Foliar Fungicides for Winter Wheat in 2008

Paul Esker, Craig Grau, Shawn Conley, and John Gaska, Department of Plant Pathology and Department of Agronomy

Since June 2007, winter wheat prices have risen dramatically. Wisconsin's winter production again increased for the 2007-2008 growing season, as 330,000 acres were planted (up by about 14% over 2006-2007). One major question that has been raised is whether foliar fungicides will help improve wheat yield in Wisconsin. Current knowledge and information from the U.S. winter wheat regions would suggest that "yes" foliar fungicides could be beneficial. However, in order to most effectively consider the use of a foliar fungicide requires knowledge of your entire production system.

Application of Foliar Fungicides for Winter Wheat Using an IPM Framework:

The decision to apply a foliar fungicide for winter wheat should not be driven by the current market alone. Many factors interact and following a good integrated pest management approach is critical to most effectively use a foliar fungicide. These include:

1. **Scout your fields!** Any sound decision begins by understanding what is occurring in the field. Scouting is important for understanding all possible yield-limiting problems, including winter survival and diseases. Specifically in regards to scouting for diseases, two aspects are important: (i) identifying what diseases are present and (ii) how severe is each disease (or the potential for being severe).

2. **Know the growth stage.** For many of the wheat diseases that can be managed using foliar fungicides, it is critical to properly identify the growth stage post-dormancy. Proper growth stage identification is important for proper use of fungicides, since many of the products have different growth stage requirements for when they can last be applied. The following pictorial identifies some of the critical growth:

Feekes 7: Note 2nd detectable node (Image Source: S. Conley, UW-Madison)

Feekes 10: Boot Swollen **Feekes 10.51: Anthesis begins**

(Images Source: S. Conley, UW-Madison)

3. **Understand the disease risk.** Sound crop scouting and identification of the major foliar diseases that can impact yield is necessary for making a good decision whether or not to apply a foliar fungicide. The major diseases of concern in Wisconsin that may be controlled by fungicides include: (i) Rust (leaf, stripe, or stem), (ii) Fusarium head scab, (iii) Powdery mildew, (iv), Septoria leaf blotch, (v) Glume blotch, and (vi) Tan spot. Note not all yield-limiting diseases can be managed with foliar fungicides, including viruses and Take-all.

4. **Variety planted.** Current winter wheat varieties have varying degrees of resistance to many of the foliar diseases that can cause yield loss. Knowledge of the disease reaction is important for justifying if a foliar fungicide is necessary. For example, if the winter wheat variety has good resistance to rust, the need for a foliar fungicide may be reduced. However, this recommendation would also be based on knowledge that the other diseases listed above are not of risk in your area.

5. **Stand quality coming out of dormancy.** Know your yield potential! Knowledge of previous wheat yields in the field and scouting for winter kill helps in the decision process if a maximum yield can be attained that could justify the use of a fungicide. It is important to know that a fungicide cannot make yield, but it can help ensure yield.

6. **Crop development.** If the spring is cool and maturity is slow, the risk for foliar disease development is increased as a larger window for infection and disease may occur. Also note that yield potential may be greater if cooler environments extend the grain fill period.

7. **Weather.** All of the diseases listed above are favored by moisture. Monitoring the forecasts for May and June are critical to know if conditions are favorable for disease development.

8. **Understand your fungicides.** There are numerous fungicides labeled for control of foliar diseases of winter wheat (see *Pest Management in Wisconsin Field Crops-2008* (A3646, UW-Extension)), however, the diseases that are controlled vary by fungicide. Furthermore, both application timing and the active ingredient differ among these products. Always consult the label and follow label recommendations before applying a foliar fungicide. This is especially important for determining the pre-harvest interval if harvesting for hay versus grain and straw, as well as if a product can be used on winter wheat when the wheat straw will used as a forage. Not all fungicides have a feeding restriction, but it is important to closely examine the label regarding this requirement. For example, Quilt® has a specific use restriction on its label that states, "Do not harvest wheat for forage. Do not graze or feed livestock treated forage or cut green crop for hay or silage".

9. **Wheat prices.** Most current recommendations around the U.S. suggest a market price of $3.50/bushel as the low economic threshold for the consideration to apply a foliar fungicide. While the current market prices would justify that consideration, it is important to determine the potential economic return based on the market price before applying a foliar fungicide (see below).

Understanding Possible Economic Returns:

Given the knowledge of the above factors, an estimate of the expected net return per acre for applying a foliar fungicide can be estimated using the following equations:

Expected percent increase × *Expected yield* × *Expected selling price* = ***Expected gross return***

Expected gross return – Fungicide application cost = ***Expected net return per acre***

The *expected percent increase* is the expected yield return (%) from applying a foliar fungicide. When using it in the calculation, the proportion value would be used, for example, 10% = 0.10. The *expected yield* is the estimated yield in bushels per acre. The *expected selling price* is the dollars per bushel expected. *Fungicide application cost* is the combined cost for product and application ($/acre). For both *expected selling price* and *fungicide application cost*, we recommend examining different values when determining the ***expected net return per acre***.

Another factor that must be considered in our decision to apply a fungicide is the cost in bushels per acre of the wheel tracks that we leave following a fungicide application. Unlike soybean we do not have data (work being conducted in 2008 to resolve this) that defines what is the yield loss due to wheel track damage. The following is our best estimate of the maximum yield loss associated with wheel track damage in wheat. Given a sprayer with 13-inch tires, we assume that we will run down 4 total rows (two for each tire pass). In a 90-foot spray pass there are 144,

7.5 inch rows. If we lose 4 of those rows (4/144) that equals 2.8% of the area that is run down. We will assume that this application completely killed the plants in those rows. If we normally raise 70 bushel wheat the yield loss is 70 bushel x 2.8% yield loss = 1.96 or 2 bushel yield loss. This estimate is likely high however it does provide a worst case estimate to include into our management plan.

Notes about wheel track damage estimates:
1.This estimate assumes we spray with the rows and not perpendicular to the rows. If we spray across the wheat rows yield loss is decreased.
2. In this example we also do not factor in any compensation from the adjoining rows. This may or may not occur depending upon the application timing and year.

For example, consider the *expected selling price* at $3, 5, 7, and 9 per bushel, and *fungicide application cost* at $15, 20, and 25 per acre.

An Example:

Expected percent increase = 10% (0.10)
Expected yield = 70 bushels/acre
Expected selling price = $7.50/acre
Expected gross return = 0.10 × 70 × 7.50 = $52.50/acre

Fungicide application cost = $20/acre
Expected net return per acre = 52.50 – 20 = $32.50/acre

Putting It All Together:

To illustrate how different components of the wheat production system need to be considered to fully determine the cost-benefit of applying a foliar fungicide, we examined the results of the 2006-2007 foliar fungicide trials that were conducted at the Arlington and West Madison Agricultural Research Stations. In these experiments, two cultivars (Kaskaskia and Pioneer 25R78) were examined in combination with the following fungicide treatments: nontreated control, Quilt® at Feekes 7, Quilt® at Feekes 7 and 8, Quilt® at Feekes 8, Quilt® at Feekes 10.5 and Proline at Feekes 10.5.1. A significant variety by fungicide interaction was observed. This meant that the yield response for each variety was affected differently by fungicide application (Table 1). Our results also suggest that the effects were not influenced by experimental location.

(Table 1 is on next the page)

Table 1. Grain yields for different combinations of wheat variety and fungicide product based on field experiments conducted at the Arlington and West Madison Agricultural Research Stations in 2006-2007.

Variety	Fungicide	Yield (bu/A)
Kaskaskia	Nontreated control	87.3
	Quilt® at Feekes 7	100.7
	Quilt® at Feekes 7 and 8	100.6
	Quilt® at Feekes 8	100.6
	Quilt® at Feekes 10.5	97.6
	Proline at Feekes 10.5.1	94.9
P 25R78	Nontreated control	107.7
	Quilt® at Feekes 7	111.6
	Quilt® at Feekes 7 and 8	111.6
	Quilt® at Feekes 8	107.1
	Quilt® at Feekes 10.5	110.0
	Proline at Feekes 10.5.1	102.8
	***P*-value**	**0.018**
	LSD	**2.4**

Based on these results, an economic analysis was performed by first calculating the number of bushels that were above or below the nontreated control. This value was then used to determine (i) the number of bushels above the minimum number of bushels necessary to cover the cost of the fungicide application or (ii) the number of bushels that were below the minimum number of bushels necessary to cover the cost of the fungicide application. For example, for Kaskaskia and the nontreated control compared with Quilt® at Feekes 7, the difference in yield was 13.4 bushels. At a fungicide cost (including application) of $15/acre and a market price of $5/bushel, a minimum of 3 bushels would be needed to cover the cost of the fungicide spray. This meant that there was net gain of 10.4 bushels above the breakeven point. Similarly, for P 25R78 and the nontreated control compared with Quilt® at Feekes 8, the yield difference was -0.6 bushels. Using the same 3 bushels necessary to cover the fungicide spray, the net loss was 3.6 bushels. The net economic gain or loss was calculated as the number of bushels above or below the breakeven point times the market price. Again, for our two examples, this would correspond to 10.4 bushels/acre * $5/bushel = $52/acre (positive) for Kaskaskia and Quilt® at Feekes 7, and -3.6 bushels * $5/bushel = $-18/acre for P 25R78 and Quilt® at Feekes 8. The overall summary of the different treatments can be found in Table 2.

(Table 2 in on the next page)

Results from these trials suggest that the decision to apply a fungicide must be made for more than prophylactic control. For example, variety differences can be noted, especially for disease resistance. The P 25R78 has excellent leaf rust and lodging resistance and moderate powdery mildew resistance, while Kaskaskia has resistance to some races of leaf rust, but is susceptible to stem rust and powdery mildew. At the time of fungicide applications, the primary disease noted was powdery mildew.

Table 2. Net positive and negative economic return comparing different wheat varieties and foliar fungicides. The field research was conducted during the 2006-2007 winter wheat production season at the Arlington and West Madison Agricultural Research Stations.

		$3/A[a]			$5/A			$7/A			$9/A		
Variety	**Fungicide**	**15[b]**	**20**	**25**	**15**	**20**	**25**	**15**	**20**	**25**	**15**	**20**	**25**
Kaskaskia	Quilt® at Feekes 7	25[c]	20	15	52	47	42	79	74	69	106	101	96
	Quilt® at Feekes 7 and 8[d]	10	0	-10	37	27	17	63	53	43	90	80	70
	Quilt® at Feekes 8	25	20	15	52	47	42	78	73	68	105	100	95
	Quilt® at Feekes 10.5	16	11	6	37	32	27	57	52	47	78	73	68
	Proline at Feekes 10.5.1	8	3	-2	23	18	13	38	33	28	53	48	43
Pioneer 25R78	Quilt® at Feekes 7	-3	-8	-13	5	-1	-6	12	7	2	20	15	10
	Quilt® at Feekes 7 and 8	-18	-28	-38	-11	-21	-31	-3	-13	-23	5	-5	-15
	Quilt® at Feekes 8	-17	-22	-27	-18	-23	-28	-19	-24	-29	-20	-25	-30
	Quilt® at Feekes 10.5	-8	-13	-18	-4	-9	-14	1	-4	-9	6	1	-4
	Proline at Feekes 10.5.1	-30	-35	-40	-40	-45	-50	-49	-54	-59	-59	-64	-69

[a] Represents different market prices for wheat: $3, 5, 7, or 9/A,
[b] Represents different fungicide costs, including application cost: $15, 20, or 25/acre.
[c] Represents the net positive or negative return ($) per acre.
[d] For Quilt® at Feekes 7 and 8, estimated returns were based on two fungicide applications.

Material for these recommendations were compiled from the following sources:

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Bowden, R. L. 1995. *Wheat Foliar Fungicides*. Cooperative Extension Service, Kansas State Univeristy, MF-1026.

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Acknowledgements: We thank Mike Rankin (Fond du Lac County Crops and Soil Agent) and Mike Ballweg (Sheboygan County Crops and Soil Agent) for their review of this article.