

Fungicides compared for Southern Rust Control in Corn in Southwest Alabama in 2014

June 22, 2015

PP-760

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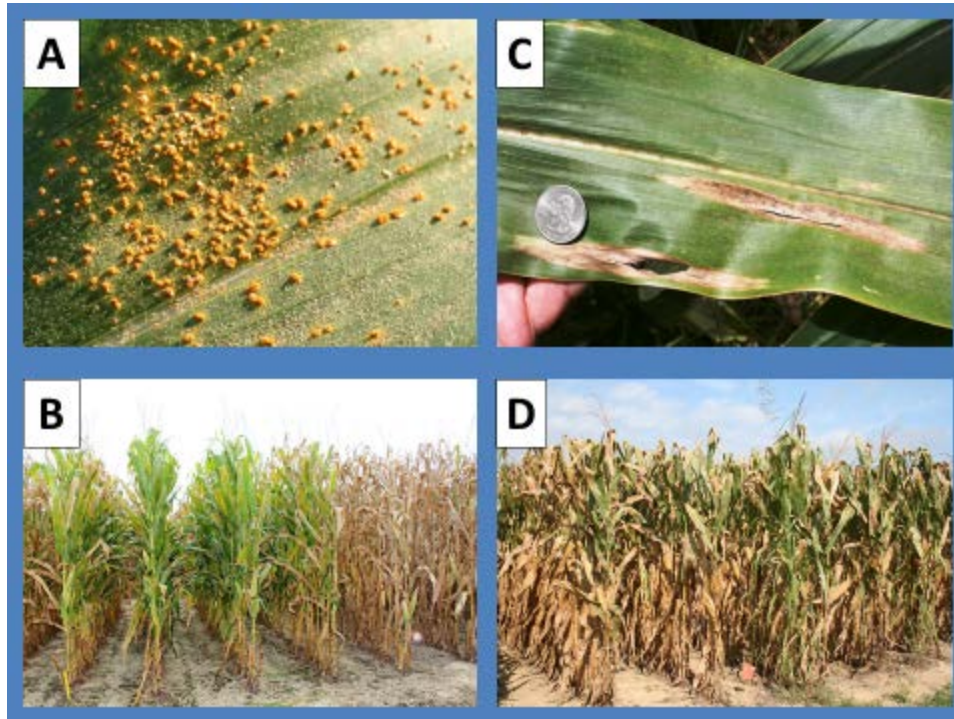
Southern rust (*Puccinia polysora*) poses a significant threat to corn production in the southern third of Alabama, particularly in Baldwin and Mobile Co. Yield gains from 2014 fungicide trials of up to 80 bu/A show that sizable kernel losses are likely under severe rust pressure.

Destructive southern rust outbreaks do not occur every year in Alabama corn but typically occur every three to four years, with disease onset typically occurring at tasseling or silking in outbreak years. The later in the corn maturity cycle that southern rust appears, particularly after the dough stage, the less likely that this disease will adversely impact yield. Late corn sown after wheat harvest in South Alabama is particularly vulnerable to southern rust as inoculum pressure can be very high in July and August. Regardless of the planting date, rapid disease development and subsequent yield losses are also more likely in irrigated than dryland corn. Frequent showers coupled with weather systems moving from Mexico or Florida over the Gulf of Mexico accelerates disease onset and development.

So far, rust pressure has not been high but planting a sizable portion of Alabama's 2015 corn was delayed by heavy late winter and early spring rains. Recently, the disease was found in a corn variety trial at the Field Crops Research Unit in Central Alabama and may be present in producer fields in west central Alabama. Southern rust has been found in several counts in south central Georgia and may also be present on corn in the Florida Panhandle.

Should a southern rust outbreak occur, protective fungicide treatments will be key to slowing disease progress and protecting kernel yield. Based on previous Alabama field trials, sizable yield gains from fungicide inputs are realized only when serious damage attributed to either southern rust or Northern corn leaf blight develops on the ear and ear-1 leaves. So, no disease activity translates into no yield gains from fungicide inputs. All corn fields are not candidates for fungicide treatments. Name-brand fungicides at \$20 to \$30 per acre are fairly costly and producers are likely to see good returns on their fungicide investment in irrigated or dryland fields with yield potentials exceeding 150 to 175 bu/A, particularly with corn prices hovering a bit below \$4 bu mark. Ideally, fungicide treatments should be initiated for rust control based on a scouting report(s) and corn growth stage.

Figure 1. Corn Diseases in Alabama A) southern rust pustules on upper leaf surface, B) southern rust blighted corn (right) compared with corn treated twice with Priaxor, C) Northern corn leaf blight (NCLB) lesions on corn leaf, and D) Southern corn leaf blight (SCLB) canopy blighting of Pioneer 31G65.



Currently, a number of fungicides, which are listed below in table 1, are registered for the control of southern rust as well as other potentially damaging diseases such as Northern corn leaf blight (NCLB), Southern corn leaf blight (SCLB), and gray leaf spot (GLS). The fungicide list includes a number of brand name products as well as generic formulations of tebuconazole (Muscle, Tebuzole, Tebustar among many others) and propiconazole (Tilt, Bumper, Propimax). Under heavy pressure from rust and possibly other diseases, fungicide applications have typically been first scheduled at tasseling to silking (GS VT to R1) followed by a second application 7 to 14 days later at kernel blister to milk stage (GS R2 to R3). Final applications of some fungicides can be made up until 15 days of harvest but it's unlikely such late applications would be of any value against the above diseases. However, programs have been introduced that feature an application at GS V4 to V8 followed by a second application as needed at tasseling or silking. Data addressing the effectiveness of the above early spray program as compared with the standard application schedule for southern rust control in corn is unavailable. Good efficacy data for the standard application schedule for most registered fungicides against southern rust is also hard to find.

The objective of this series of studies is to assess the effectiveness of single and two early and standard schedule application programs with a wide selection of registered fungicides for the control of southern rust on irrigated early and late corn at two Alabama locations. Each study will be discussed separately.

Table 1. Fungicides with application rates that are registered for the control of common foliar diseases of corn found in Alabama.

FUNGICIDE	Rate/A	FUNGICIDE	Rate/A
Approach*	6-12 fl oz	Quadris*/ Custodia	6.2-9 fl oz
Approach Prima*	3.4 – 6.8 fl oz	Quilt Xcel*	10.5 – 14 fl oz
Evito/Evito T*	2-5.7 fl oz	Stratego YLD	4-5 fl oz
Fortix*	4–5 oz	Tilt/PropiMax/ Bumper	2-4 fl oz
Headline SC*	6-12 fl oz	Muscle/TebuStar /TebuZol 3.6F	4-6 fl oz
Headline AMP*	10-14 fl oz	Topguard	7-14 fl oz
Priaxor*	4-8 fl oz		

*Do not apply a strobilurin fungicide + adjuvant from V8 to VT.

Fungicide Application Number and Timing compared for Southern Rust Control in Corn in coastal Alabama, 2014.

A cover crop of wheat, which was drilled on December 16, 2013, was killed with 22 fl oz/A Roundup WeatherMax on March 10, 2014. Prior to planting, 202 lb/A of 11-19-19 blended fertilizer with 10 lb/A sulfur, 3 lb/A zinc and 0.5 lb/A boron was broadcast on March 12, 2014 and the rows laid off with a KMC strip till leveler into the wheat cover on March 14. On March 27, the corn variety Pioneer 2023BVT was planted in a Malbis fine sandy loam (organic matter <1%) at the Gulf Coast Research and Extension Center (GCREC). Immediately after planting, a tank mixture of 1.5 pt/A Medal + 1 qt/A Atrazine was broadcast for pre-emergent weed control. Post-directed broadcast applications of 3 pt/A Atrazine + 1 qt/A Roundup WeatherMax and 1 qt/A Roundup WeatherMax + 1 qt/A Flame were made on May 2 and July 24, respectively for post-emergent weed control. On May 6, 52 gal/A of 28% liquid nitrogen (28-0-0-5S) was broadcast. Plots received 1.0 acre inches of water via a lateral irrigation system on May 20. The experimental design was a randomized complete block with four replications. Individual plots consisted of four 25-foot rows on 3.2 foot centers. A non-fungicide treated control was included. Fungicides were broadcast with a ‘high-boy’ sprayer with TX-12 nozzles spaced 19 inches apart mounted on a four row boom in 18 gal/A of spray volume at 40 psi as indicated at growth stage (GS) V6 on May 8, GS 8 on May 19, GS VT (tasselling) on June 6 and GS R2 (kernel blister) on June 18 as specified in Table 2. Induce non-ionic surfactant at 0.125% v/v was added to all fungicide tank mixtures. Southern rust was assessed at GS R6 (black layer) on a scale of 1 to 11 where 1 = no disease, 2 = 1 to 10%, 3 = 11 to 20%, 4 = 21 to 30%, 5 = 31 to 40%, etc. of leaf area diseased on 5 ear leaves in each plot on July 8. Plots were combined on August 8. Yields

are reported at 15.5% moisture. Statistical analyses for southern rust intensity were calculated on rank transformations of data. For presentation, data are back transformed. Means for all variables were separated using Fisher's least significant difference (LSD) test ($P \leq 0.05$).

While southern rust was first observed as early as GS VT, rapid disease development occurred during an extended period of wet weather immediately after GS R2. The two application GS VT fb R2 Priaxor, Quilt XCEL, Stratego YLD, Headline AMP, and Aproach fb Aproach Prima programs gave equally effective southern rust control (Table 2). Although less effective than the above Priaxor and Quilt XCEL programs, significant reductions in rust severity were also obtained with the two application GS V6 fb R2 Quadris fb Quilt XCEL and GS V6 fb VT Aproach fb Aproach Prima programs when compared with the non-fungicide treated control. Single VT applications of Headline AMP and Aproach Prima along with the 2 and 4 fl oz rates of Stratego YLD at VT also significantly reduced rust intensity below those recorded for the non-fungicide treated control. Rust intensity ratings for the single GS V6 application programs of 2 and 4 fl oz rates of Stratego YLD and non-fungicide treated control were similar. When compared with the non-fungicide treated control, significant yield gains were obtained with the GS VT fb R2 Priaxor, Quilt XCEL, Stratego YLD, Headline AMP, and Aproach fb Aproach Prima programs as well as GS V6 fb VT Aproach fb Aproach Prima and single GS V6 application of 4 fl oz of Stratego YLD. Yields recorded for the remaining single application GS V6 and VT programs along with GS V6 fb VT Quadris fb Quilt XCEL program did not significantly differ from the non-fungicide treated control.

Table 2. Impact of fungicide application timing and number on the control of southern rust on Pioneer 2023BVT corn at the GCREC in 2014.

Fungicide treatment and rate/A	Application timing	Southern rust rating*	Yield bu/A
Non-fungicide treated control	---	8.0 a**	162 d
Stratego YLD 4.18SC 2 fl oz	V6	6.9 a	189 cd
Stratego YLD 4.18SC 4 fl oz	V6	7.3 a	205 abc
Stratego YLD 4.18SC 4 fl oz	VT	5.0 b	193 bcd
Stratego YLD 4.18SC 2 fl oz	VT	5.3 b	195 bcd
Aproach Prima 2.34SC 6.8 fl oz	VT	5.2 b	199 bcd
Headline AMP 1.68 SC 10 fl oz	VT	4.9 cd	193 bcd
Aproach 2.08SC 9 fl oz fb Aproach Prima 2.34SC 6.8 fl oz	V6 fb VT	5.4 bcd	218 abc
Quadris 2.08SC 6 fl oz fb Quilt XCEL 2.20SC 10.5 fl oz	V6 fb R2	4.8 cd	188 cd
Stratego YLD 4.18 SC 4 fl oz	VT fb R2	3.4 de	218 abc
Aproach 2.08SC 9 fl oz fb Aproach Prima 2.34 SC 6.8 fl oz	VT fb R2	3.7 cde	208 abc
Priaxor 4.07SC 8 fl oz	VT fb R2	2.5 e	242 a
Headline AMP 1.68SC 10 fl oz	VT fb R2	3.0 de	234 ab
Quilt XCEL 2.20SC 10.5 fl oz	VT fb R2	2.5 e	222 abc

*Southern rust intensity was assessed on July 8 on the flag leaf of five plants using a 1 to 11 scale at GS R6.

**Means in each column that are followed by the same letter are not significantly different according to Fisher's protected least significance (LSD) test ($P \leq 0.05$).

Application timing and number impact southern rust control but not yield response in corn in coastal Alabama, 2014.

A cover crop of wheat, which was drilled on December 16, 2013, was killed with 22 fl oz/A Roundup WeatherMax on March 10 2014. Prior to planting, 202 lb/A of 11-19-19 blended fertilizer with 10 lb/A sulfur, 3 lb/A zinc and 0.5 lb/A boron was broadcast on March 12 and the rows laid off with a KMC strip till leveler into the rye cover on March 14. On March 27, the corn variety Pioneer 1319HR was planted in a Malbis fine sandy loam (organic matter <1%) at the Gulf Coast Research and Extension Center (GCREC). Immediately after planting, a tank mixture of 1.5 pt/A Medal + 1 qt/A Atrazine was broadcast for pre-emergent weed control. Post-directed broadcast applications 3 pt/A of Atrazine + 1 qt/A of Roundup WeatherMax and 1 qt/A Roundup WeatherMax + 1 qt/A of Flame were made on May 2 and July 24, respectively. On May 6, 52 gal/A of 28% liquid nitrogen (28-0-0-5S) was broadcast. Plots received 1.0 acre inch of water via a lateral irrigation system on May 20. The experimental design is a randomized complete block with four replications. Individual plots consisted of four 25-foot rows on 3.2 foot centers. A non-fungicide treated control was included. Treatments, including Glyphos (glyphosate) herbicide, were broadcast with a 'high-boy' sprayer with TX-12 nozzles spaced 19 inches apart mounted on a four row boom in 18 gal/A of spray volume at 40 psi as indicated in the table at growth stage (GS) V6 on May 8, GS 8 on May 19, GS VT (tasseling) on June 6 and GS R2 (kernel blister) on June 18 as specified in Table 3. Induce non-ionic surfactant at 0.125% v/v was added to all fungicide tank mixtures. Southern rust on the ear leaf was assessed at GS R6 (black layer) on a scale of 1 to 11 where 1 = no disease, 2 = 1 to 10%, 3 = 11 to 20%, 4 = 21 to 30%, 5 = 31 to 40%, etc. of leaf area diseased on 5 ear leaves in each plot on July 8. Plots were combined on August 8. Yields are reported at 15.5% moisture. Statistical analyses for southern rust intensity were done on rank transformations of data. For presentation, data are back transformed. Means for all variables were separated using Fisher's least significant difference (LSD) test ($P \leq 0.05$).

While southern rust was observed as early as GS VT, rapid disease development occurred after GS R2. While significant differences in rust severity were observed between treatments, highest disease ratings were recorded for the non-treated control. Most effective southern rust control was obtained with two applications of Quilt XCEL, Headline AMP, and Stratego YLD at GS VT fb R2. When applied on the same schedule, Fortix proved as effective in controlling southern rust as the latter but not two former fungicide programs. While less efficacious than the above treatments, single applications of Headline AMP as well as 4 and 5 fl oz rates of Fortix also reduced southern rust severity below values recorded for the non-treated control. When compared with the non-treated control, significant reductions in rust severity were also obtained with single applications of Fortix and Headline AMP tank mixtures with the herbicide Glyphos (glyphosate) herbicide as well as Glyphos alone. When compared with the non-treated control, significant yield gains up to 47 bu/A were obtained with the VT fb R2 Quilt XCEL, Headline AMP, Fortix, and Stratego YLD programs as well as single VT applications of both rates of Fortix. Although numerically higher than the non-treated control, no significant yield gains were obtained with Glyphos herbicide.

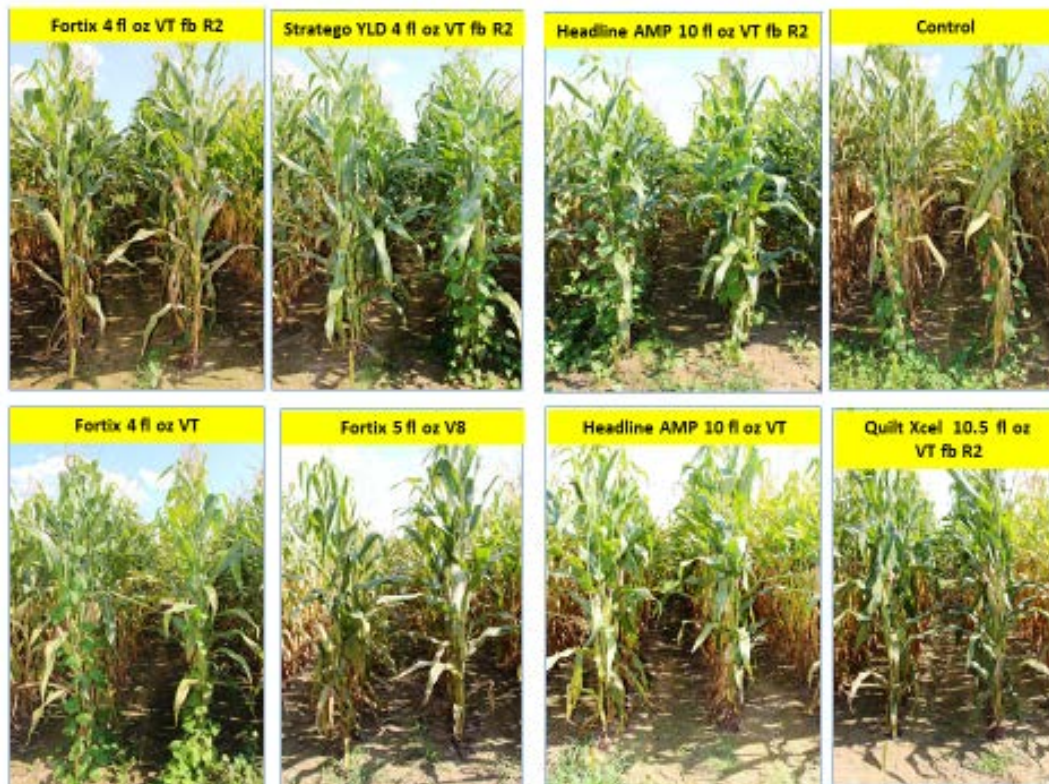
Table 3. Fungicide application number and timing influences southern rust control and kernel yield at the GCREC in 2014.

Fungicide Treatment	Application timing	Southern rust rating*	Yield bu/A
Non-treated control	---	8.6 a**	177 d
Glyphos 32 fl oz	V6	7.3 b	195 cd
Fortix 5 fl oz + Glyphos 32 fl oz	V6	6.9 b	204 abc
Headline AMP 10 fl oz + Glyphos 32 fl oz	V6	7.3 b	209 abc
Fortix 4 fl oz	VT	5.6 c	202 bcd
Fortix 5 fl oz	VT	5.1 cd	222 ab
Headline AMP 10 fl oz	VT	5.2 cd	218 ab
Quadris 6 fl oz V4-V6 fb	V6 fb	4.8 cd	206 abc
Quilt XCEL 10.5 fl oz	R2		
Stratego YLD 4.0 fl oz	VT fb R2	3.5 ef	231 a
Quilt XCEL 10.5 fl oz	VT fb R2	3.1 f	228 ab
Headline AMP 10.0 fl oz	VT fb R2	3.0 f	219 ab
Fortix 4.0 fl oz	VT fb R2	4.2 de	227 ab

*Southern rust intensity was assessed on July 8 at GS R6 o on a 1 to 11 scale.

**Means in each column followed by the same letter are not significantly different according to Fisher's protected least significance (LSD) test ($P \leq 0.05$).

Figure 2. Images of above southern rust fungicide screening trial at the GCREC in 2014.



Registered fungicides compared for southern rust control on late-planted corn in southwest Alabama, 2014.

The study site at the Brewton Agricultural Research Unit (BARU), which was planted to soybean in 2013, was prepared for planting with a disk harrow and finished with a ripper bedder. A broadcast pre-plant application of 256 lb/A of 20-60-60 fertilizer supplemented with 10% sulfur on March 11 was followed with applications of 200 lb/A of a 30-0-0 analysis fertilizer on May 28 and June 6 along with a June 16 application of 400 lb/A of 15-0-15 analysis fertilizer. Pioneer 2023YHR field corn was sown at a rate of 2 seed/row-ft (29,120 seed/A) on 7 May. Weed control was provided by an at-plant application of 1.33 pt/A Dual Magnum II followed by a June 16 post emergent application of 0.5 gal/A Atrazine + 1 pt/A Dual Magnum II. Plots received 0.9, 0.9, 0.9, 0.6, and 0.8 acre inches of water on June 20, July 2, July 9, August 5, and August 8, respectively, using a lateral irrigation unit. The experimental design was a randomized complete block. Individual plots consisted of four, 25-foot rows on 3-foot centers in four replications. A non-fungicide treated control was included. Fungicides were broadcast with a 'high-boy' sprayer with TX-12 nozzles spaced 19 inches apart mounted on a four row boom in 15 gal/A of spray volume at 40 psi as indicated in Table 4 at growth stage (GS) VT (tasseling) on July 8 and GS R2 (kernel blister) on July 23. Induce non-ionic surfactant at 0.125% v/v was added to all fungicide tank mixtures. Southern rust was assessed at GS R6 (black layer) on a scale of 1 to 11 where 1 = no disease, 2 = 1 to 10%, 3 = 11 to 20%, 4 = 21 to 30%, 5 = 31 to 40%, etc. of leaf area diseased on 5 ear leaves in each plot on August 12. Plots were combined on September 12. Yields are reported at 15.5% moisture. Statistical analyses for southern rust intensity were done on rank transformations of data. For presentation, data are back transformed. Means for all variables were separated using Fisher's least significant difference (LSD) test ($P \leq 0.05$).

During the study period, monthly rainfall totals and mean temperatures at BARU were at or slightly above the 30-year average. The combination of late planting and frequent showers through early August favored rapid southern rust development. The Headline and Quilt XCEL programs proved more effective than the other fungicide programs in controlling southern rust (Table 4). Though less efficacious than the latter fungicide programs, Headline AMP and Priaxor also gave a high level of southern rust control. With the exception of Tilt 3.6E, all fungicide programs had lower southern rust ratings than the non-fungicide treated control. When compared with the non-fungicide treated control, all fungicide programs except for Tilt 3.6E and Muscle 3.6E significantly increased yield. Equally high yield gains were obtained with the fungicide programs that gave superior disease control, Headline, Quilt XCEL, Priaxor, and Headline AMP.

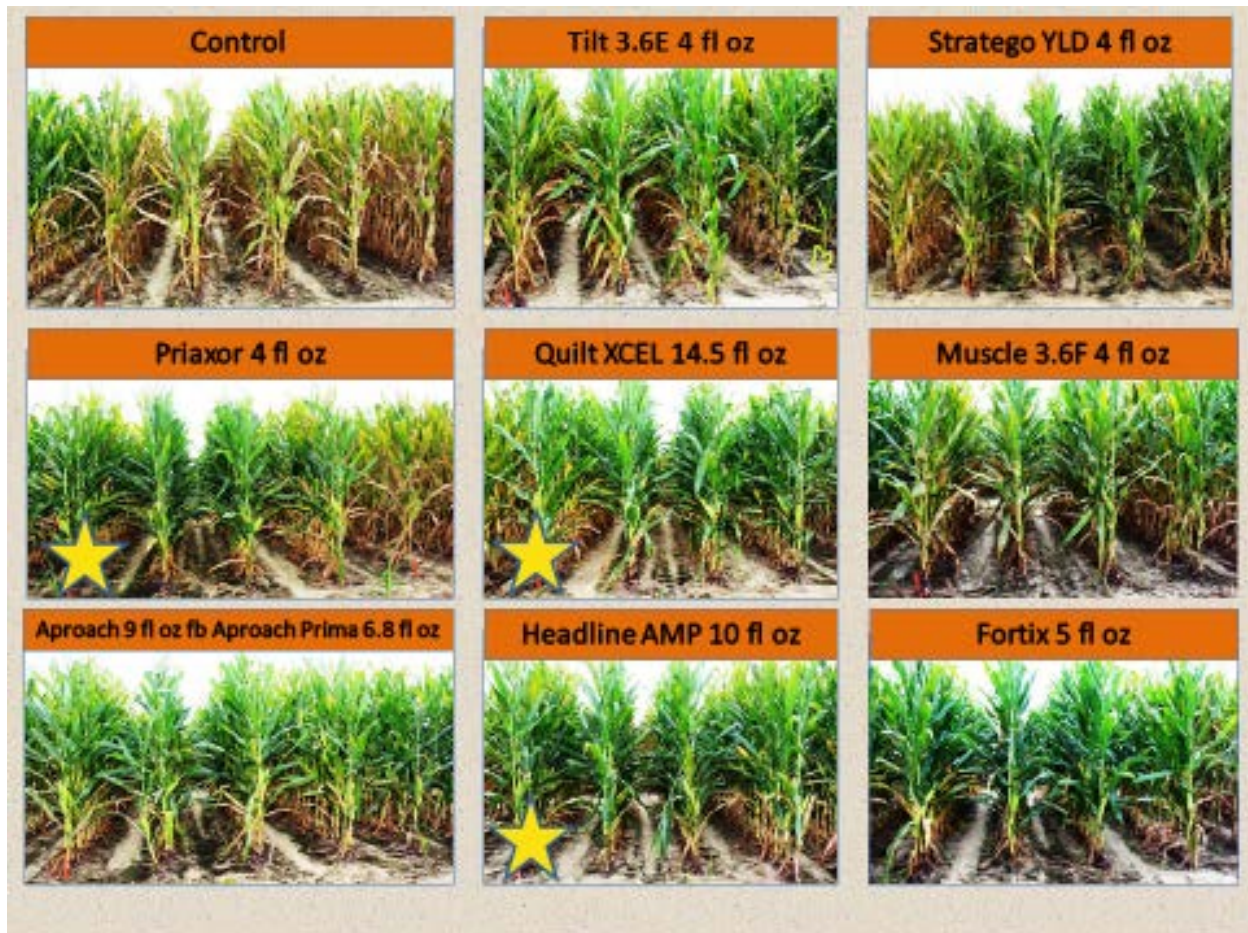
Table 4. Comparison of recommended fungicide programs for the control of southern rust on late planted corn at the BARU in 2014.

Fungicide treatment and rate/A	Application timing (GS)	Southern rust intensity*	Yield bu/A
Stratego YLD 4.0 fl oz	VT		
Stratego YLD 4.0 fl oz	R2	5.9 cd**	164 d
Tilt 4.0 fl oz	VT		
Tilt 4.0 fl oz	R2	7.5 ab	145 e
Headline AMP 10.0 fl oz	VT		
Headline AMP 10 fl oz	R2	2.7 h	180 abc
Headline 2.09SC 9.0 fl oz	VT		
Headline 2.09SC 9 fl oz	R2	2.2 i	190 a
Muscle 3.6F 4.0 fl oz	VT		
Muscle 3.6F 4.0 fl oz	R2	6.7 bc	142 e
Quilt XCEL 14.5 fl oz	VT		
Quilt XCEL 14.5 fl oz	R2	2.2 i	189 a
Fortix 5.0 fl oz	VT		
Fortix 5.0 fl oz	R2	5.3 de	174 bcd
Evito T 4.0 fl oz	VT		
Evito T 4.0 fl oz	R2	4.3 ef	168 cd
Approach 9.0 fl oz	VT		
Approach Prima 6.8 fl oz	R2	3.4 fg	167 cd
Priaxor 4.0 fl oz	VT		
Priaxor 4.0 fl oz	R2	2.9 gh	184 ab
Control	--	8.4 a	134 e

*Southern rust intensity was assessed on August 12 on a 1 to 11 scale at GS R6.

**Means in each column that are followed by the same letter are not significantly different according to Fisher's protected least significance (LSD) test ($P \leq 0.05$).

Figure 3. Plot images from southern rust control study at BARU in 2014. Note the extensive leaf blighting in untreated control as compared with fungicide treatments, particularly the highest yielding treatments marked with a gold star.



Summary

All three studies illustrate the magnitude of the yield losses that early onset southern rust can cause in irrigated corn in South Alabama. Yield protection from the most efficacious fungicide programs ranged from 55 to 80 bu/A, which translates into an income increase of \$209 to \$304 per acre at 2015 prices. Two application programs of Aproach fb Aproach Prima, Fortix, Headline, Headline, AMP, Quilt EXCL, Priaxor, and Stratego YLD provided superior rust control and yield protection in at least one of the above trials and several showed consistent excellence across multiple trials.

Unfortunately, low cost generic fungicides demonstrated poor activity against southern rust. In the BARU study, Muscle 3.6F (tebuconazole) and Tilt 3.6E (propiconazole) failed to noticeably reduce southern rust severity or increase kernel yield. Prior Alabama trials have also shown that generic tebuconazole fungicides have little activity against southern rust on corn.

Single fungicide applications as early as GS V6 provided some protection from southern rust. Some improvement in disease control when single applications of Stratego YLD or Fortix were delayed from GS V6 to VT. Despite higher southern rust ratings, yield response with single V6 and VT application programs often did not significantly differ from that of the two application programs where several fungicides that gave superior disease control. So, a single fungicide application at GS VT may be adequate, particularly in dryland corn, in lower risk situations but the two application programs, which consistently gave the best control, is the way to go for producers consistently pushing irrigated corn yields past the 200 bu/A mark when rust pressure is high.