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Corn Fungicide Screening Summary and Updated Fungicide List for 2011

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Extended drought conditions have greatly restricted disease development on irrigated corn and destroyed dryland corn crop across much of Alabama. As of mid-June, southern rust has not been found even on heavily irrigated corn in Alabama as well as Georgia but has been reported in a heavily irrigated field of silage corn in north Florida. While common rust has been seen in some fields, damage is far below the threshold required to trigger fungicide treatments. In addition, weather patterns in the Tennessee Valley are too dry to trigger a major outbreak of gray leaf spot in irrigated corn. As a result, there's some question whether or not a corn producer would realize a significant return from investing in one or two fungicide applications.

A few irrigated corn producers either plan on or have made early fungicide applications designed to enhance 'plant health'. Otherwise fields need to be scouted to determine whether or not noticeable southern rust, Northern corn leaf blight, Southern corn leaf blight, or gray leaf spot development has occurred. If not, there's probably very little need for protective fungicide treatments anytime from tasseling through soft dough stage. Should some disease activity be seen in irrigated corn with good yield potential, then one and possibly a second application of one of the fungicides listed in Table 1 is recommended.

Market focus for some of the fungicides listed in the table below is likely to change. Bayer will target Stratego 250EC to rice and away from grain crops and peanut. As a result, the price of this product will be significantly higher than in past years. Addition of the triazole fungicide metconazole, makes Headline AMP a better choice compared with Headline SC (which is a new formulation as well) for controlling a broad range of diseases, including southern rust, on corn. With the reduced disease pressure in irrigated corn, generic tebuconazole and propiconzaole products, which are not as efficacious as the brand name fungicides against southern rust, may make most sense because of their lower cost. In high disease pressure settings, recent research results suggest that the name brand fungicides are the way to go.

High afternoon temperatures coupled with scarce rainfall have made for very stressful growing conditions for corn. Environmental stress is also an issue with some corn fungicides. Apparently some fungicides such as Quilt and Quilt Xcel (but not Quadris) may interfere with ear formation or other parameters that influence yield when applied during periods of high stress to prior to tassel emergence. Also, use limitations during periods of environmental stress are also specified on the labels of Stratego and Stratego YLD. Apparently, the triazole fungicide component in the above products can interfere with ear and kernel development while those in Headline AMP along with the generic tebuconazole products do not. Surprisingly, there are no restrictions concerning the timing of applications of Tilt and other propiconzaole products to corn prior to tassel extension.

Table 1. Fungicides registered for use on corn in 2011

Fungicide	Rate	Comments
azoxystrobin QUADRIS FLOWABLE	6.0-9.0 fl. oz.	**For common rust control** - Apply when symptoms first appear on lower leaves and repeat 7 to 14 days later as needed. **DO NOT** make more than two consecutive applications of Quadris Flowable. **Not labeled for southern rust control.**
	6.0-15.5 fl. oz.	**For control of northern corn leaf blight, southern corn leaf blight, gray leaf spot, eyespot, and leaf anthracnose on field corn -** Apply when symptoms first appear on lower leaves and repeat 7 to 14 days later as needed. **DO NOT** make more than two consecutive applications of Quadris Flowable.
	0.4-0.8 fl. oz. per 1000 row ft.	**Rhizoctonia root and stalk rot** – For in-furrow applications, apply Evito in 3 to 15 gallons of water per acre directed into the furrow just before the seed is covered with the press wheel. Use higher rate when treat of disease is high or on no-till corn.
azoxystrobin + propiconzaole QUILT	7-14 fl. oz.	**For control of northern and southern corn leaf blight -** Apply when disease first appears on leaves and make a second application 7 to 14 days later as needed. DO NOT apply before tasselling as kernel development may be inhibited, especially under drought and heat stress. See label for use restrictions and resistance management instructions.
	10.5-14 fl. oz.	**For control of anthracnose leaf blight, southern rust, gray leaf spot, and eyespot**. Apply when disease appears on leaves. If conditions favoring disease persist, make a second application 14 days later. **DO NOT apply before tasselling as kernel development may be inhibited, especially under drought and heat stress.** See label for use restrictions and resistance management instructions.
azoxystrobin + propiconzaole QUILT XCEL	10.5-14 fl. oz.	**For control of northern and southern corn leaf blight, rust diseases, gray leaf spot, anthracnose, eyespot, and Diplodia ear rot** - Apply when disease first appears on leaves or at blister (R2) stage and make a second application 14 days later as needed. Use of a crop oil concentrate (COC) or other spray adjuvant is recommended for optimal disease control. Better results will be obtained if Quilt XCEL residues dry before a rain. **Applications of Quilt XCEL made before tasseling may interfere with normal kernel formation and may ultimately reduce yield.**
fluoxastrobin EVITO 480SC	2.0-5.7 fl. oz.	**Control of common and southern rust, anthracnose, gray leaf spot, Northern corn leaf blight, Southern corn leaf blight, and eye spot.** Make one or two applications with second application no later than dough (R4) stage with a minimum interval between applications of 7 days. **DO NOT** apply more than 11.4 fl ounces per acre of Evito 480 SC per year.
	0.16-0.24 fl. oz. per 1000 row ft	**Rhizoctonia root and stalk rot** – For in-furrow applications, apply Evito in 3 to 20 gallons of water per acre directed into the furrow just before the seed is covered with the press wheel. Use higher rate when treat of disease is high or on no-till corn.
propiconazole BUMPER 41.8 EC PROPIMAX TILT 3.6E	2-4 fl. oz. 2-4 fl. oz. 2-4 fl. oz.	For controlling diseases listed above. Apply when disease first appears. Continue at 7- to 14-day intervals. **DO NOT** exceed 16 fluid ounces per acre per season. **DO NOT** harvest corn for forage or grain within 30 days of application. Refer to label for recommended treatment rate for each disease.
propiconazole + trifloxystrobin STRATEGO 250EC	10-12 fl. oz.	**For control of northern and southern corn leaf blight, eyespot, southern rust, and gray leaf spot -** Apply at silking or milk stage and repeat 7 to 14 days later when conditions favor further disease development. DO NOT apply to corn grown for seed. **DO NOT** harvest corn for forage or silage within 30

		days of application. Apply no more than 24 fl. oz. of Stratego per season. **DO NOT apply Stratego to corn under environmental stress.**
prothioconazole + trifloxystrobin STRATEGO YLD	4-5 fl. oz.	**For control of northern and southern corn leaf blight, eyespot, southern and common rust, and gray leaf spot -** Apply at silking or milk stage and repeat 7 to 14 days later when conditions favor further disease development. Include lowest rate of a NIS surfactant in tank mixture. **DO NOT** apply more than 10 fluid ounces per acre per year. See label for further use restrictions. **DO NOT apply Stratego YLD to corn under environmental stress.**
	2.0-5 fl. oz.	**For early season leaf anthracnose and eyespot control**. Apply at V4 to V6 growth stages when weather patterns favor disease. For season-long control of the above diseases as well as gray leaf spot and rust, apply sequential treatments of Stratego YLD as specified above. Include lowest rate of a NIS surfactant in tank mixture. **DO NOT** apply more than 10 fluid ounces per acre per year. See label for further use restrictions. Forage may be harvested that same day as the application. **DO NOT apply Stratego YLD to corn under environmental stress.**
pyraclostrobin HEADLINE SC	6-12 fl. oz.	**For control of anthracnose, northern and southern corn leaf blight, yellow leaf spot, southern rust, and gray leaf spot -** Apply when conditions favor disease and repeat application 7 to14 days later as needed to control disease. Apply at higher rate and shorter intervals when weather patterns favor disease. Make no more than two consecutive applications of Headline. See label for application and resistance management instructions.
pyraclostrobin + metconazole HEADLINE AMP	10-14.4 fl. oz.	**For control of anthracnose, northern and southern corn leaf blight, Physoderma brown spot, southern and common rust, and gray leaf spot** - apply prior to disease development and repeat at 7- to 14-day intervals as needed. Use higher rate at shorter interval when conditions favor disease. DO NOT make more than two consecutive applications of Headline AMP for purposes of resistance management and rotate with a non Group 3 and Group 11 fungicide. Maximum product per acre per season is 57.6 fluid ounces. Up to four applications can be made per crop.
tebuconazole MONSOON ORIUS 3.6F TEBUZOL 3.6F TEBUSTAR 3.6F	 4-6 fl. oz. 4-6 fl. oz. 4-6 fl. oz. 4-6 fl. oz.	**For control of rust, southern corn leaf blight, northern corn leaf blight, and gray leafspot -** Apply as protective treatment when conditions favor disease or when symptoms first appear. Repeat applications at 7- to 14-day intervals. A maximum of 24 fluid ounces may be applied per year. See labels for additional instructions.

2010 CORN FUNGICIDE SCREENING TRIAL RESULTS

Fungicides Screened for Southern Rust Control on Early Corn at GCREC

The site at the Gulf Coast Research and Extension Center in Fairhope, AL was prepared with a strip till unit on March 26 and corn planted on March 29 in a Malbis fine sandy loam (OM<1%). On 25 March, 174 lb/A of 9-23-23 fertilizer with 10 lb/A sulfur, 3 lb/A zinc, and 0.5 lb/A boron was broadcast and incorporated with a disk harrow. An at-plant broadcast application of Dual Magnum at 1.5 pt/A + Atrazine at 1qt/A + Micro Tech at 2.5 qt/A was followed by a post directed application of Roundup Weathermax at 22 fl oz/A + Atrazine at 1 qt/A on May 7. On April 29, 42 gal/A of 28% liquid nitrogen was broadcast. The test was not irrigated. The experimental design was a split plot with corn hybrid (Pioneer 33M53 and DeKalb 67-88) as the whole plot and fungicide treatments as the split-plot. Individual split plots consisted of four 30-foot rows on 3.2 feet centers in four replications. A non-treated control was also included in the trial. Fungicide treatments were broadcast with a 'high-boy' sprayer with TX-12 nozzles spaced 19 inches apart mounted on a four row boom in 17 gal/A of spray volume at 40 psi at the growth stages (GS) and dates listed in the table 2. Southern rust (SR) ratings on the ear leaf were recorded on July 7 on a scale of 1 to 11 where 1 = no disease, 2 = 1 to 10%, 3 = 11 to 20%, 4 = 21 to 30%, 4 = 31 to 40%, etc. of leaf area diseased on 10 leaves in each plot. Plots were harvested on August 9. Yields are reported at 15.5% moisture. Significance of treatment effects were tested by analysis of variance and Fisher's protected least significant difference (LSD) test ($P \leq 0.05$). Since the corn hybrid x treatment interaction was not significant, data presented in the table for each variable was averaged across corn hybrids.

Monthly rainfall totals during the study period were below to well below the 30 year historical average for this location in April and July but average to above average for May and June. While rust ratings were similar, higher TSWGT were noted for Pioneer 33M53 compared with DKC 67-88 (Table 1). However, average yield was higher for the DKC 67-88 than Pioneer 33M53.

Table 1. Rust rating and yield components for two corn varieties.

Corn Variety	Rust rating	TSWGT[y]	Yield
Pioneer 33M53 ……....	1.8 a[x]	55.7 a	146.6 b
DKC 67-88 ……	1.8 a	55.2 b	151.7 a

[z]Southern rust ratings on the ear leaf were recorded on 7 July on a scale of 0 to 10 on 10 leaves in each plot.
[y]TSWGT = thousand kernel weight in pounds per bushel.
[x]Means in each column that are followed by the same letter are not significantly different according to Fisher's protected least significant difference (LSD) test ($P \leq 0.05$).

When compared with the non-fungicide treated control, reductions in southern rust severity were obtained with the Quadris 6 fl oz at V10/A fb Quilt Xcel at 10.5 fl oz/A at VT, Quadris 10.5 fl oz at V10 fb Quilt Xcel at 14 fl oz/A at VT and the single application of Quilt Xcel at 10.5 fl oz/A at VT (Table 2). All fungicide treatment programs had similar yields when compared to the non-fungicide treated control. Yield for the Quadris /Quilt Xcel at 14 fl oz/A was higher compared with the single application of Quilt Xcel at GS VT.

Table 2. Fungicide selection and application timing influence on southern rust intensity and on yield at GCREC in 2010.

Treatment and rate/A	Application GS[z]	Application Date		Southern rust[y]	Yield (bu/A)
Tilt 3.6E 4 fl oz	R4	6 July	……	2.1 a[x]	147.4 ab
Quadris 2.08F 6 fl oz fb	V10	13 May			
Quilt Xcel 2.2F 10.5 fl oz	VT	9 June	……	1.5 b	151.4 ab
Headline 2.09E 9 fl oz	R4	6 July	……	2.0 a	149.6 ab
Stratego 2.08E 10 fl oz.	R4	6 July	……	2.2 a	150.1 ab
Quilt Xcel 2.2F 10.5 fl oz	VT	9 June	……	1.6 b	146.2 b
Quadris 2.08F 10.5 fl oz fb	V10	13 May			
Quilt Xcel 2.2F 14 fl oz	VT	9 June	……	1.4 b	151.8 a
Non-treated control	---	---	……	2.2 a	148.6 ab

[z]Applications were made at growth stages (GS) V10, VT (vegetative terminal or tasseling), or R4 (soft dough).
[y]Southern rust ratings on the ear leaf were recorded on July 7 on a scale of 0 to 10 on 10 leaves in each plot.
[x]Means in each column that are followed by the same letter are not significantly different according to Fisher's protected least significant difference (LSD) test ($P \leq 0.05$).

Summary – While some reduction in southern rust severity was obtained with some fungicide programs, overall disease severity was insufficient for fungicide programs to have a significant impact on corn yield. As a result, yield gains are likely to be seen unless southern rust damage levels on the ear leaf are above those observed in this study. In addition, no 'plant health' yield gains were obtained with any fungicide program.

Impact of recommended fungicides on the control of southern rust as well as on the yield of double crop corn, GCREC 2010.

The tier was prepared with a moldboard plow and disk harrow. On April 14, 186 lb/A of 11-21-21 fertilizer with 10 lb/A sulfur, 3 lb/A zinc, and 0.5 lb/A boron was incorporated. Prior to planting, weed control was obtained with broadcast applications of Prowl at 1 quart/A on April 14 and Roundup Weathermax at 22 fluid ounces/A on May 14. Following a broadcast application of 46 gallons/A of 28% liquid nitrogen, the rust resistant 'Pioneer 33M52' and rust susceptible 'Pioneer 33M57', which are near isolines, were sown on June 25. A post-directed application of Roundup Weathermax at 22 fl oz/A was made on July 7. The test was not irrigated. The experimental design was a split plot with corn variety as the whole plot and fungicide treatments as the split-plot. Individual split plots consisted of four 30-foot rows on 3.2 feet centers in four replications. Fungicides were broadcast with a 'high-boy' sprayer with TX-12 nozzles spaced 19 inches apart on a four-row boom in 15 gallons of spray volume /A at 40 psi at growth stage R1 on August 20 and R4 on September 2. Southern rust and southern corn leaf blight ratings on the ear leaf were taken on a 1 to 11 scale 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 10 leaves in each plot. Plots were harvested on October 1. Yields are reported at 15.5% moisture. Significance of treatment effects were tested by analysis of variance and Fisher's protected least significant difference (LSD) test ($P \leq 0.05$). Since the corn variety x fungicide treatment interaction was not significant, data presented in table 3 are averaged by fungicide or corn variety.

Yield was reduced by unusually hot and dry weather that occurred as the corn matured. Regardless of the fungicide treatment, southern corn leaf blight damage to the ear leaves of both varieties was limited to less than 10% of total leaf area. Southern rust severity was lower and yield higher for the rust resistant Pioneer 33M52 compared with rust susceptible Pioneer 33M57 (Table 3). Significant differences in rust ratings and yield were noted between fungicide treatments. Quadris, Headline AMP and Quilt Xcel, which gave superior rust control when compared with Tilt 3.6E, Stratego 250EC, and generic tebuconazole 3.6F (Folicur 3.6F), also had equally high yields. Rust ratings for Tilt 3.6E and

the non-treated control were similar as were the yields for Tilt 3.6E, Stratego 250EC, and generic tebuconazole 3.6F as well as the non-treated control.

Table 3. Fungicide impact on the severity of southern rust and yield of double crop corn, GCREC 2010.

Split plot analysis *P*(F)	Southern rust[*]	Yield (bu/A)
Corn variety …….....	<0.0001	<0.0001
Fungicide ……	<0.0001	<0.0001
Variety x treatment ……	0.5283	0.6868
Variety means		
Pioneer 33M52 …….....	4.2 b[**]	64.4 a
Pioneer 33M57 …….....	8.3 a	38.3 b
Fungicide means[***]		
Generic tebuconazole 3.6F 6 fl oz/A …….....	7.1 bc	41.6 b
Headline AMP 1.68E 10 fl oz/A ……..	4.7 e	60.7 a
Quadris 2.08E 15.4 fl oz/A …….	4.9 de	68.6 a
Quilt Xcel 2.2F 10.5 fl oz/A …….....	4.9 e	64.3 a
Stratego 250EC 10 fl oz/A ……..	6.1 cd	45.9 b
Tilt 3.6E 4 fl oz/A …….....	7.7 ab	40.1 b
Non-treated control ……..	8.3 a	39.0 b

[*]Southern rust was rated at growth stage R6 on a 1 to 11 scale on September 9.
[**]Means followed by the same letter in each column are not significantly different according to Fisher's protected least significant difference (LSD) test ($P \leq 0.05$).
[***]All fungicides were applied at GS R1 and R4.

Summary – Southern rust is a significant yield reduce factor for late planted or double crop corn. Yield for the rust susceptible Pioneer 33M57 was 40% below that of the rust resistant Pioneer 33M52. Fungicide selection also had a significant impact on rust control and subsequent yield response. Equally effective rust control was obtained with Headline AMP, Quadris 2.08E and Quilt Xcel. Higher yields were also reported for the latter fungicides as well. In contrast, generic tebuconazole, Stratego 250E and Tilt 3.6E gave poor southern rust control and failed to boost corn yield above those of the non-treated control.

Headline 2.09E application number impacts the control of southern rust and yield of double crop corn, BARU 2010

After laying out rows with a KMC subsoiler + coulter + rolling basket rig, the corn varieties 'Pioneer 33M52' (southern rust resistant) and 'Pioneer 31P42' (southern rust susceptible) were sown on June 25. Weed control was provided by an at-plant, broadcast application of Dual Magnum II at 1.3 pints/A + Roundup Ultra at 22 fluid ounces/A. A post-plant, broadcast application of 0.5 gallons/A of Atrazine + 1 pint/A of Dual Magnum was made on July 22. The study area was drip irrigated. Broadcast applications of 176 lb/A of ammonium nitrate (34-0-0) were made on 13 July 13 and July 22. The experimental design was a split-plot with corn variety as the whole plot and fungicide treatments as the split plot arranged in four replications. Individual subplots consisted of four 20 foot rows on 36 inch centers. Headline 2.09E at 9 fluid ounces/A was broadcast with a 'high-boy' sprayer with TX-12 nozzles on a 20 inch spacing in 15 gallons of spray volume/A at 60 psi on August 19, August 26, September 1, and September 11 at growth stages VT (vegetative terminal or tassel emergence), R2 (blister), R3 (milk), and/or R4 (soft dough), respectively. Headline 2.09E programs included a single application at growth stage R4; applications at growth stages R2 and R4; applications at growth stages R1, R2, and R4; and applications at growth stages VT, R1, R2, and R4. A non-treated control was also included. Southern rust and northern corn leaf blight (NCLB) were rated on the ear leaf on 16 September and September 22 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 10 leaves in each plot. Ears were hand harvested on October 19 and hand shelled on November 21. Yields are reported at 15.5% moisture. Significance of treatment effects were tested by analysis of variance and Fisher's protected least significant difference (LSD) test ($P \leq 0.05$). Since the corn variety x treatment interactions for disease, test weight, and yield were not significant, data presented are pooled by corn variety and fungicide treatment.

While the study was drip irrigated, hot and dry late summer weather suppressed corn yield. Despite significantly higher rust ratings, the rust susceptible Pioneer 31P42 had significantly higher yield than rust resistant Pioneer 33M52 (Table 5). Rust severity increased on both corn varieties as the number of Headline 2.09E applications declined, while yields rose as the number of applications increased. Equally high yields were obtained with three and four applications of Headline 2.09E.

Table 5. Headline application number impacts rust severity and corn yield. BARU 2010.

Split plot analysis *P*(F)		Southern rust[z]	Yield (bu/A)
Corn variety		<0.0001	<0.0001
Fungicide		<0.0001	<0.0001
Variety x treatment		0.5283	0.6868
Corn variety			
Pioneer 33M52		2.7 b[y]	62.5 b
Pioneer 31P42		3.9 a	82.2 a
Headline application timing by growth stage	No. Applications		
VT-R2-R3-R4[x]	4	1.7 e	83.6 a
R2-R3-R4	3	2.3 d	80.9 ab
R3-R4	2	3.0 c	73.1 bc
R4	1	4.3 b	65.9 cd
Non-treated control	0	5.1 a	58.1 d

[z]Southern rust was rated at growth stage R6 on a 1 to 11 scale on September 16.
[y]Means followed by the same letter in each column are not significantly different according to Fisher's protected least significant difference (LSD) test ($P \leq 0.05$).
[x]Applications of Headline 2.09E at 9 fl oz/A were made at growth stages VT (vegetative terminal), R2 (blister), R3 (milk), and/or R4 (soft dough).

Summary - On late planted or double crop corn, a minimum of three fungicide applications may be needed to control southern rust as well as protect corn yield. The one and to a lesser extent two application programs failed to effectively check the spread of rust or protect corn yields.