COTTON YIELD RESPONSE AND TARGET SPOT CONTROL WITH SECLECTED FUNGICIDES

A. K. Hagan
A. Strayer-Scherer
K. Burch
Auburn University, Department of Entomology and Plant Pathology
Auburn, AL
H. B. Miller
Brewton Agricultural Research Unit
Brewton, AL

Abstract

The fungicides, Miravis Top @ 13.7 fl oz/A, Miravis Top @ 13.7 fl oz/A + Quadris @ 5.47 fl oz/A, Propulse @ 13.7 fl oz/A, Provost Silver @ 13 fl oz/A, Aproach @ 6 and 9 fl oz/A, and Revytek @ 8, 12, and 15 fl oz/A were compared with the Priaxor @ 4 fl oz/A and Priaxor @ 8 fl oz/A + Bravo WeatherStik @ 1 pt/A for the target spot control of target spot, on Stoneville 6182 GLT and PhytoGen 580 W3FE in 2019 and 2020, respectively AL. Trials were maintained according to the recommendations of the Alabama Cooperative Extension System and irrigated as needed. The experimental design is a factorial with year as the main plot and fungicide program as the split plot treatment. Individual plots arranged in four replications had four 25 ft rows spaced 3 ft apart. Fungicides were broadcast with a high clearance sprayer at the 3rd and 5th week of bloom except the Priaxor + Bravo WeatherStik positive control with applications 1st, 3rd, 5th, and 7th week of bloom. A non-fungicide treated control was included. Target spot intensity was assessed at 2-week intervals. Over the two study years, significant reductions in target spot-incited defoliation compared with the no fungicide control were provided by Miravis Top alone or tank mixed with Quadris, Priaxor, 8, 12, and 15 fl oz/A Revytek, 6 but not the 9 fl oz/A Aproach, and Priaxor + Bravo WeatherStik. Revytek @ 8 and 15 fl oz/A along with Miravis Top alone, which had similarly low defoliation values, gave better target spot control than Provost Silver, Propulse, and both Aproach programs. The former programs also matched the high level of disease control obtained with the Priaxor + Bravo WeatherStik positive control. Equally effective target spot control was also obtained with the 8, 12, and 15 fl oz/A rates of Revytek. With a significant year × fungicide interaction, yield was segregated by study year and fungicide program. Compared with the no fungicide control, significant yield gains were obtained in 2019 with the two higher rates of Revytek, Miravis Top, and Priaxor + Bravo WeatherStik umbrella program. For 2020, the similar yield recorded for the no-fungicide control and all fungicide programs was due to damage attributed to two late summer tropical storms.

Introduction

Target spot, which is caused by the fungus *Corynespora cassiicola* Berk. & M.A. Curtis) C.T. Wei, can cause significant yield losses in cotton (Bowen et al, 2018; Hagan et al, 2018). Mehl et al. (2019) has also reported a significant 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 near the Gulf Coast where frequent afternoon summer showers favor early disease onset and development (Hagan 2014). The risk of damaging disease outbreaks declines sharply with increasing distance from the Gulf of Mexico. 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). Cultivars also greatly differ in their susceptibility to target spot with some such as the widely grown Deltapine 1646 B2XF displaying good disease tolerance and greatly reduced risk of significant target spot-incited yield loss (Hagan et al. 2020).

Fungicides are an effective tool for limiting premature defoliation and disease-incited yield loss, particularly in intensively managed target spot susceptible cultivars in high risk settings in Coastal Alabama and the Florida Panhandle (Hagan, 2014). Yield protection obtained with registered fungicides ranges 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 significant reductions in premature defoliation compared with the no fungicide control.

The study objective was to assess the efficacy of developmental fungicides Miravis Top, Revytek, Provost Silver, and Propulse for the control of target spot as well as their impact on yield parameters in a high disease pressure setting in Southwest Alabama.

Production Methods

Studies were conducted in 2019 and 2020 in tiers maintained in a one year out rotation with cotton following peanut or corn at the Brewton Agricultural Research Unit in Brewton, AL. The experimental design for each study year was a randomized complete block with four replications. Individual plots consisted of four 25 ft rows spaced 3 ft apart. In 2019 and 2020, the cotton cultivar Stoneville 6182 GLT and PhytoGen 580 W3FE, respectively, were hill dropped at a rate of 3 seed/row ft in a Benndale fine sandy loam. Recommendations of the Alabama Cooperative Extension System for fertility along with insect and weed control, canopy management, and harvest preparation were followed. Plots were irrigated as needed with a lateral irrigation system. Fungicides were broadcast with a high clearance sprayer on 3th week of bloom and 5th week of bloom 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 < 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) beginning at the 3rd week of bloom through the 9th week of bloom at 2 week intervals. Defoliation values were calculated using the formula [% Defoliation = 100/(1+e(-(leaf spot scoring system -6.0672)/0.7975)] (Li et al. 2012). Counts of open, locked (hardlock), and rotted bolls were made in 3.2 ft of a border row just prior to harvest. Cotton was mechanically harvested. Area under disease progress curve (AUDPC) values were calculated using defoliation values (Shaner and Finney 1977). In order to compare AUDPCs across years, relative AUDPCs (relAUC) were determined by dividing AUDPC values by the number of days over which disease was monitored in each study year. 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

As has been previously noted, onset of leaf spot symptoms often occurs several weeks following canopy closure with noticeable leaf shedding beginning between the 3rd and 5th week of bloom for the no fungicide control with defoliation rapidly intensifying though cut out at the end of September (Figure 1). During the period of rapid target spot intensification, defoliation levels at each September rating date were equally reduced for the Miravis Top, Priaxor, along with all rates of Revytek compared with the no fungicide control. In contrast, both rates of Aproach along with Provost Silver and Propulse were not as effective in the above fungicides along with Miravis Top + Quadris in suppressing disease-incited defoliation. At the final rating date, equally significant reductions in % defoliation were obtained with Miravis Top alone or in combination with Quadris, Priaxor, and all rates of Revytek but not either rate of Aproach, Provost Silver, or Propulse compared with the no fungicide control (Table 1). In addition, the former fungicide programs proved as efficacious in slowing premature defoliation as the three-application Priaxor + Bravo WeatherStik positive control. Despite generally favorable rainfall patterns and two tropical storms, defoliation levels were greater in 2019 than 2020.

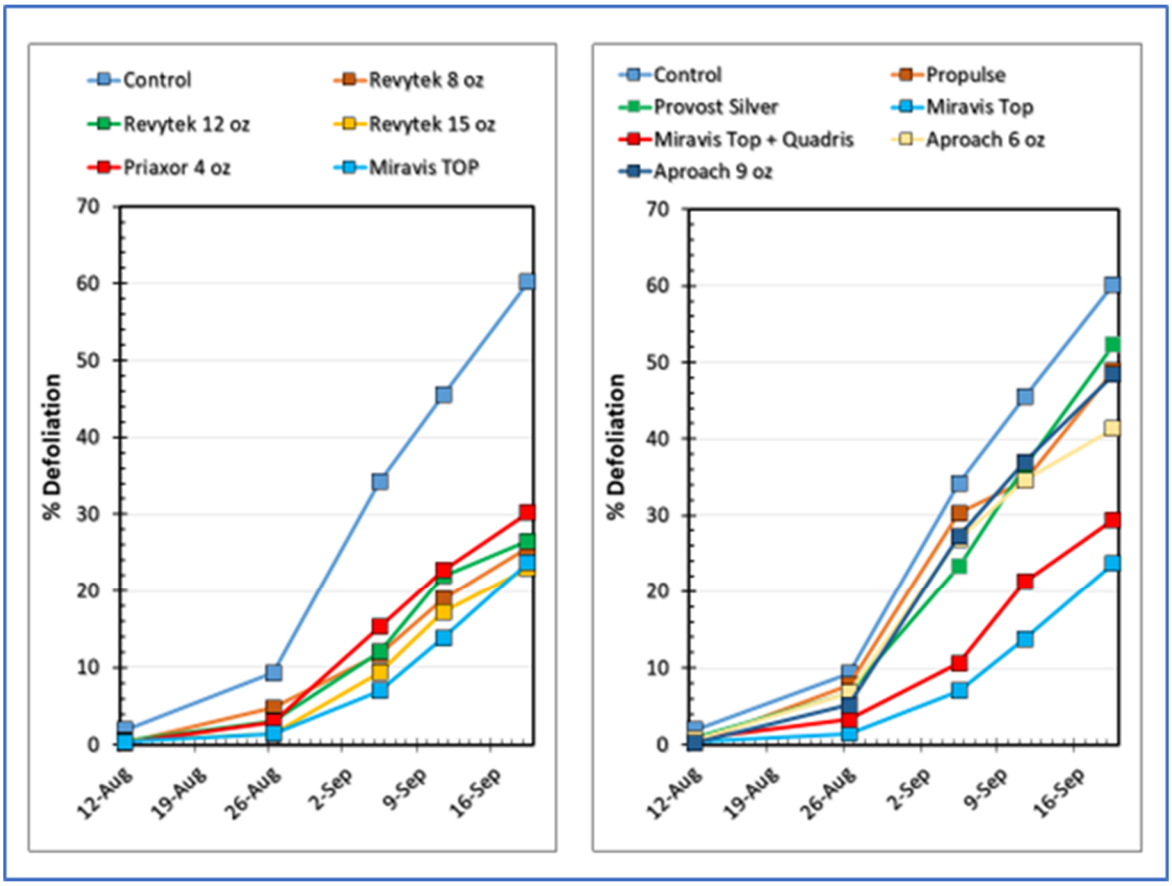

Figure 1. Mean target spot-incited defoliation averaged over 2019 and 2020 on Stoneville 6182 GLT and PhytoGen 580 W3FE, respectively, at Brewton Agricultural Research Unit.

Overall, relAUC season-long defoliation rankings mirrored those for final % defoliation (Table 1). Absence of a significant year × fungicide program interaction for relAUC indicate that the ranking for this variable for each fungicide program were similar across both study years. The low relAUC values obtained with the Priaxor + Bravo WeatherStik umbrella program were equaled by all Revytek rates along with Miravis Top alone or in combination with Quadris. When compared with the no fungicide control, significant reductions in relAUC values were also noted for Priaxor alone and the 6 fl oz Aproach program. Application rate had no impact on relAUC values for Revytek or Aproach. The addition of Quadris also did not enhance the efficacy of Miravis Top against target spot.

Boll counts, which were greater in 2019 than 2020, were not significantly impacted by fungicide program (Table 1). A significant year × fungicide program showed that the ranks for fungicide programs differed by study year ($P \leq 0.10$). For 2019, yield for the Miravis Top along with the two higher rates of Revytek and Priaxor + Bravo WeatherStik umbrella program were significantly greater compared with the no fungicide control. All other fungicide programs and the no fungicide control produced similar seed yield. Following two September tropical storms in 2020, yield was consistently lower for all fungicide programs, including the no fungicide control than in 2019. Seed yield for the no fungicide control and all other fungicide programs were similar.

Table 1. F values for generalized linear models for effects of year and fungicide on target spot defoliation, relAUC values, counts of open bolls, and seed yield.

Source of Variation	Target spot		Open bills	Seed yield	
	defoliation	relAUC			
Year	53.27***	14.49***	21.62*	1237.18***	
Fungicide Program	9.16***	11.43***	1.06	1.33	
Year × Fungicide Program	0.91	1.40	1.00	1.66^	
Year	%	#	#	lb/A	
2019	44.3 a	11.8 a	62.9 a	---	
2020	27.2 b	7.4 b	46.1 b	---	
Fungicide and rate/A				2019	2020
No fungicide control	47.9 a	17.9 a	50.6 a	4139 cd	2045 ef
Aproach 2.08SC 6 fl oz/A	34.6 abc	12.5 bc	61.7 a	4268 bcd	2044 ef
Aproach 2.08SC 9 fl oz/A	37.0 ab	13.3 abc	55.1 a	4163 bcd	2093 ef
Miravis Top 200SC 13.7 fl oz/A	13.8 d	4.9 de	57.2 a	4555 a	2053 ef
Miravis Top 1.67SC 13.7 fl oz/A + Quadris 250SC 5.47 fl oz/A	21.3 cd	7.4 de	51.6 a	4397 abc	2024 f
Priaxor 4.17SC 4 fl oz/A	22.7 bcd	8.0 cd	49.5 a	4400 abc	2240 ef
Propulse 3.34F 13.7 fl oz/A	34.5 abc	13.7 ab	54.6 a	4082 d	2227 e
Provost Silver 3.52SC 13 fl oz/A.	36.5 abc	13.2 abc	53.6 a	4217 bcd	2160 ef
Revytek 3.33SC 8 fl oz/A	18.9 cd	7.1 de	53.4 a	4350 abc	2047 ef
Revytek 3.33SC 12 fl oz/A	21.9 cd	7.4 de	52.1 a	4452 ab	2171 ef
Revytek 3.33SC 15 fl oz/A	17.2 d	6.9 de	55.8 a	4432 ab	2089 ef
Priaxor 4.17SC 8 fl oz + Bravo WeatherStik 6F 1 pt/A	13.3 d	5.0 e	58.3 a	4433 ab	2024 f

[z] Counts of open, were made on 3.2 ft of a border row in each plot just prior to harvest.
[y] Target spot intensity was rated using a 1 to 10 leaf spot scoring system and converted to % defoliation values.
[x] Seed yield = wright of lint + seed.
[w] Significance of *F* values at the 0.10, 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 Fisher's protected least significant difference (LSD) test ($P \leq 0.05$) unless otherwise indicated.

Summary

Over the two-year study period, superior disease control was obtained with all rates of Revytek along with Miravis Top and Priaxor, the current industry standard for controlling target spot in cotton. In contrast, both rates of Aproach along with Provost Silver and Propulse failed to consistently reduce target spot-incited defoliation. Generally, fungicide efficacy was reflected in the level of yield protection provided by the fungicide programs. In 2019, the two higher rates of Revytek along with Miravis Top alone matched the yield protection provided by the Priaxor + Bravo WeatherStik umbrella program. The absence of significant yield protection in 2020 can be attributed in part to the boll and lint shedding associated with two tropical storms along with the significantly reduced level of disease related defoliation observed that year in comparison with 2019.

The absence of significant yield protection form fungicide inputs on cotton is not unusual. Woodward et al. (2016) failed to record significant yield gains from fungicide inputs in multiple studies across Texas and mid-South in the absence of damaging foliar disease activity. Also, reductions in defoliation resulted in significant yield protection on target spot-susceptible compared with tolerant or partially resistant cotton cultivars (Hagan et al. 2017; Bowen et al. 2018; Mehl et al. 2019). Overall, use of fungicides for the control of target spot or other fungus-incited foliar diseases of cotton should be based not only on the yield potential and cultivar sensitivity (Hagan et al. 2017) to disease but also on whether environmental conditions are favorable at the growth stage cotton is vulnerable to attack (Woodward et al. 2016).

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