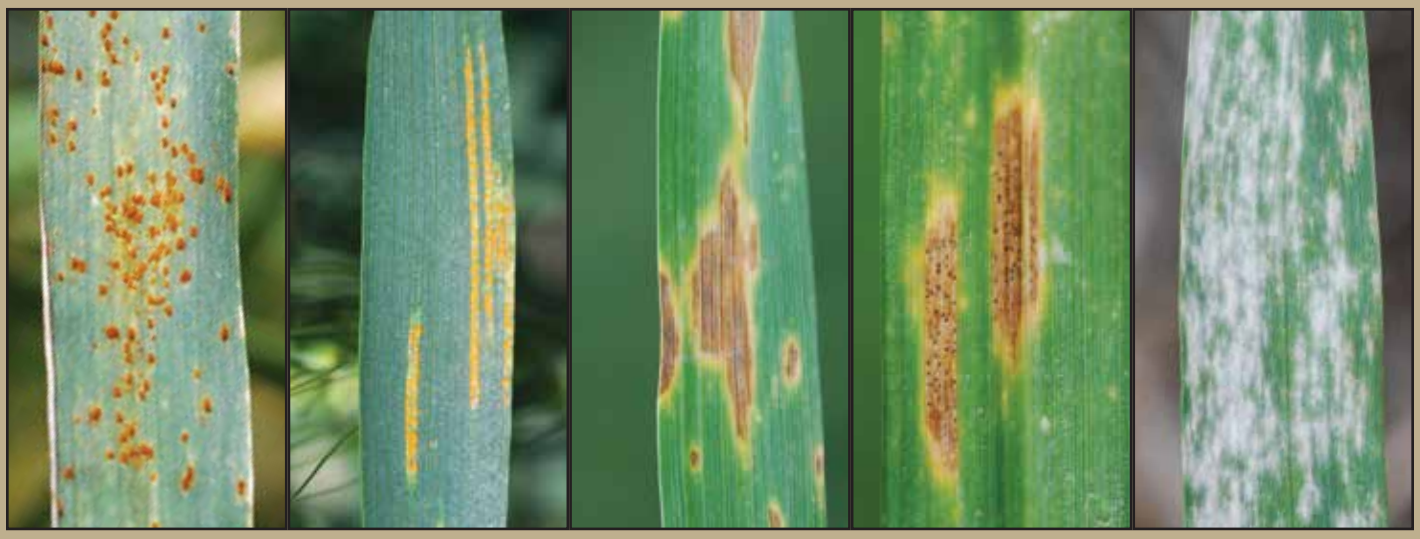
K-STATE Research and Extension

Evaluating the Need for Wheat Foliar Fungicides

The leaf diseases leaf rust, stripe rust, tan spot, Septoria tritici blotch, and powdery mildew are the most common cause of disease-related yield loss (Figure 1). These diseases frequently reduce statewide grain production by more than 10 percent, resulting in financial losses exceeding $200 million for Kansas farmers. Often, leaf diseases are managed by a combination of genetic resistance and crop rotation; however, foliar fungicides may be needed when these practices fail to keep diseases at low levels.

The yield response of wheat to foliar fungicides is highly variable. This yield response is influenced by many factors, including a variety's genetic resistance to disease, the amount of disease present in a field, yield potential of the crop, and weather conditions. This publication answers common questions about the role of fungicides in wheat disease management and helps evaluate the need for a fungicide by analyzing information available at the time of application.

Figure 1. *Symptoms of the most common leaf diseases of wheat in Kansas.*



Leaf rust: Symptoms of leaf rust include small, reddish-brown lesions. These blister-like lesions are most common on leaves, but also may occur on the leaf sheath. Lesions are scattered on infected plant parts. Infections of heads and stems are rare.

Stripe rust: This fungal disease causes yellow, blister-like lesions that are arranged in stripes. The disease is most common on leaves, but heads also can be infected when the disease is severe. Infections of the leaf sheaths and stems are rare.

Tan spot: Symptoms of tan spot include tan lesions with a yellow margin. Mature tan spot lesions often have a darkened area in the center. Lesions may merge as they expand, resulting in large sections of affected leaf tissue.

Septoria tritici blotch: This disease causes tan, elongated lesions. These lesions often have a thin, yellow margin, but the amount of yellowing varies among varieties. Dark-colored reproductive structures of the fungus that causes this disease are a key diagnostic feature.

Powdery mildew: Powdery mildew causes white lesions on wheat leaves, leaf sheaths, and heads. Fungal growth is primarily restricted to outer plant surfaces. Mature lesions may contain dark reproductive structures intermixed with the white, cottony growth of the fungus.

When should a fungicide be applied relative to crop growth?

The upper leaves present during the early stages of grain development provide most of the energy the plants use to produce grain. Diseases that damage plants at these early stages often reduce the grain yield significantly. Fungicides can best protect these critical growth stages from disease when applied between full emergence of the flag leaf and anthesis (flowering) (Figure 2). Fungicide applications made before flag leaf emergence generally result in less disease control on the upper leaves during grain development and smaller yield responses. Always check and follow product label recommendations to ensure full compliance with growth-stage limitations and pre-harvest intervals.

How long will the fungicide provide disease control?

The residual life of the fungicide application is influenced by the product used, rate of application, and disease targeted for control. In general, products belonging to the triazole and strobilurin classes of fungicide will provide 14 to 21 days of disease control. Small differences in residual life among products typically do not result in large differences in grain yield.

How well do the fungicides move throughout the plant?

Plant tissues readily absorb most products belonging to the triazole and strobilurin classes of fungicides; however, the chemicals do not move far within the plant. In general, the fungicides stay near the site of application or move toward the leaf tip. The fungicides only protect leaves, stems, and heads present at the time of application.

Are there important differences in how well various fungicide products work?

Nearly all fungicide products labeled and widely marketed for use on wheat in Kansas contain active ingredients belonging to triazole and strobilurin classes of fungicides or mixtures of these classes. Both fungicide classes are effective at controlling common leaf diseases in Kansas. Products containing only the triazole class of fungicides are the best option in areas prone to Fusarium head blight (head scab). More information about product options and efficacy against diseases can be found in the K-State Research and Extension publication *Foliar Fungicide Efficacy Ratings for Wheat Disease Management*, EP130.

Figure 2. *Range of growth stages at which foliar fungicides are often applied to protect the upper leaves of wheat from diseases.*

Flag leaf emergence complete: At least two nodes are visible in lower third of the stem, and base of the flag leaf is visible.

Boot: Head is still covered by leaf sheath, but is large enough that the leaf sheath appears swollen. Awns are visible at the base of the flag leaf.

Head emergence: Leaf sheath is opening as head continues to enlarge and elongate. Head begins to move past base of the flag leaf.

Heading complete: Entire head has moved beyond the base of the flag leaf. The stem supporting the head continues to elongate.

Anthesis (flowering): Anthers emerge from florets. The middle section of the head flowers first and is followed by the florets at the tip and base.

What is the typical yield response of wheat to foliar fungicides?

Researchers with K-State Research and Extension have been evaluating the potential role of fungicides in leaf disease management for many years. In most situations, these experiments were specifically designed to evaluate the benefits of fungicides when susceptible varieties are grown in environments extremely favorable for disease development. A summary of experiments conducted between 1991 and 2011 indicates that a single fungicide application between flag leaf emergence and anthesis often results in a yield increase between 4 and 14 percent, with an average yield increase of 10 percent (Figure 3). These figures can be combined with yield potential of a wheat crop to estimate the potential yield response in bushels per acre.

What information maximizes the potential benefits of the fungicide application?

Because the yield response to fungicides is variable, it is often helpful to consider different approaches that can maximize the potential benefits of the fungicide application. While it may not be possible to predict the yield response to a fungicide application perfectly, it is possible to use the information at the time of application to improve the chances of obtaining an above-average yield response.

Set priorities based on a variety's balance of genetic resistance and susceptibility to disease.

Research continues to demonstrate that wheat varieties that are susceptible to the most common leaf diseases are more likely to experience severe disease and disease-related yield loss than varieties with resistance to these same diseases (Table 1 and Figure 4). Information about the disease resistance of a wheat variety is often available well before fungicide decisions need to be made. In fact, for most varieties this information is available before purchase of the seed. Selecting a variety with resistance to the most common leaf diseases in Kansas reduces the risk of severe disease and the need for fungicide applications to protect yield.

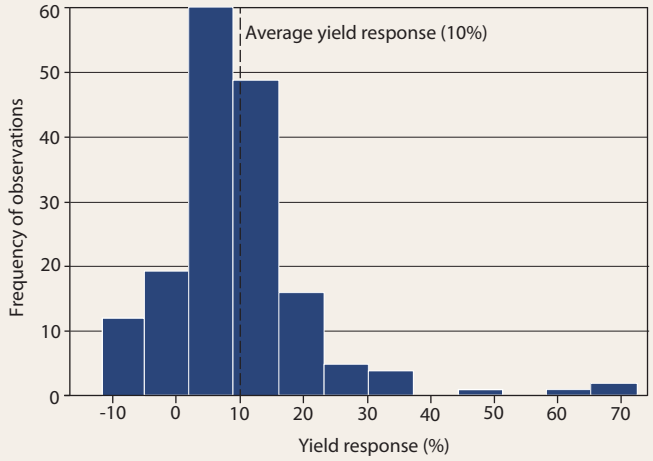
Table 1. *Reaction of wheat varieties to the most common leaf diseases in Kansas.*

Varieties resistant or moderately resistant to multiple leaf diseases		Varieties susceptible or moderately susceptible to multiple leaf diseases		
Armour	Santa Fe	1863	Fuller	Ruby Lee
Aspen (W)	Sy-Wolf	AP503 CL2	Hitch	TAM 111
Duster	T158	Bill Brown	Jackpot	TAM 112
Gallagher	TAM 304	CJ	Jaggalene	WB-4458
Garrison	WB-Cedar	Danby (W)	Jagger	WB-Redhawk
Hatcher	WB-Deuce CL+	Endurance	Overley	Winterhawk
Iba	WB-Grainfield	Everest	PostRock	

(W) White wheat variety

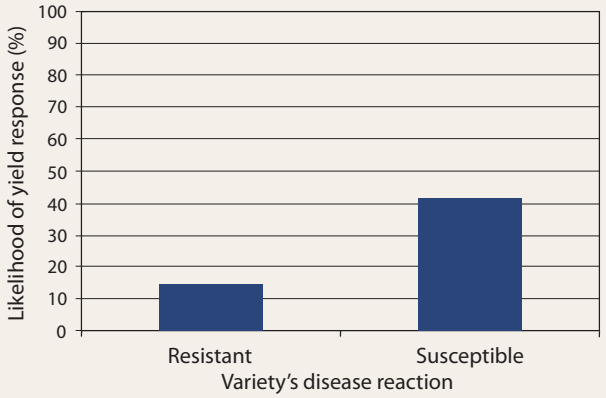
A variety is considered resistant to multiple leaf diseases if the ratings for leaf rust, stripe rust, tan spot, Septoria tritici blotch, and powdery mildew (on a 1–9 scale) sum to less than 26. Refer to *Wheat Variety Disease and Insect Ratings*, MF991, for more information about varieties.

Figure 3. *Summary of yield response of wheat to foliar fungicides in Kansas.*



Summary includes research results gathered from multiple locations in Kansas between 1991 and 2011. Trials include a single application of a labeled fungicide applied between flag leaf emergence and anthesis. Varieties were considered susceptible or moderately susceptible to the targeted disease in the study. Environment at the testing locations was extremely favorable for disease development. Yield response = percent increase or decrease in grain yield of research plots receiving a fungicide compared to those not receiving the application.

Figure 4. *Likelihood of an above-average yield response to a foliar fungicide based solely on a variety's reaction to the most common leaf diseases in Kansas.*



Based on research comparing the influence of fungicides on disease control and grain yield for multiple varieties between 2008 and 2011 at multiple locations. Yield response = increase or decrease in grain yield of research plots that received a fungicide compared to those that did not receive the application. A yield response must be 4 bushels per acre or greater to be considered above average. A variety is considered to have resistance to multiple leaf diseases if the ratings for leaf rust, stripe rust, tan spot, Septoria tritici blotch, and powdery mildew (on a 1–9 scale) sum to less than 26 (Table 1).

Additional information about the disease reaction of wheat varieties to leaf diseases in Kansas can be found in the *Wheat Variety Disease and Insect Ratings*, MF991, available from K-State Research and Extension. A variety's reaction to disease often changes over time and it is important to use the most recent information when evaluating a variety's disease resistance. These variety ratings are updated annually to ensure the most current information is available.

Refine the decision based on the risk of severe disease.

In Kansas, the two primary indicators of disease risk are regional outbreaks of the rust diseases and the presence of disease within a field before the heading stages of growth. Using this information, the risk of disease can be classified as low, moderate, or high (Table 2). Research indicates that fungicides are most likely to result in an above-average yield response in production scenarios that combine varieties that are susceptible to multiple leaf diseases with high levels of disease risk (Figure 5). The likelihood of an above-average yield response is reduced at the moderate and low levels of disease risk. Production scenarios that combine varieties with resistance to multiple leaf diseases and low levels of disease risk are least likely to result in an above-average yield response.

Integrate yield potential and weather into the decision.

While a variety's reaction to disease and risk of disease are important, they are not the only factors influencing the yield response of wheat to a fungicide application. Yield potential of a wheat crop and weather information available at the time of application also can influence the final decision to apply a fungicide. Fields with a good yield potential, at least 40 bushels per acre, at the time of application and fields intended for seed production should be a high priority. These priorities are further reinforced when weather forecasts indicate conditions are likely to remain favorable for wheat growth and disease development. It is wise to more carefully analyze the use of fungicides (and avoid additional input costs) when drought, freeze injury, viral diseases, or other production problems make a crop's yield potential uncertain.

Erick De Wolf
Plant Pathologist

William Bockus
Plant Pathologist

Doug Shoup
Agronomist

Rachel Eddy
Graduate Student

Stewart Duncan
Agronomist

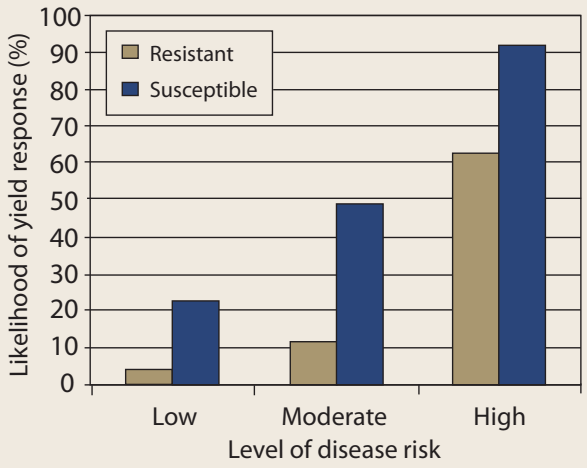
James Shroyer
Agronomist

Acknowledgements: The authors wish to thank Allan Fritz, Robert Bowden, Kent Martin, and Brian Olson for their help collecting the data used in this publication. We also thank Kansas Wheat for its support of this project.

Table 2. *Suggestions for defining disease risk based on regional reports of disease outbreaks and in-field observations of disease.*

Level of disease risk	Production scenario based on information available before flowering
Low	No reports of rust diseases locally or outbreaks of rust in the southern Great Plains Disease found on lower leaves with less than 5 percent of the plants infected
Moderate	Regional reports of rust diseases locally or outbreaks of rust in the southern Great Plains Disease found on lower leaves with 5 percent or more of the plants infected Multiple diseases may be present in the lower canopy
High	Regional reports of rust diseases locally or outbreaks of rust in the southern Great Plains Disease found on upper two leaves with 5 percent or more of the plants infected

Figure 5. *Likelihood of an above-average yield response to a foliar fungicide based on a variety's reaction to multiple leaf diseases and low, moderate, and high levels of disease risk.*



Based on research comparing the influence of fungicides on disease control and grain yield for multiple varieties between 2008-2011 at multiple locations. Yield response = increase or decrease in grain yield of research plots that received a fungicide compared to those that did not receive the application. A yield response must be 4 bushels per acre or greater to be considered above average. A variety is considered to have resistance to multiple leaf diseases if the ratings for leaf rust, stripe rust, tan spot, Septoria tritici blotch, and powdery mildew (on a 1-9 scale) sum to less than 26 (Table 1).

Kansas State University
Agricultural Experiment Station and Cooperative Extension Service

MF3057 November 2013