Foliar Disease Control on Winter Wheat in the Northern Texas Blacklands: II. Fungicide Timing

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ABSTRACT

Several foliar fungicides were applied to control both leaf rust (*Puccinia recondita*) and Septoria leaf blotch (*Septoria tritici*) on winter wheat. The later applications provided the most effective control. An application at Feeke's growth stage 9 or 10 was most beneficial.

KEY WORDS: Leaf rust, leaf blotch

The proper timing of fungicide applications is an important component of any intensive management program. Not only is timing of fungicides important for pathogen control, but it is also critical for minimizing costs. If a field is sprayed too early, and the pathogen is polycyclic (able to reproduce more than once within a cropping season), the pathogen would have a chance to reinfect the crop before it matures. The rust disease is an example of a polycyclic pathogen. Therefore, yield loss is still possible after a fungicide application if the disease reappears during the growing season. A second application of a foliar fungicide may sometimes be required to protect the crop, but that has not been shown to be economically sound. Another problematic situation can also occur if the fungicide is applied too late. After the pathogen has established itself within the plant system, the damage may have already occurred, and may be irreversible. In this situation, no fungicide can really help the crop.

The type of fungicide is also a consideration with regard to the timing of application. A protectant fungicide must be applied about five days prior to infection. The systemic fungicides have some currative properties so timing is probably less critical.

An experiment conducted in 1985 demonstrated the potential efficacy of foliar fungicides for disease suppression and wheat grain yield increase in the Northern Blacklands of Texas (Table 1). These materials were chosen because of their activity on pathogens prevalent in the region. Yields were increased by 21.5 bushels per acre from fungicides applied at Feekes growth stage 10.2. That study prompted

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the present work concerning the timing of foliar fungicide applications. Current recommendations by some of the manufacturers suggest applications of fungicides at growth stage 8 (see Tilt label). Some reports indicate that responses due to foliar fungicides were better when fungicides were applied early or at GS 7 or 8, (Roth, 1987; Brown, 1983; Jenkins & Lescar, 1980), whereas others report higher yield responses when fungicides were applied at GS 9 and 10. (Dannenberg, et al., 1989; Conner & Kuzyk, 1988; Willis, 1984; Bissonnette et al., 1969) Rowell (1968) concluded that the progress of the epidemic in the field at the time of the application and the type of chemical to be used were the major concerns. Bissonnett (1969) reported that the most effective time of application for a protectant fungicide was when the head was emerging from the boot (GS 10.1). He also advocated a second application ten days later.

Cook (1980) found the largest positive responses to fungicides occurred when they were sprayed at "flag leaf emergence" (GS 8) and the "in-boot" (GS 10) stage. Jenkins and Lescar (1980) reported that disease control was best when the fungicides were applied after flag leaf emergence.

Brown (1983) reported that the U.K. Agricultural Development and Advisory Service recommended that a spray program be initiated before the pathogen covered 5% of the flag and/or F-1 leaves, regardless of the growth stage.

The purpose of these experiments was to attempt to determine the optimum timing of foliar fungicides in this region. Both protectant and systemic fungicides were included.

Table 1. Efficacy of selected fungicides on leaf rust, Chisholm HRWW, 1985, Feekes GS 10.2.

Fungicide program	Yield (Bu/A)
Folicur	60.7 a
Bayleton + mancozeb	57.7 ab
Tilt	52.9 b
Untreated check	40.6 c
PR > F	.0001
C.V.	6.9
R-Square	.893

MATERIALS AND METHODS

In Schuster et al. (1992) the specific research techniques were discussed in some detail. All of the experiments were randomized complete block designs with four replications. The experiments were initiated on standing wheat. The sites were selected for variety, uniformity, and yield potential. The fungicides were applied with a CO_2 powered backpack sprayer.

The fungicide treatments in the experiments reported in this paper are as follows: 1) Bayleton 50(WP) at 2 ounces + mancozeb (80WP) at 2 pounds/acre, 2) Tilt (3.6

E.C.) at 4 oz. per acre, and 3) Folicur (3.6 FL) at 6 oz. per acre. The fungicides are expressed as weight of formulated material per acre.

The plots were 20 feet long and sprayed on 8 foot centers. They were harvested with a Suzue grain binder and a large Vogel plot thresher.

RESULTS AND DISCUSSION

Some growing seasons lend themselves to fungicide trials more than others since a combination of disease pressure and wheat with yield potential is required. A susceptible variety is also required. The year 1986 was such a year. In more recent years we have experienced conditions for effective fungicide tests only in isolated situations.

Feekes growth stage 10.2 is when the majority of the spikes are 50% exerted from the boot. (Table 1). While that was late in the growing season and the rust infection was quite advanced at the time of application, the yield increases still ranged from 12 to 20 bushels per acre. Folicur was significantly better than Tilt and all of the fungicide treatments were significantly different from the check.

The data from a Folicur timing experiment on Vona hard red winter wheat are reported in Table 2.

Table 2. Efficacy of foliar on leaf rust at 4 different timings on Vona HRWW, 1986.

Timing	Mean Flag Leaf Rating on 3 May 86	Mean Yield (Bu/A)
Feekes GS 10	0 a	57.4 a
Feekes GS 9	48 b	55.6 a
Feekes GS 8	59 b	48.1 b
Feekes GS 7	59 b	42.3 c
Untreated check	93 c	36.7 d
PR > F	.0003	.0001
C.V.		6.2
R-Square		.924

There were highly significant differences in both leaf ratings and yields. The rating system was described in Schuster et al. (1992). Folicur appeared to provide complete control soon after treatment but the effect diminished through time.

Yields from plots treated with Folicur at GS 9 & GS 10 were not significantly different from each other but they were significantly greater than both the earlier applications and the check.

The leaf ratings for seven different experiments with fungicides on leaf rust are summarized in Table 3.

Table 3. Mean leaf ratings for seven experiments on leaf rust with 3 fungicides sprayed at 4 growth stages, 1986.

Timing	Tilt		Folicur			Bayleton + mancozeb		Mean
	1	2	3	4	5	6	7	All locations
Feekes GS 10	25 a	3 a	0 a	0 a	0 a	0 a	2 a	4
Feekes GS 9	70 b	18 ab	48 b	0 a	0 a	2 b	12 a	21
Feekes GS 8	93 c	23 b	59 b	1 a	6 a	3 b	18 ab	29
Feekes GS 7	93 c	55 c	59 b	17 b	25 b	3 b	36 b	41
Untreated check	100 c	70 c	93 c	70 c	59 c	3 b	59 c	65
PR > F	.0001	.0001	.0003	.0001	.0001	.0001	.0006	

Some of the yields were confounded by a late season infection of Barley yellow dwarf virus so only the leaf ratings have been reported.

The responses were somewhat different between experiments but the overall trends were quite consistent. In general, the later treatments showed fewer rust pustules and better disease control at the time of rating.

The experiment reported in Table 4 was conducted in 1991. The fungicides were applied at flowering (GS 10.5.1).

Table 4. Efficacy of selected fungicides on leaf rust, McNair 1003, SRWW, Feekes GS 10.5.1 (flowering).

Fungicide program	Flag leaf rating on 14 May 1991	Yield (Bu/A)
Folicur	0 a	68.9 a
Tilt	70 b	62.7 a
Bayleton + mancozeb	59 b	59.2 ab
Untreated check	100 c	51.5 b
PR > F	.0001	.0195
C.V.	23.4	10.2
R-SQUARE	.933	.701

The fungicide treatments were not significantly different from each other. However, both Folicur and Tilt were significantly better than the check. This experiment supports the earlier studies that have shown that the applications at later growth stages tend to provide better rust control than the same treatments applied at a less mature stage.

Several other experiments were conducted which are not reported here. Most of these experiments failed to show differences because of insufficient disease pressure. However, in none of these experiments were the earlier timings superior to the later

applications.

Two experiments in 1986 had Septoria leaf blight (*Septoria tritici*) (Table 5).

Table 5. Mean flag leaf ratings for 2 experiments *Septoria tritici* with 2 materials at 4 different timings in HRWW, 1986.

Timing	Folicur	Tilt	Mean
Feekes GS 10	0 a	10 a	5
Feekes GS 9	2 ab	24 a	13
Feekes GS 8	34 b	51 ab	43
Feekes GS 7	30 ab	81 bc	56
Untreated check	81 c	100 c	91
PR > F	.0006	.0026	
C.V.	68.4	51.2	
R-Square	.801	.727	

The control of Septoria leaf blight appears to follow a similar trend to that of leaf rust. The later treatments are superior to the earlier ones but the differences were not always significant. This is somewhat unexpected because Septoria leaf blight normally occurs earlier in the growing season than leaf rust. If the earlier applications were to provide better protection, it would seem more likely on Septoria leaf blight than on leaf rust.

CONCLUSIONS

The development of the ergosterol biosynthesis inhibitor types of fungicides dramatically changed the entire stategy of foliar disease control on winter wheat. Their curative properties allow the grower to wait until after the onset of the disease to make a fungicide application. The older protectant fungicides had to be applied some time before the spore shower occurred.

The experiments that made up this study were intended to examine fungicide efficacy and to detect the optimum timing of application for maximum yields. Almost without exception the late applications were superior. Growth stages 9 and 10 proved to be the best stages to apply a foliar fungicide.

Unfortunately, only one of these treatments can currently be used legally at Feekes GS 9 or 10. The Bayleton + mancozeb combination is labeled for use at this stage while Folicur is not yet labeled and Tilt cannot legally be used after GS 8 according to the label.

It appears that wheat growers will not be able to realize the maximum economic benefit unless the fungicide labels are expanded to include the later application timings.

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