 and 15 fl oz/A Revytek, and the Priaxor + Bravo WeatherStik positive control compared with the no fungicide control. High seed yields recorded with Miravis Top alone were matched by 12 and 15 fl oz/A Revytek along with Miravis Top + Quadris, 6 fl oz/A Aproach, Priaxor alone, and the Priaxor + Bravo WeatherStik positive control. Also, greater seed yield was noted for the two higher compared with lowest rate of Revytek. Propulse, Provost Silver, and 9 fl oz/A Aproach programs produced yield significantly less than Miravis Top (Table 1.).

Table 1. Fungicides compared for the control of target spot and seed yield response on Stoneville 6182 cotton cultivar.

Fungicide program and rate/A	Application timing	Open bolls [z]	Target spot % defoliation [y]	Seed yield lb./A
No fungicide control	---	59.8 a [x]	73.3 a	4,139 cd
Aproach 2.08SC, 6 fl oz/A	3rd & 5th week bloom	70.7 a	56.6 bc	4,267 a-d
Aproach 2.08SC, 9 fl oz/A	3rd & 5th week bloom	67.5 a	56.1 bc	4,163 bcd
Miravis Top 200SC, 13.7 fl oz/A	3rd & 5th week bloom	68.5 a	26.9 d	4,555 a
Miravis Top 1.67SC, 13.7 fl oz/A + Quadris 250SC, 5.47 fl oz/A	3rd & 5th week bloom	59.5 a	30.9 d	4,397 abc
Priaxor 4.17SC, 4 fl oz/A	3rd & 5th week bloom	60.0 a	33.0 d	4,400 abc
Priaxor 4.17SC, 8 fl oz + Bravo WeatherStik 6F, 1 pt./A	3rd, 5th & 7th week bloom	65.5 a	25.1 d	4,433 ab
Propulse 3.34, 13.7 fl oz/A	3rd & 5th week bloom	57.8 a	61.0 ab	4,082 d
Provost Silver, 3.52SC 13 fl oz/A	3rd & 5th week bloom	60.0 a	62.9 a	4,217 bcd
Revytek 3.33SC, 8 fl oz/A	3rd & 5th week bloom	64.8 a	31.8 d	4,111 cd
Revytek 3.33SC, 12 fl oz/A	3rd & 5th week bloom	52.8 a	40.8 cd	4,452 ab
Revytek 3.33SC, 15 fl oz/A	3rd & 5th week bloom	67.5 a	33.6 d	4,432 ab
p-value		0.5760	0.0001	0.0730

[z] Counts of open bolls were made on 3.2 ft of row on 24 October.

[y] Target spot intensity were rated on 19 September using a 1 to 10 leaf spot scoring system and converted to % defoliation values.

[x] Means in each column followed by the same letter are not significantly different according to Fisher's protected least significant difference (LSD) test ($P \leq 0.05$) unless otherwise indicated.

Selected fungicides were compared with a recommended two application Priaxor program for the curative control of target spot on rainfed Deltapine 1646 B2XF cotton. Concurrent to the first fungicide application, leaf spotting and a low level of target spot-incited defoliation was observed. Disease intensification progressed from the 28 Jul through the 26 Aug rating dates. When compared with the no fungicide control, significant reductions in premature defoliation were obtained with all fungicide programs except for the one and two applications programs with both rates of Aproach along with the two application Provost Silver programs. Similarly, low defoliation levels recorded for 12 and 15 fl oz/A Revytek along with Priaxor were equaled by Miravis Top, and Priaxor + Bravo WeatherStik. In addition, superior disease control was provided by the two higher than the lowest rate of Revytek. While counts of open and unopened bolls was not impacted by fungicide program, a significant reduction in hardlocked bolls compared with the no fungicide control was noted for the two higher rates of Revytek along with two applications of 9 fl oz/A Aproach (Table 2.). Despite significant differences in turn out and disease-incited defoliation yield for the no fungicide control and all remaining fungicide programs did not significantly differ.

Table 2. Developmental and established fungicides evaluated for their control of target spot and impact on yield parameters of cotton.

Fungicide program and rate/A	Spray number	Boll Counts		Target spot % defoliation [y]	Lint turn out	Lint yield lb./A
		Open[z]	Hardlock			
No Fungicide Control	---	48.8 a [x]	10.4 abc	38.1 a	0.458 abc	1610 a
Revytek 3.33SC 8 fl oz/A	2	49.0 a	9.0 a-e	26.0 bcd	0.460 abc	1684 a
Revytek 3.33 SC 12 fl oz/A	2	54.0 a	3.8 f	11.1 e	0.450 c	1583 a
Revytek 3.33SC 15 fl oz/A	2	52.8 a	6.3 def	10.5 e	0.460 abc	1591 a
Miravis TOP 200SC 13.7 fl oz/A	2	55.5 a	11.0 abc	12.7 de	0.458 abc	1633 a
Priaxor 4.17SC 4 fl oz/A	2	55.5 a	8.0 b-f	11.7 e	0.458 abc	1561 a
Aproach 2.08SC 6 fl oz/A	1	55.8 a	8.5 a-d	30.4 ab	0.460 ab	1629 a
Aproach 2.08SC 6 fl oz/A	2	51.0 a	10.0 a-d	37.2 ab	0.465 a	1632 a
Aproach 2.08SC 9 fl oz/A	1	59.8 a	5.3 ef	25.9 abc	0.453 bc	1609 a
Aproach 2.08SC 9 fl oz/A	2	54.3 a	12.3 a	36.6 ab	0.458 abc	1650 a
Priaxor 4.17SC 8 fl oz/A + Bravo WeatherStik 6F 1 pt./A	2	51.0 a	7.8 c-f	15.0 cde	0.455 abc	1664 a
Provost Silver 3.52SC 13 fl oz/A	1	55.3 a	8.3 d-e	31.1 ab	0.453 bc	1566 a
Provost Silver 3.52SC 13 fl oz/A	2	57.8 a	11.8 ab	24.6 a-d	0.458 abc	1639 a

[z] Counts of open and hardlocked bolls were made in border rows on 3.2 ft of row on 25 September.
[y] Target spot intensity were rated on 26 August using a 1 to 10 leaf spot scoring system and converted to % defoliation values.
[x] Means in each column followed by the same letter are not significantly different according to Fisher's protected least significant difference (LSD) test ($P<0.05$).

Summary

Overall, Miravis TOP alone or in combination with Quadris along with Revyteck, particularly the two higher rates, equaled the efficacy of Priaxor for the control of target spot on cotton. In contrast, the other fungicides screened not only failed to provide consistent protection from target spot but also did not give any yield protection from this disease. Significant yield protection compared with the no fungicide control was provided by Miravis TOP and the two higher rates of Revyteck on the target spot susceptible Stoneville 6182 GLT but not the partially resistant Deltapine 1646 B2XF, which is the most widely grown cotton cultivar in Alabama. Previously, yield gains have been more consistently observed for susceptible than partially resistant cotton cultivars (Hagan 2014; Hagan et al, 2016; Hagan et al, 2018).

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