

04-02. Evaluation of Foliar Fungicides for the Control of Stripe Rust (*Puccinia striiformis*) in SRWW in the Northern Texas Blacklands

COOPERATIVE RESEARCH PROJECT 2004

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OBJECTIVE

Stripe rust, *Puccinia striiformis*, was a sporadically occurring disease in North Texas prior to 2000. Over the past four years, however, stripe rust infections have occurred every year, causing widespread damage and loss of yield. There has been a limited database on the performance and economic impact of foliar fungicides for the control of this pest.

The purpose of this experiment was to evaluate the efficacy of selected foliar fungicides (Tilt®, Quilt®, Stratego®, Headline®, Quadris®, and Folicur®) for the control of stripe rust in soft red winter wheat in the Northern Texas Blacklands. A variety that was highly susceptible to stripe rust, but resistant to leaf rust, was selected to attempt to determine the impact of stripe rust alone on wheat. Leaf ratings, yields, and bushel weights were used as measures of product efficacy.

MATERIALS AND METHODS:

A block of soft red winter was planted on October 21, 2003 near Royse City, Texas, for this trial. The variety (Agridrop Patton) was chosen for this test because it had a history of susceptibility to the stripe rust pathogen and had shown excellent resistance to leaf rust (*Puccinia recondita*). The plots were superimposed over the wheat in a randomized complete block experimental design with six replications. The plots were sprayed with a three-nozzle boom with 8002VS stainless steel tips on 19-inch spacings. The individual plots were 4 feet wide by 20 feet long. The treatments were applied on April 2 with a CO₂-powered backpack sprayer. The wheat was in Feekes Growth Stage 9 at the time of application. The materials were applied in 14 gallons of water per acre with 8002VS tapered, flat-fan nozzles at 30 p.s.i.

Conditions at the time of application were as follows: 78.9° F ambient temperature, 41% relative humidity, and 1.8 mph wind speed. The following treatments were evaluated:

<u>Treatment</u>	<u>Formulated Rate (oz. /A)</u>
Untreated check	-
Tilt 3.6 EC	4 oz.
Quilt	10.5 oz.
Quilt	14 oz.
Quadris 2.08 Fl.	6.2 oz.
Stratego 2.08 EC	10 oz.
Stratego 2.08 EC	8 oz.
Headline	6 oz.
Headline	9 oz.
Folicur 3.6 FL	4 oz.
Folicur 3.6 FL	6 oz.

The plots were evaluated on April 28. The flag leaves were rated for percent infection from the stripe rust pathogen, and the rust virulence was also noted. The plots were harvested on June 2 with a research combine manufactured by Kincaid Manufacturing at Haven, Kansas. Grain samples were cleaned, processed, and weighed in the laboratory.

RESULTS AND DISCUSSION:

Leaf rust infection levels varied among the treatments. Folicur, Tilt, Quilt, Quadris, and the high rate of Stratego had slightly lower visual leaf infection levels than Headline (Table 1). However, both Headline treatments were significantly better than the untreated check. There were also differences in infection virulence among the fungicide treatments (Table 2). Disease virulence in all of the fungicide treatments was significantly less than in the untreated plots.

None of the fungicide treatments were significantly different from one another; however, all of them produced significantly more grain than the untreated check (Table 3). Yield increases over the untreated plots ranged from 34 to 41 percent. There was no rate response with the fungicides – the low rates were just as good as the higher rates.

Bushel weight differences among the treatments followed the same trend as the yield differences. All of the fungicides produced grain with significantly higher bushel weights than

the untreated plots (Table 4). The grain produced from the fungicide treated plots averaged 3 pounds higher test weights than with the untreated check.

The weight of a thousand kernels is often used to indicate seed size. Thousand kernel weight differences followed a similar trend in response to the fungicide application. All of the fungicides produced significantly higher thousand kernel weights than those of the untreated plots. Increases ranged from 29 to 34 percent over the untreated check.

CONCLUSIONS:

Wheat yield is governed by three factors; number of heads per acre, number of seeds per head, and the weight of the individual seeds. At the time of a fungicide application, the number of heads per acre has already been determined. Therefore, the only yield components that fungicides can impact are the number of seeds per head, and the weight of the individual seeds.

In this experiment, most but perhaps not all of the yield increase can be explained by an increase in the weight of the individual seeds. Healthier plants would continue to “fill” longer, thereby producing plumper, heavier seeds. For example, plots treated with Folicur @ 4 ounces produced 41% more grain than the untreated plots and had thousand kernel weights 33% higher than the untreated plots. Both infection and treatment occurred prior to pollination (shortly after heading); therefore healthier plants likely set and retain more seeds per head.

Foliar fungicides were widely used to control stripe rust in Northeast Texas in 2004. Based on these data, growers likely realized a 2 to 3 fold return on their investment, where susceptible varieties were sprayed with a foliar fungicide. Growers have reported experiencing yield responses of similar magnitude this year.

Evaluation of Selected Foliar Fungicides for the Control of Stripe Rust (*Puccinia striiformis*) in Patton Soft Red Winter Wheat. Commerce, TX 2004

Table 1: Percent Flag Leaf Infection 28 DAT 04/30/02

Treatments (Formulated Rate/A)	1	2	3	4	5	6	Mean
Folicur 3.6 FL @ 6 oz.	0.0	0.0	0.0	0.0	0.0	0.0	0.0a
Folicur 3.6 FL @ 4 oz.	0.0	0.0	0.0	0.0	0.0	0.0	0.0a
Tilt 3.6 EC @ 4 oz.	0.5	0.0	0.0	0.5	0.0	0.0	0.2a
Quilt @ 14 oz.	1.0	0.5	0.0	0.5	0.0	0.0	0.3a
Stratego 2.08 EC @ 10 oz.	0.5	1.0	0.5	0.5	0.5	0.5	0.6a
Quadris 2.08 FL @ 6.2 oz.	1.0	0.5	1.0	0.5	0.5	1.0	0.8a
Quilt @ 10.5 oz.	5.0	5.0	0.5	0.5	0.0	1.0	2.0a
Stratego 2.08 EC @ 8 oz.	2.0	8.0	3.0	1.0	8.0	3.0	4.2ab
Headline 2.09 EC @ 9 oz.	8.0	4.0	10.0	15.0	8.0	5.0	8.3b
Headline 2.09 EC @ 6 oz.	1.0	5.0	15.0	20.0	8.0	3.0	8.7b
Untreated Check	90.0	95.0	80.0	90.0	85.0	75.0	85.8c

ANOVA

Source of Variation	Sum of Squares (SS)	Degrees of Freedom (DF)	Mean Square (MS)	F	Appx p
Between Subject	80.21	5			
Within Subject	39122.91	60			
Repeated Factor	38505.54	10	3850.55	311.85**	< .001
Error	617.37	50	12.35		
TOTAL	39203.12	65			

Mean Separation: Newman Keuls Multiple Comparison Test @ 5%

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Table 2: Virulence Rating 28 DAT

Treatments (Formulated Rate/A)	1	2	3	4	5	6	Mean
Folicur 3.6 FL @ 4 oz.	1.0	1.0	1.0	1.0	1.0	1.0	1.0a
Folicur 3.6 FL @ 6 oz.	1.0	1.0	1.0	1.0	1.0	1.0	1.0a
Tilt 3.6 EC @ 4 oz.	2.0	1.0	1.0	1.5	1.0	1.0	1.3ab
Quilt @ 14 oz.	2.0	2.0	1.0	2.0	1.0	1.0	1.5abc
Stratego 2.08 EC @ 10 oz.	1.5	2.0	2.0	1.5	1.5	1.5	1.7bc
Quadris 2.08 FL @ 6.2 oz.	2.0	1.5	2.0	2.0	1.5	1.5	1.8bcd
Quilt @ 10.5 oz.	2.5	3.0	1.5	2.0	1.0	1.5	1.9cd
Stratego 2.08 EC @ 8 oz.	2.0	2.5	2.0	2.0	2.0	2.0	2.1d
Headline 2.09 EC @ 6 oz.	2.0	2.5	2.5	2.5	2.0	1.5	2.2d
Headline 2.09 EC @ 4 oz.	2.5	3.0	3.0	3.0	2.0	2.0	2.6e
Untreated Check	4.0	4.5	4.5	4.0	4.0	4.0	4.2f

ANOVA

Source of Variation	Sum of Squares (SS)	Degrees of Freedom (DF)	Mean Square (MS)	F	Appx p
Between Subject	2.88	5			
Within Subject	53.41	60			
Repeated Factor	47.92	10	4.79	43.62**	< .001
Error	5.49	50	0.11		
TOTAL	56.29	65			

Mean Separation: Newman Keuls Multiple Comparison Test @ 5%

VIRULENCE SCALE:

- 1 = Spore “hits” but no pustules
- 2 = a few weak pustules surrounded by large necrotic margin
- 3 = larger pustules, surrounded by moderate necrotic margin
- 4 = profuse, robust pustules, surrounded by small necrotic margin
- 5 = profuse, robust pustules – no necrotic margin

Evaluation of Selected Foliar Fungicides for the Control of Stripe Rust (*Puccinia striiformis*) in Patton Soft Red Winter Wheat. Commerce, TX 2004

Table 3: Yield in Bushels Per Acre

Treatments (Formulated Rate/A)	1	2	3	4	5	6	Mean
Folicur 3.6 FL @ 4 oz.	97.4	90.7	96.9	92.6	101.6	98.4	96.3a
Stratego 2.08 EC @ 10 oz.	99.6	87.0	99.0	99.6	92.6	92.2	95.0a
Headline 2.09 EC @ 6 oz.	99.2	93.8	94.3	91.2	91.1	96.4	94.3a
Headline 2.09 EC @ 9 oz.	97.2	92.9	91.7	93.5	90.5	100.2	94.3a
Folicur 3.6 FL @ 6 oz.	96.4	93.9	91.8	96.2	91.2	93.5	93.8a
Quilt @ 10.5 oz.	89.9	91.4	95.9	99.4	95.4	85.8	93.0a
Stratego 2.08 EC @ 8 oz.	96.5	96.9	94.6	90.7	94.3	83.3	92.7a
Tilt 3.6 EC @ 4 oz.	89.2	99.7	88.5	88.7	100.0	86.0	92.0a
Quadris 2.08 FL @ 6.2 oz.	91.8	94.2	87.6	92.5	96.8	88.6	91.9a
Quilt @ 14 oz.	90.4	101.6	93.7	91.1	88.0	85.3	91.7a
Untreated Check	66.2	62.3	68.7	70.9	72.3	68.5	68.2b

ANOVA

Source of Variation	Sum of Squares (SS)	Degrees of Freedom (DF)	Mean Square (MS)	F	Appx p
Between Subject	78.33	5			
Within Subject	4625.52	60			
Repeated Factor	3628.91	10	362.89	18.21**	< .001
Error	996.60	50	19.93		
TOTAL	4703.85	65			

Mean Separation: Newman Keuls Multiple Comparison Test @ 5%

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Table 4: Pounds Per Bushel

Treatments (Formulated Rate/A)	1	2	3	4	5	6	Mean
Stratego 2.08 EC @ 10 oz.	58.3	57.3	57.6	57.9	58.2	57.9	57.9a
Folicur 3.6 FL @ 4 oz.	57.6	58.0	57.6	58.0	57.8	58.3	57.9a
Quilt @ 14 oz.	57.8	57.8	57.7	58.2	57.0	58.0	57.8a
Quadris @ 6.2 oz.	57.6	57.8	57.9	57.6	57.8	57.5	57.7a
Folicur 3.6 FL @ 6 oz.	57.4	57.8	57.4	57.7	57.8	57.8	57.7a
Headline 2.09 EC @ 6 oz.	57.2	57.6	57.6	58.1	57.9	57.7	57.7a
Headline 2.09 EC @ 9 oz.	57.6	57.7	57.7	57.7	57.9	57.5	57.7a
Quilt @ 14 oz.	57.6	57.8	57.8	57.2	57.1	57.4	57.5a
Stratego 2.08 EC @ 8 oz.	57.7	57.6	57.6	57.9	57.0	57.0	57.5a
Tilt 3.6 EC @ 4 oz.	57.3	58.0	57.6	56.7	57.5	57.3	57.4a
Untreated Check	54.1	54.4	54.7	54.3	55.5	54.9	54.7b

ANOVA

Source of Variation	Sum of Squares (SS)	Degrees of Freedom (DF)	Mean Square (MS)	F	Appx p
Between Subject	0.13	5			
Within Subject	56.74	60			
Repeated Factor	50.75	10	5.07	42.35**	< .001
Error	5.99	50	0.12		
TOTAL	56.87	65			

Mean Separation: Newman Keuls Multiple Comparison Test @ 5%

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Table 5: Thousand Kernel Weights (grams)

Treatments (Formulated Rate/A)	1	2	3	4	5	6	Mean
Folicur 3.6 FL @ 4 oz.	39.3	40.0	41.0	40.5	38.9	40.8	40.1a
Quilt @ 10.5 oz.	40.8	40.1	40.3	40.1	38.4	39.7	39.9a
Quilt @ 14 oz.	41.0	40.6	40.4	38.8	38.6	40.0	39.9a
Headline 2.09 EC @ 9 oz.	40.4	39.9	40.2	38.0	40.2	40.1	39.8a
Folicur 3.6 FL @ 6 oz.	41.0	39.2	40.3	40.1	39.3	38.5	39.8a
Stratego 2.08 EC @ 10 oz.	40.4	39.5	40.5	40.1	38.5	39.3	39.7a
Headline 2.09 EC @ 6 oz.	40.6	39.9	39.4	39.5	38.7	39.7	39.7a
Quadris 2.08 FL @ 6.2 oz.	40.3	40.3	39.4	38.4	40.4	38.6	39.6a
Stratego 2.08 EC @ 8 oz.	40.2	39.6	39.0	38.5	39.3	37.8	39.1a
Tilt 3.6 EC @ 4 oz.	37.9	39.4	38.5	37.1	39.9	39.2	38.7a
Untreated Check	29.9	30.2	29.6	30.2	29.6	30.2	30.0b

ANOVA

Source of Variation	Sum of Squares (SS)	Degrees of Freedom (DF)	Mean Square (MS)	F	Appx p
Between Subject	8.26	5			
Within Subject	546.95	60			
Repeated Factor	517.23	10	51.72	87.00**	< .001
Error	29.73	50	0.59		
TOTAL	555.21	65			

Mean Separation: Newman Keuls Multiple Comparison Test @ 5%