



Current Report

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Foliar Fungicides and Wheat Production in Oklahoma

Bob Hunger
 Extension Wheat Pathologist
 Department of Entomology & Plant Pathology

David Marburger
 Extension Wheat Agronomist
 Plant & Soil Sciences

Question: How are the growth stages of wheat described?

Answer: The Feekes' scale (Figure 1) is commonly used to describe the growth stages of wheat. This scale describes the growth stages of wheat numerically, and is commonly used to indicate the recommended timing of pesticide applications.

Question: How much damage can a foliar disease such as leaf rust cause on wheat?

Answer: A foliar disease such as leaf rust causes the most damage when it is severe at heading, flowering or milk, and not as damaging at soft dough or later (Table 1).

Question: When should I apply a fungicide?

Answer: All the fungicides listed in Tables 2 and 3 can be applied up to growth stage 10.5 (heads completely emerged)

Table 1. Approximate percent loss of yield caused by leaf rust at combinations of leaf rust severity and growth stage of wheat.

Growth stage	Severity (%) of leaf rust on the flag leaf				
	10	25	40	65	100
Flowering	10	15	20	30	35
Milk	2	5	8	14	20
Soft dough	1	3	4	7	10
Hard dough	1	1	1	3	5

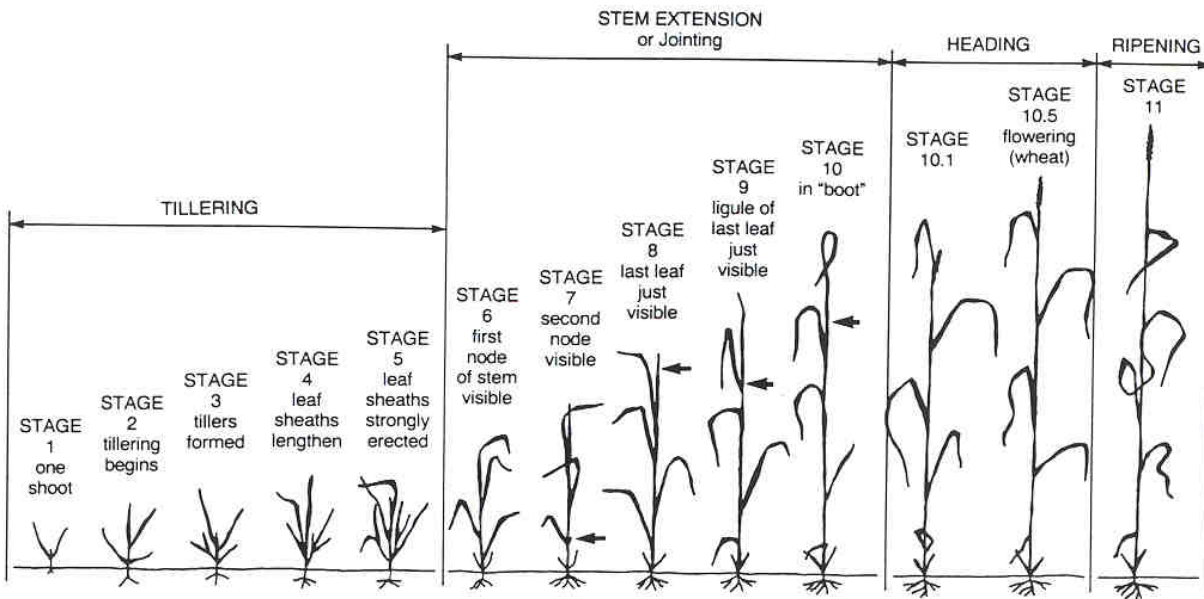


Figure 1. The Feekes scale of wheat development.

Large, E.C. 1954. Growth stages in cereals: Illustration of the Feekes' scale. *Plant Pathology* 3:128-129.

but not yet flowering) or in a few cases, up to growth stage 10.5.4 (flowering completed; kernel watery ripe; see Table 3). In most years, the optimum period for application is from growth stages 9 (flag leaf fully emerged) to 10.5 (heads fully emerged) because application in this range most likely provides protection during the critical times of flowering and milk (Table 1).

Question: What fungicides are available for use in Oklahoma?

Answer: Many fungicides currently are labeled for use on wheat. A comparison of the relative effectiveness of these fungicides is presented in Table 3. REMEMBER to consult the label for the most current and accurate information.

Question: What is the potential benefit from using a foliar fungicide?

Answer: More than 20 years of fungicide trials including years with little or no disease and several years with high disease pressure have documented an average yield increase of approximately 10 percent from using fungicides. Such an increase usually justifies fungicide use if the yield potential and price of wheat are high. Hence, consider the following to assist in deciding whether to apply a fungicide to control a foliar disease (Table 4):

- **Will a foliar fungicide help to regain yield?** The answer to this is “NO!” Foliar fungicides can only help protect the yield potential present at application.

Table 2. Effect of foliar fungicides on grain yield, test weight, and severity of wheat leaf rust and powdery mildew in a “low” foliar disease year (2014) and a “high” foliar disease year (2016).

	<i>Growth stage</i> ¹	<i>Yield</i>	<i>Test weight</i>	<i>Leaf rust</i>	<i>Powdery mildew</i>
Stillwater 2014 (no disease pressure)		bu/ac	lb/bu	-----% severity-----	
No treatment	----	53	58	0	0
Priaxor® @ 2 oz FB ²					
TwinLine® @ 7 oz	6 FB 10.3	58	58	0	0
Aproach® @ 3 oz FB					
Aproach Prima® @ 6.8 oz	6 FB 10.3	55	58	0	0
Twinline® @ 9 oz	10.3	53	58	0	0
Aproach® @ 9 oz	10.3	53	58	0	0
Aproach Prima® @ 6.8 oz	10.3	51	58	0	0
Folicur® @ 4 oz	10.3	54	58	0	0
Stratego YLD® @ 4 oz	10.3	56	58	0	0
Prosaro® @ 6.5 oz	10.3	54	58	0	0
Quilt Xcel® @ 10.5 oz	10.3	54	58	0	0
Alto® @ 3.5 oz	10.3	54	58	0	0
Tilt® @ 4 oz	10.3	56	58	0	0
LSD (p=0.05)		NS	NS	--	---

	<i>Growth stage</i> ¹	<i>Yield</i>	<i>Test weight</i>	<i>Leaf rust</i>		<i>Powdery mildew</i>
				<i>May 6</i>	<i>May 15</i>	
Stillwater 2016 (high disease pressure)		bu/ac	lb/bu	-----% severity-----		
No treatment	---	56	57	40	92	18
Nexicor® @ 3.5 oz FB						
Nexicor® @ 7 oz	6 FB 9	72	58	4	66	2
Aproach® @ 3 oz FB						
Aproach Prima® @ 6.8 oz	6 FB 9	69	58	9	65	1
Tilt® @ 4 oz	9	59	58	24	95	16
Folicur® @ 4 oz	9	63	58	6	73	21
Nexicor® @ 7 oz	9	66	58	9	69	13
Aproach Prima® @ 6.8 oz	9	68	59	4	73	7
Trivapro® @ 13.7 oz	9	72	59	2	43	9
Quilt Excel® @ 10.5 oz	9	72	58	3	59	8
Alto® @ 5.5 oz	9	63	58	4	46	13
Absolute Maxx® @ 5 oz	9	72	59	2	59	10
Prosaro® @ 5 oz	9	64	58	4	49	10
LSD (p=0.05)	--	9	NS	9	19	8

¹ Growth stage 6 = first node visible; growth stage 9 = flag leaf fully emerged; growth stage 10.3 = heads about half emerged from the boot.

² FB=followed by.

Table 3. Management of Small Grain Diseases Fungicide Efficacy for Control of Wheat Diseases (Revised March 2017).

The North Central Regional Committee on Management of Small Grain Diseases (NCERA-184) has developed the following information on fungicide efficacy for control of certain foliar diseases of wheat for use by the grain production industry in the U.S. Efficacy ratings for each fungicide listed in the table were determined by field testing the materials over multiple years and locations by the members of the committee. Efficacy is based on proper application timing to achieve optimum effectiveness of the fungicide as determined by labeled instructions and overall level of disease in the field at the time of application. Differences in efficacy among fungicide products were determined by direct comparisons among products in field tests and are based on a single application of the labeled rate as listed in the table. Table includes most widely marketed products, and is not intended to be a list of all labeled products. This information is provided only as a guide. It is the responsibility of the pesticide applicator by law to read and follow all current label directions. No endorsement is intended for products listed, nor is criticism meant for products not listed. Members or participants in the NCERA-184 committee assume no liability resulting from the use of these products.

Active ingredient	Product	Rate/A (fl. oz)	Fungicide(s)										Harvest Restriction
			Powdery mildew	Stagonospora leaf/ glume blotch	Septoria leaf blotch	Tan spot	Stripe rust	Leaf rust	Stem rust*	Head Scab			
Strobilurin	Approach SC	6.0 - 12.0	G1	VG	VG2	VG	E3	VG	VG	NL	Feekes 10.5		
	Evito 480 SC	2.0 - 4.0	G	--	--	VG	--	VG	--	NL	Feekes 10.5 and 40 days		
	Headline SC	6.0 - 9.0	G	VG2	VG2	VG2	E3	E	G	NL	Feekes 10.5		
Triazole	Caramba 0.75 SL	10.0 - 17.0	VG	VG	--	VG	E	E	E	G	30 days		
	Folicur 3.6 F4	4.0	NL	NL	NL	NL	E	E	E	F	30 days		
	Proline 480 SC	5.0 - 5.7	--	VG	VG	VG	VG	VG	VG	G	30 days		
	Prothioconazole19%												
	Protopicoconazole19%												
Propiconazole 41.8%	Prosaro 421 SC	6.5 - 8.2	G	VG	VG	VG	E	E	E	G	30 days		
	Tilt 3.6 EC4	4.0	VG	VG	VG	VG	VG	VG	VG	P	Feekes 10.5.4		
Mixed mode of actions*	Absolute Maxx SC	5.0	G	VG	VG	VG	VG	VG	E	NL	35 days		
	Approach Prima SC	3.4-6.8	VG	VG	VG	VG	E	VG	--	NR	45 days		
	Fortix	4.0 - 6.0	--	--	VG	VG	E	VG	--	NL	Feekes 10.5 and 40 days		
	Nexitor EC	7.0 - 13.0	G	VG	VG	VG	E	E	VG	NL	Feekes 10.5		
	Priaxor	4.0 - 8.0	G	VG	VG	VG	VG	VG	G	NL	Feekes 10.5		
	Quit Xcel 2.2 SE4	10.5 - 14.0	VG	VG	VG	VG	E	E	VG	NL	Feekes 10.5.4		
	Stratego YLD	4.0	G	VG	VG	VG	VG	VG	VG	NL	Feekes 10.5 35 days		
	Trivapro SE	9.4 - 13.7	VG	VG	VG	VG	E	E	VG	NL	Feekes 10.5.4 14 days		
	TwinLine 1.75 EC	7.0 - 9.0	G	VG	VG	VG	E	E	VG	NL	Feekes 10.5		

1 Efficacy categories: NL=Not Labeled; NR=Not Recommended; P=Poor; F=Fair; G=Good; VG=Very Good; E=Excellent; -- = Insufficient data to make statement about efficacy of this product.
 2 Product efficacy may be reduced in areas with fungal populations that are resistant to strobilurin fungicides.
 3 Efficacy may be significantly reduced if sole strobilurin products are applied after stripe rust infection has occurred.
 4 Multiple generic products containing the same active ingredients also may be labeled in some states. Products including tebuconazole include: Embrace, Monsoon, Muscle 3.6 F, Onset, Orius 3.6 F, Tebucon 3.6 F, Tebustar 3.6 F, Tebusol 3.6 F, Tegrol, and Toledo. Products containing propiconazole include: Bumper 41.8 EC, Fitness, Propiconazole E-AG, and ProplMax 3.6 EC. Products containing prothioconazole + azoxystrobin include: Atrame Plus, Avaris 2XS.
 5 Products with mixed modes of action generally combine triazole and strobilurin active ingredients. Priaxor is an exception to this general statement and combines carboxamide and strobilurin active ingredients.

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- **What is the yield potential of the wheat?** This should be 30 to 40 bu/acre at a minimum, but can go up or down, depending on the price of wheat.
- **What is the price of wheat?** The higher the price, the more economical fungicide application becomes. See Table 4.
- **What is the growth stage of the wheat?** Foliar diseases do the most harm when infection is severe at stages such as heading, flowering and milk. So be sure to apply fungicide before disease is severe.
- **What about a split application of a fungicide?** For example, applying a reduced rate at an early growth stage (for example at GS 6 to 7) and then a full rate at GS 10 or so. Splitting the application of a fungicide may provide benefit for early season stripe rust or for diseases such as tan spot, septoria/stagonospora and powdery mildew that initiate from fungal inoculum on wheat residue left on the soil surface such as in no-till situations. A split application also may have benefit if a variety is extremely susceptible to these diseases and they are present in the late winter or early spring. However most data indicates that a single application from stages 9 to 10.5 is usually the most beneficial. If a split application is used, the first application should not be made with topdressing as the nitrogen needs to be applied prior to finding nodes at the base of tillers (GS 6 to 7) so the fertilizer moves into

the root zone prior to jointing. Consider making the first (early) application a lower-cost generic, reserving the higher cost and more effective fungicides for a subsequent application, if needed. ALSO, take care to not exceed the maximum amount of a fungicide that can be applied in one season. Check the label to ascertain this.

- **What diseases are present?** Be sure which foliar fungal diseases are present. Stripe rust can be especially damaging because of its ability to quickly kill entire leaves. Hence, if you are considering a fungicide application to protect against stripe rust, it is critical to apply the fungicide before the appearance of rust pustules on the flag leaf.
- **What is the disease reaction of the variety?** Refer to the OSU Extension Fact Sheet PSS-2142 “Wheat Variety Comparison Chart,” available online at osufacts.okstate.edu or <http://www.wheat.okstate.edu/wheatmanagement/varieties/index.htm>. Some pathogens (e.g., the pathogen that causes wheat leaf rust) can adapt to resistance genes, and a resistant variety may become susceptible when a new race appears.
- **What is the weather forecast?** Hot and dry conditions inhibit further disease development and hasten ripening, while cool and moist conditions promote disease and lengthen the period of time for grain development and filling.

Table 4. The formulas below can be used to help determine the potential value of a fungicide application. This is a simple cost-benefit evaluation where the yield potential, the price of a bushel of wheat, and the cost of a fungicide can all be easily adjusted.

Potential increase		Estimated yield goal		Estimated selling price		Fungicide + app. cost ¹		Potential return on investment	
Grain production scenario									
10%	X	30 bu/A	X	\$4.00/bu	–	\$8.00/A	=	+\$4.00/A	
10%	X	50 bu/A	X	\$4.00/bu	–	\$8.00/A	=	+\$12.00/A	
10%	X	30 bu/A	X	\$7.00/bu	–	\$16.00/A	=	+\$5.00/A	
10%	X	50 bu/A	X	\$7.00/bu	–	\$16.00/A	=	+\$19.00/A	
Same scenario for certified seed production									
10%	X	30 bu/A	X	\$15.00/bu	–	\$8.00/A	=	+\$37.00/A	
10%	X	50 bu/A	X	\$15.00/bu	–	\$8.00/A	=	+\$67.00/A	
10%	X	30 bu/A	X	\$15.00/bu	–	\$16.00/A	=	+\$29.00/A	
10%	X	50 bu/A	X	\$15.00/bu	–	\$16.00/A	=	+\$59.00/A	

¹ Fungicide costs can vary greatly depending on chemical used and application method.

The pesticide information presented in this publication was current with federal and state regulations at the time of printing. The user is responsible for determining that the intended use is consistent with the label of the product being used. Use pesticides safely. Read and follow label directions. The information given herein is for educational purposes only. Reference to commercial products or trade names is made with the understanding that no discrimination is intended and no endorsement by the Cooperative Extension Service is implied.

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