Foliar Disease Control on Winter Wheat in the Northern Texas Blacklands: I. Fungicide Efficacy

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ABSTRACT

This study evaluated three fungicide treatments on three foliar diseases of winter wheat in the Northern Texas Blacklands. Twenty-five experiments were conducted over a five year period. Data from 11 different experiments are included. Grain yields and leaf ratings are reported. Fungicides were efficacious and profitable in some, but not all, situations on each of the diseases studied.

KEY WORDS: Leaf rust, stripe rust, septoria

Foliar diseases are a major yield limiting factor for winter wheat production on the Northern Texas Blacklands. Some years foliar diseases have been devastating.

The older fungicides could be used as protectants but had no curative activity. These fungicides (i.e. mancozeb) would control several foliar diseases when they were applied prior to the onset of the disease (Fehrmann, 1985; Scheinpflug, 1986). Such prophylactic applications are not practical. In recent years, a whole new group of fungicides has been introduced. They are known as ergosterol biosynthesis inhibitors (EBIs). These fungicides are systemic and have displayed both protectant and curative properties (Berg, 1986; Schwinn, 1983; Siegel, 1981). Their characteristics have greatly altered wheat disease management.

Leaf rust, caused by *Puccinia recondita*, has been the worst foliar disease of wheat in this region. It appears as scattered pustules primarily on the leaf sheaths and the upper surface of the leaf blades.

The uredia are orange-red to dark red, and the telia are dark brown in color (Weise, 1977; Zillinsky, 1983). Leaf rust can be found in this region each year but seems to be economically damaging every second or third year on susceptible varieties.

Stripe rust, caused by *Puccinia striiformis*, is an early season disease that is more severe at lower temperatures than leaf rust. The pustules develop in linear bands on the leaves and spikelets. The uredia are yellow. Stripe rust is a sporadic disease (Weise, 1977; Zillinsky, 1983).

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Two different diseases are caused by fungi of the genus *Septoria* and are difficult to separate with certainty in the field (Weise, 1977; Zillinsky, 1983). Leaf blotch, caused by *Septoria tritici*, occurs early in the season during wet years. It causes necrotic lesions on the leaf blades and leaf sheaths. Later, these areas are peppered with black dots--the pycnidia. Glume blotch, caused by *Septoria nodorum*, is generally associated with high humidity and warmer temperatures later in the growing season (Weise, 1984; Zillinsky, 1983). It is more often a problem east of the Blacklands. The fungus causes lesions on both leaves and glumes. The lesions are said to assume somewhat different shapes, and the pycnidia are less noticeable than with *S. tritici*, but these are only matters of degree.

Powdery mildew, caused by *Erysiphe graminis*, is an early season foliar disease that thrives in cool, wet weather (Weise, 1977; Zillinsky, 1983). The disease is recognized as scattered small white spots which are actually a cottony mass of mycelium on the upper surface of the leaves. It tends to fade away during warm, dry weather. The authors have not been able to measure yield responses associated with powdery mildew control because the tests were always confounded with other diseases later in the growing season.

The purpose of this research was to evaluate the efficacy of foliar applied fungicides on winter wheat in the Northern Texas Blacklands. This was a promising but unproven management technique.

MATERIALS AND METHODS

Foliar disease control experiments were superimposed on local, commercial wheat fields in a three county area. Fields were selected based on the susceptibility of the variety, uniformity of stand and yield potential. Both hard red winter wheat (HRWW) and soft red winter wheat (SRWW) varieties were included. Three fungicide application programs were used in a number of experiments on several fields. The fungicides used were: Bayleton® (Mobay Corp.), Folicur® (Mobay Corp.), mancozeb (DuPont & Co. and Rohm & Haas Company), and Tilt® (Ciba-Geigy Corp.).

Mancozeb is a protectant type of fungicide while Bayleton, Folicur, and Tilt are EBIs. Mancozeb was originally labeled in 1968, Bayleton in 1984, and Tilt in 1989. The Folicur formulation was changed in 1989. Prior to 1989 a 1.2 emulsifiable concentrate (E.C.) formulation was used. Since then, Folicur has been available as a 3.6 flowable (FL). Registration is anticipated in 1992.

The treatments used in the experiments and reported in this paper were 1) Bayleton (50 WP) at 2 ounces + mancozeb (80 WP) at 2 pounds/ acre 2) Tilt (3.6 E.C.) at 4 oz. per acre and 3) Folicur at a rate equivalent to (3.6 FL) at 6 oz. per acre.

All applications were made with a $C0_2$ powered backpack sprayer (R & D Sprayers, Opelousas, LA.), using a three nozzle boom and tapered flat fan spray tips. There was some variation between calibrations but the materials were generally applied in 20 gallons of water per acre at 15 pounds pressure per square inch. An electronic metronome was used to help standardize walking speeds.

The experiments were all established using a randomized complete block design and four replications. The individual plots were 8 feet wide, with a 5 foot spray pattern, and 20 feet long.

Visual disease assessment ratings were made by either two or three individuals,

and a final rating was established by consensus. The rating system used for leaf rust, stripe rust and *Septoria sp.* is an approximation of the percentage of necrotic leaf surface area.

The plots were harvested with a 24 inch Suzue grain binder. The bundles were threshed with a large Vogel stationary thresher. Grain yields were recorded and final weights adjusted to 12% moisture. Moisture content was determined using a Burrow's Digital Moisture Computer Model 700.

Growth stages (GS) were determined using the Feekes Scale (Large, 1954) in which GS 9 designates a completely expanded flag leaf, and GS 10 designates the boot stage.

RESULTS AND DISCUSSION

Leaf rust can be effectively controlled with foliar fungicides as shown in Tables 1, 2, and 3.

Table 1. Mean flag leaf ratings for leaf rust on eight experiments. Fungicides applied at Feekes GS 9, 1986-89.

	Experiment								
Treatment	1	2	3	4	5	6	7	8	Mean
Untreated Check	100	93	59	70	70	59	48	70	71
Tilt	70	48	20	18	17	15	3	18	26
2 + 2*	36	55	12	18	15	12	2	15	21
Folicur	18	48	0	0	0	0	0	3	9
PR>F	.0001	.0841	.0006	.0001	.0001	.0003	.0012	.0001	

*Bayleton + mancozeb

Table 1 shows the average flag leaf rating for four replications on eight different experiments over a period of several years. It is apparent that all of the fungicide treatments reduced the number of pustules on the upper surface of the flag leaves. In every experiment, except #2, the differences were highly significant. Experiments 1 and 2 were exposed to extremely high rust pressure.

Tables 2 & 3 show the relationship between the fungicide treatment, leaf ratings and yields on two of the experiments summarized in Table 1. Both 'Mustang' HRWW and 'Vona' HRWW are susceptible to leaf rust.

Comparing leaf ratings in Table 2, both the Bayleton + mancozeb treatment and Folicur were superior to the Tilt treatment. All three fungicide treatments were significantly better than the check. The yields reflect the same differences, however, there does not appear to be a very close correlation between disease rating and yield.

Leaf ratings in Table 3 were not significantly different. However, yields showed highly significant differences. According to the Duncan's Multiple Range Test, Folicur provided the greatest yields while yields from both Bayleton + mancozeb

and Tilt were greater than the check, but not significantly different from each other.

Table 2. Efficacy of selected foliar fungicides on leaf rust. Fungicides applied at Feekes GS 9, Mustang HRWW, 1986.

Fungicide	Mean Flag Leaf Rating on 3May8	Mean Yield (Bu/A)
Bayleton + mancozeb	36 a*	61.0 a
Folicur	18 a	60.9 a
Tilt	70 b	56.4 b
Untreated check	100 c	43.4 c
PR > F	.0001	.0001
C.V.		4.1
R-SQUARE		.950

* Means flanked by the same letter are not significantly different at the 5% level by Duncan's Multiple Range Test.

Table 3. Efficacy of selected foliar fungicides on leaf rust. Fungicide applied at Feekes GS 9, Vona HRWW, 1986.

Fungicide	Mean Flag Leaf Rating on 3May86	Mean Yield (Bu/A)
Folicur	48	55.6 a*
Bayleton + mancozeb	55	49.4 b
Tilt	48	46.2 b
Untreated check	93	36.7 c
PR > F	.0841	.0001
C.V.		6.4
R-SQUARE		.904

* Means flanked by the same letter are not significantly different at the 5% level by Duncan's Multiple Range Test.

Table 4 shows similar trends when stripe rust is the pathogen. Stripe rust is an early season disease that only occurs sporadically in this area. Applications were made at Feekes GS 7 (2 internodes expanded), due to its earlier appearance. There is not much stripe rust data available because many experiments are confounded with a later infection by leaf rust.

The data in Table 5 were obtained from two experiments where *Septoria sp.* were damaging. According to our ratings all of the fungicide treatments reduced *Septoria sp.* infection significantly compared to the untreated check.

Table 4. Efficacy of foliar fungicides on stripe rust. Fungicides applied at Feekes GS 7, Coker 747 SRWW, 1987.

Fungicide	Mean Flag Leaf Rating on 27 Apr	Yield (Bu/A)
Folicur	4	47.8 a*
Bayleton + mancozeb	2	45.4 ab
Tilt	2	43.8 abc
Untreated check	14	38.6 c
PR > F	.2587	.0057
C.V.		8.1
R-SQUARE		.635

* Means flanked by the same letter are not significantly different at the 5% level by Duncan's Multiple Range Test.

Table 5. Mean flag leaf ratings for *Septoria sp.* control with three programs. Fungicides applied at Feekes GS 9, HRWW, 1986.

Fungicide Program	Location 1	Location 2	MEAN
Untreated check	81 a*	100 a	91
Bayleton + mancozeb	31 b	35 b	33
Tilt	16 b	24 b	20
Folicur	2 b	1 b	2
PR > F	.0160	.0014	

*Means flanked by the same letter are not significantly different at the 5% level by Duncan's Multiple Range Test.

Table 6 shows the efficacy of the fungicide treatments on *Septoria nodorum*. The fungicides were applied at GS 10.5--the stage at which the spike has been completely exerted from the boot. Based on the data from this experiment, both Tilt and Folicur appear to be more active against the organism than the Bayleton + mancozeb treatment.

In this region a fungicide application generally costs about $14 per acre. Folicur is not currently labeled and is unavailable for commercial use.

The highest yield was selected for these calculations without reference to a specific treatment or its current label status. These calculations show conclusively that with productive wheat and disease pressure, a fungicide application can be profitable at almost any wheat price.

Table 6. Efficacy of selected foliar fungicides on *Septoria nodorum*. Fungicides applied at Feekes GS 10.5, Florida 302 SRWW, 1990.

Fungicide Program	Mean Flag Leaf Rating 1 May	8 May	Mean Yield (Bu/A)
Folicur	7 a*	50 a	47.4 a
Tilt	7 a	44 a	44.0 ab
Bayleton + mancozeb	19 b	88 b	39.4 bc
Untreated check	70 c	100 b	35.7 c
PR > F	.0001	.0009	.0282

* Means flanked by the same letter are not significantly different at the 5% level by Duncan's Multiple Range Test.

Table 7. Estimated returns from a fungicide application at GS 9.

	Table 2	3	4	6	
Best Treatment	61.0	55.6	47.8	47.4	bu/A
Check	43.4	36.7	38.6	35.7	bu/A
Difference	17.6	18.9	9.2	11.7	yield increase
Cost	14.00	14.00	14.00	14.00	fungicide +appl.
Returns/Ac	$21.20	$23.80	$4.40	$9.40	@ $2/bushel
	$38.80	$42.70	$13.60	$21.10	@ $3/bushel
	$56.40	$61.60	$22.80	$32.80	@ $4/bushel

CONCLUSIONS

Fungicides are a valuable management tool on winter wheat in northeast Texas. Disease pressure is a reflection of the susceptibility of the cultivar and the presence of inoculum. Given reasonable yield potential and disease pressure a fungicide application should prove profitable.

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