



# Current Report

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## Foliar Fungicides and Wheat Production in Oklahoma – April, 2009

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**Question:** How are the growth stages of wheat described?

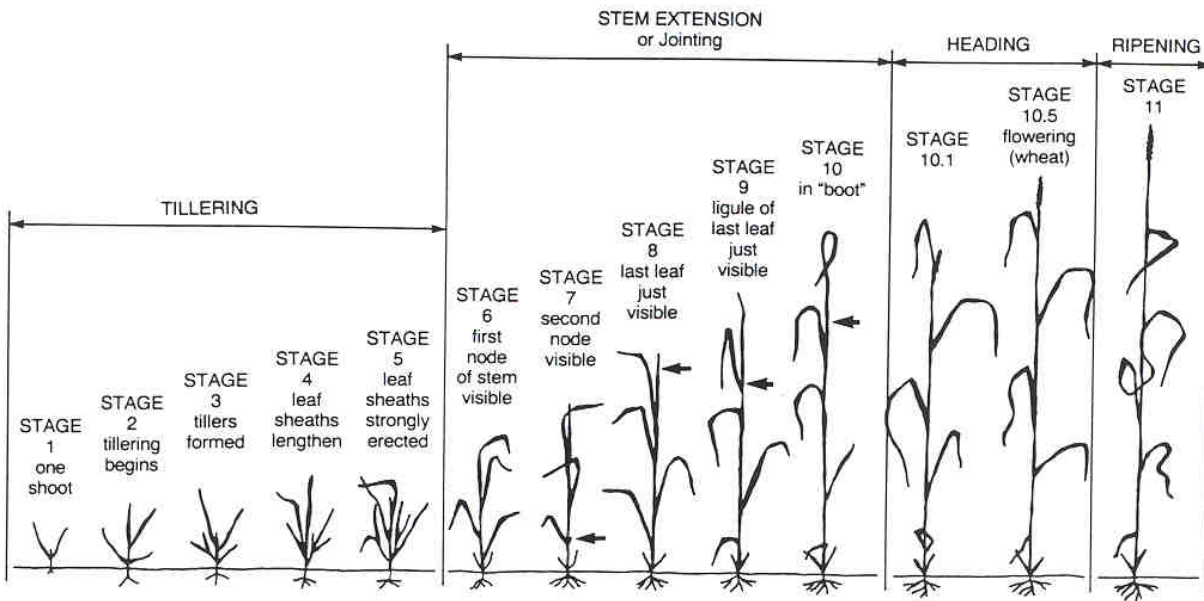
**Answer:** The Feekes' scale is commonly used to describe the growth stages of wheat. This scale describes the growth stages of wheat numerically, and is commonly used to indicate the recommended timing of pesticide applications.

**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).

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

	Severity (%) of leaf rust on the flag leaf				
	10	25	40	65	100
Growth stage-----% yield loss-----					
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.

**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 but not yet flowering). 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 provides protection during the critical times of flowering and milk (Table 1).

**Question: What fungicides are available for use in Oklahoma?**

**Answer:** Currently there are five fungicides most commonly mentioned in relation to controlling foliar wheat diseases. These include Tilt® (Syngenta), PropiMax® (Dow AgroSciences), Quilt® (Syngenta), Stratego® (Bayer CropScience), and Headline® (BASF). 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.
- **What is the yield potential of the wheat?** This should be 40 to 50 bu/acre at a minimum, but can go up or down, depending on the price of wheat.
- **What is the price of wheat?** \$3.50 to 4.00/bu or more is desirable.
- **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.
- **What about a split application of a fungicide?** For example, applying half of the full rate at an early growth stage (for example at GS 6 to 7) and the other half or

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

	<i>Growth Stage</i> <sup>†</sup>	<i>Yield</i>	<i>Test weight</i>	<i>Leaf rust</i>	<i>Powdery mildew</i>
<b>Stillwater 2005</b>					
		bu/ac	lb/bu	-----% severity-----	
No treatment	-	68	57	90	18
Tilt® 3.6 EC @ 4 oz	9	69	57	<b>64</b> <sup>‡</sup>	<b>6</b>
	10.5	72	57	<b>35</b>	15
Stratego® 250 EC @ 10 oz	9	76	58	<b>33</b>	<b>3</b>
	10.5	<b>78</b>	58	<b>5</b>	13
Quilt® 200 SE @ 14 oz	9	76	57	<b>13</b>	<b>1</b>
	10.5	<b>79</b>	57	<b>5</b>	<b>10</b>
	LSD (P=0.05)	9	NS <sup>§</sup>	20	7
<b>Perkins 2005</b>					
No treatment	-	48	56	2	15
Tilt® 3.6 EC @ 4 oz	9	48	56	<b>0</b>	<b>4</b>
	10.5	49	56	<b>0</b>	10
Stratego® 250 EC @ 10 oz	9	53	56	<b>0</b>	10
	10.5	49	56	<b>0</b>	10
Quilt® 200 SE @ 14 oz	9	54	57	<b>0</b>	<b>7</b>
	10.5	52	56	<b>0</b>	10
	LSD (P=0.05)	NS	NS	0.1	7
<b>Stillwater 2004</b>					
No treatment	-	75	57	50	15
Stratego® 250 EC @ 10 oz	9	<b>87</b>	57	<b>20</b>	7
	10.5	<b>83</b>	<b>58</b>	<b>18</b>	10
Quilt® 200 SE @ 14 oz	9	<b>87</b>	57	<b>18</b>	8
	10.5	<b>88</b>	57	<b>4</b>	15
Headline® 250 F @ 6.1 oz	9	<b>87</b>	57	<b>15</b>	8
	10.5	<b>83</b>	<b>58</b>	<b>7</b>	13
	LSD (P=0.05)	6	1	8	NS

<sup>†</sup> Growth stage 9 = flag leaf fully emerged; growth stage 10.5 = heads fully emerged.

<sup>‡</sup> treatments statistically different from the nontreated check are highlighted in bold type.

<sup>§</sup> NS = nonsignificant.

**Table 3. Efficacy of fungicides for wheat disease control based on appropriate application timing.**

Class	Fungicide(s)		Stagonospora								
	Active ingredient	Product	Rate/A (fl. oz)	Powdery mildew	leaf/ glume blotch	Septoria leaf blotch	Tan spot	Stripe rust	Leaf rust	Head scab	Harvest Restriction
Strobilurin	Azoxystrobin 22.9%	Quadris 2.08 SC	6.2 - 10.8	F(G) <sup>1</sup>	VG	VG	E	E <sup>2</sup>	E	NR	45 days
	Pyraclostrobin 3.6%	Headline 2.09 EC	6.0 - 9.0	G	VG	VG	E	E <sup>2</sup>	E	NR	Feekes 10.5
Triazole	Metconazole 8.6%	Caramba	10.0 - 17.0	-- <sup>3</sup>	-- <sup>3</sup>	-- <sup>3</sup>	-- <sup>3</sup>	E	E	G	30 days
	Propiconazole 41.8%	Tilt 3.6 EC									
		PropiMax 3.6 EC Bumper 41.8 EC	4.0	VG	VG	VG	VG	VG	VG	P	40 days
	Prothioconazole 41%	Proline 480 SC	5.0 - 5.7	-- <sup>3</sup>	VG	VG	VG	-- <sup>3</sup>	VG	G	30 days
	Tebuconazole 38.7%	Folicur 3.6 F <sup>4</sup>	4.0	G	VG	VG	VG	E	E	F	30days
	Prothioconazole 19% Tebuconazole 19%	Prosaro 421 SC	6.5 - 8.5	G	VG	VG	VG	E	E	G	30 days
Mixed mode of action	Metconazole 7.4% Pyraclostrobin 12%	TwinLine	6.0 - 11.0	G	VG	VG	E	E	E	NR	Feekes 10.5 and 30 days
	Propiconazole 11.7% Azoxystrobin 7.0%	Quilt 200 SC	14.0	VG	VG	VG	VG	E	E	NR	45 days <sup>5</sup>
	Propiconazole 11.4% Trifloxystrobin 11.4%	Stratego 250 EC	10.0	G	VG	VG	VG	VG	VG	NR	35 days

- <sup>1</sup> Efficacy categories: NR=Not Recommended; P=Poor; F=Fair; G=Good; VG=Very Good; E=Excellent. Efficacy designation with a second rating in parenthesis indicates greater efficacy at higher application rates.
- <sup>2</sup> Efficacy may be significantly reduced if solo strobilurin products are applied after stripe rust infection has occurred
- <sup>3</sup> Insufficient data to make statement about efficacy of this product
- <sup>4</sup> There are several generic products containing tebuconazole but products may not be labeled in all states
- <sup>5</sup> The pre-harvest interval for Quilt is under review by EPA and may be adjusted to consider a growth stage restriction.

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 labeled 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.

a full rate at GS 10 or so? Splitting the application of a fungicide may provide benefit for diseases such as tan spot and septoria that initiate from fungal inoculum on wheat residue left on the soil surface in no-till situations. A split application also may have benefit if a variety is extremely susceptible to powdery mildew and if this disease is present in the late winter or early spring. However, for rusts and varieties that have some powdery mildew resistance, 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.

- **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 Variety Characteristic Chart by selecting "Variety Info" on the web site at: <http://www.wit.okstate.edu/varietyinfo/index.html>. 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. Given the recent surge in wheat prices, there is a much greater potential benefit from protecting yields with a fungicide application. So, taking into account the above considerations, 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.**

<i>Potential increase</i>		<i>Estimated yield goal</i>		<i>Estimated selling price</i>		<i>Fungicide + app. cost</i>		<i>Potential return on investment</i>
Grain production scenario								
10%	X	30 bu/A	X	\$4.50/bu	–	\$16.00/A	=	(\$2.50/A)
10%	X	50 bu/A	X	\$4.50/bu	–	\$16.00/A	=	\$6.50/A
Same scenario for certified seed production								
10%	X	30 bu/A	X	\$9.00/bu	–	\$16.00/A	=	\$11.00/A
10%	X	50 bu/A	X	\$9.00/bu	–	\$16.00/A	=	\$29.00/A

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