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Split Versus Single Applications of Fungicides to Control Foliar Wheat Diseases

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With prices for wheat hovering around $10.00 per bushel, use of a fungicide to protect yields from foliar diseases certainly is attractive. Typically, a single application of a fungicide such as one of those listed in Table 1 is applied somewhere between full flag leaf emergence (Feekes growth stage 9) to full head emergence but prior to flowering (Feekes growth stage 10.5). A single fungicide application made with enough water to achieve thorough leaf coverage between these growth stages before disease is severe can protect a wheat crop with a high yield potential from losses to foliar diseases as indicated by the data presented in Table 2.

Over the last couple of years, an alternative approach to using a fungicide to facilitate wheat production has been proposed. This approach involves applying a half-rate of a fungicide in late winter or early spring when the first or second node is detectable (Feekes growth stages 6 or 7). A second fungicide application is made later in the season between flag leaf emergence but before flowering begins. Such a split application strategy can be beneficial as recently reported in an article by Larry Reichenberger in "The Furrow" (January, 2008, pages 34-35). However, please read this article closely to observe some important details. For example, Dr. Marcia McMullen (North Dakota State University) is quoted as saying that, "We've seen it (a split application) have an additive affect – we get 2 to 3 bushels per acre more when a half rate is applied early and a ***full rate is applied later***." Please note that this indicates a "half rate early" followed by a "full rate later." Hence, with a fungicide such as Quilt this would mean applying the maximum amount of fungicide indicated on the label for a season (20.5 fl oz/A/season).

It is also important to consider what the term "early" means in the world of fungicide application. An "early" fungicide tank mixed with topdressing will be done earlier than most of the studies reported. Growth stages 6 and 7, which correspond to the first and second nodes being visible at the base of tillers, generally occur in mid March. This would be later than when topdressing should be done, so an additional trip across the field will be needed to apply the fungicide at GS 6 or 7. Also consider that a fungicide application at full strength provides protection from a disease for approximately 2 weeks followed by a third week of partial protection. Hence, an early, half-rate application in January will not protect for as long as a full rate application, and may not be present at sufficiently high levels to inhibit infections by tan spot or septoria in late February or March.

Another consideration in this article was again indicated by a quote from Dr. McMullen, where she states that, "We see this type of response when conditions are wet, the variety being grown is susceptible to leaf spot diseases and wheat residue is present." The presence of wheat residue

indicates that this occurred in a no- or low-till situation where tan spot and/or septoria leaf spots (Figures 1-3) are commonly encountered. Tan spot and septoria can be extremely detrimental to yield by killing leaves quickly and completely (especially on susceptible varieties in wet weather). Stripe rust (Figure 4) is another disease that can quickly and completely destroy leaves, and results from a trial in Louisiana in which split and single applications were used to control severe stripe rust has been published (Table 3). Note that this data indicates little difference in terms of yield between split or single applications of fungicide.

This leads to the question of, "Is there benefit to splitting the application for diseases such as leaf rust and powdery mildew in Oklahoma?" Here the evidence is not as favorable as indicated in Table 4. Examination of this data indicates that an early application of Quilt at growth stage 7 significantly reduced powdery mildew in the early season but was not as effective in controlling leaf rust a single later application at GS 10. Further, none of the treatments significantly increased yield over the untreated check. Keep in mind that these yields were also greatly affected by heavy rain and lodging that was common in 2007. However, similar results also were observed in 2006.

Summary. Information available so far indicates that splitting a fungicide application may have the greatest benefit in wheat being produced in a low- or no-till system where a variety susceptible to tan spot and/or septoria has been planted. With weather favorable for disease development in such a scenario, an early fungicide application may reduce early infection of lower leaves by inoculum coming from the residue. However, a second fungicide application ***at a full rate*** also may be needed to continue disease protection later in the season. This logic may also apply to a disease such as stripe rust when "hot-spots" are found in a field in January or February. In contrast to this scenario, controlling powdery mildew and leaf rust may best be approached with a single application later in the season. These diseases usually do not kill leaves as quickly or effectively as tan spot and septoria, and applying a single application of a fungicide before the disease becomes severe is a sound strategy.

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Table 1. Fungicide efficacy for control of foliar wheat diseases[†]

Fungicide type	Product	Company	Rate	PHI[‡]	Leaf rust	Stripe rust[§]	Powdery mildew	Septoria complex	Tan Spot
			fl oz/A	days					
Triazole	Tilt	Syngenta	4	40	G[¶]	VG	E	VG	G
	Propimax	Dow Agrosciences	4	40	G	VG	E	VG	G
Strobilurin	Headline	BASF	6 - 9	14	E	E	G	VG	VG
Stobilurin + triazole	Quilt	Syngenta	14	45	VG	VG	E	G	VG
	Stratego	Bayer	10	35	VG	VG	E	VG	G

[†] Information provided only as a guide and no endorsement is intended for products listed, nor is criticism meant for products not listed. Always read and follow label directions!

[‡] PHI = pre-harvest interval for grain harvest or in the case of Headline, hay harvest

[§] Efficacy ratings for stripe rust control based on information obtained in 2004 from the North Central Regional Committee on Management of Small Grains Diseases

[¶] E = Excellent; VG = Very Good; G = Good; P = poor

Table 2. Effect of foliar fungicides on grain yield and test weight

	Growth Stage[†]	Yield	Test weight	Leaf rust	Powdery mildew
Stillwater 2005		bu/ac	lb/bu	----% severity----	
No treatment	-	68	57	90	18
Tilt 3.6 EC @ 4 oz	9	69	57	**64**[‡]	**6**
	10.5	72	57	**35**	15
Stratego 250 EC @ 10 oz	9	76	58	**33**	**3**
	10.5	**78**	58	**5**	13
Quilt 200 SE @ 14 oz	9	76	57	**13**	**1**
	10.5	**79**	57	**5**	**10**
LSD (P=0.05)		9	NS[§]	20	7
Stillwater 2004					
No treatment	-	75	57	50	15
Stratego 250 EC @ 10 oz	9	**87**	57	**20**	7
	10.5	**83**	**58**	**18**	10
Quilt 200 SE @ 14 oz	9	**87**	57	**18**	8
	10.5	**88**	57	**4**	15
Headline 250 F @ 6.1 oz	9	**87**	57	**15**	8
	10.5	**83**	**58**	**7**	13
LSD (P=0.05)		6	1	8	NS

[†] Growth stage 9 = flag leaf fully emerged; growth stage 10.5 = heads fully emerged
[‡] treatments statistically different from the nontreated check are highlighted in bold type
[§] NS = nonsignificant

Table 3. Control of stripe rust of wheat in Louisiana and affect on yield
(from Padgett & Purvis. 2007. Plant Disease Management Reports 1:CF009).

Fungicide (fl oz/A)	Growth stage	Stripe rust 05-Apr	Stripe rust 19-Apr	Yield (bu/A)
No treatment	----	46.3	96.9	72.3
Tilt (2.3 oz)	9**	0.8	49.4	90.5
Headline (6.2 oz)	9	8.1	54.4	89.7
Quadris (6.2 oz)	9	2.3	40.6	90.3
Quilt (14 oz)	9	0.5	12.5	101.7
Stratego (10 fl oz)	9	0.1	46.3	93.5
Tilt (2 oz) + Quadris (6.2 oz)	6* & 9	1.5	43.8	100.1
Tilt (2 oz) + Headline (6.2 oz)	6 & 9	1.8	40.0	102.3
Tilt (1.1 oz) + Quilt (10 oz)	6 & 9	1.1	1.7	93.4
LSD (P=0.05)		8.7	13.6	7.2

*Fungicide applied on 24-Feb **Fungicide applied on 13-Mar

Table 4. Control of powdery mildew (PM) and leaf rust (LR) on winter wheat in Oklahoma in 2007 using split and single applications of fungicide.

Fungicide (fl oz/A)	Growth stage	PM 05-Apr	LR 19-Apr	Yield (bu/A)
No treatment	----	77.5	97.5	10.8
Quilt (7.0 oz + 7.0 oz)	7* & 10**	13.8	72.5	14.2
Quilt (14 oz)	10	77.5	42.5	13.0
Tilt (4.0 oz)	10	77.5	56.3	12.0
Stratego (10.0 oz)	10	65.0	68.8	13.6
Headline (6.2 oz)	10	71.3	46.3	14.0
LSD (P=0.05)		18.9	15.0	3.5

*Fungicide applied on 19-Mar **Fungicide applied on 04-Apr

Figure 1. Tan spot on wheat - note underlying residue from which infective spores originated.

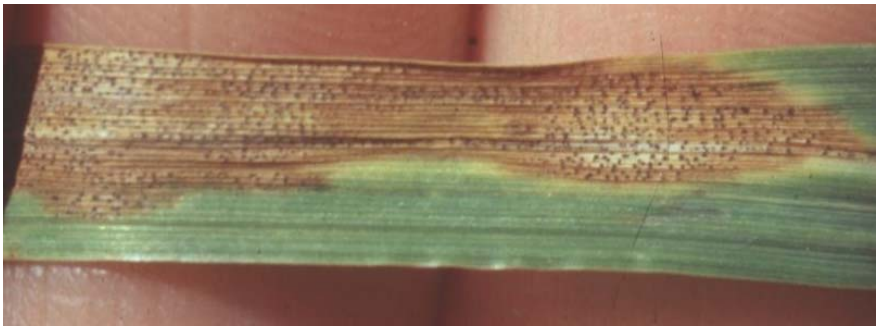

Figure 2. An infection of septoria on a wheat leaf. These infections also originate from residue as seen in Figure 1.

Figure 3. Septoria & tan spot infections killing an entire leaf.

Figure 4. Wheat stripe rust (courtesy of Cereal Disease Lab, St. Paul, MN).