An IPM Approach to Managing Foliar Diseases in Northeast Texas Wheat

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BACKGROUND

Foliar plant diseases have been a major obstacle to stabilizing wheat yields in Northeast Texas. Leaf rust, stripe rust, and glume blotch can cause devastating losses across the region some years. Plant breeding has been the preferred tactic to successfully manage leaf and stripe rust, but glume blotch resistance is not a primary goal of plant breeders. Genetically bred leaf and stripe rust resistance is not a permanent fix, and new strains of rust develop in 3 to 5 years that often overcome this initial resistance.

Wheat producers are challenged to employ a number of strategies to successfully manage these foliar diseases including a combination of genetic, cultural, and chemical approaches. The purpose of this paper is to suggest production practices that can be successfully used to minimize the impact of plant diseases and stabilize wheat production across the region.

THE IPM APPROACH

IPM (also known as Integrated Pest Management) is simply a crop management approach that combines genetic, cultural, biological, and chemical techniques to produce an economically and environmentally acceptable outcome. Adopting each of the following suggestions will improve the chances of success in managing foliar plant diseases. When all of these tactics are employed together, the odds of producing profitable and stable yields are greatly enhanced.

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GENETIC MANAGEMENT

Stripe rust *(Puccinia striiformis)*

The first line of defense to protect against leaf and stripe rust is genetically bred plant resistance. This has been primarily true in the case of leaf rust, but in recent years, efforts have been intensified to incorporate stripe rust resistance into wheat breeding programs with good success.

Stripe rust can be much more devastating than leaf rust. Local research has shown that yields in stripe rust susceptible varieties can be reduced by 50% or more in years with damaging stripe rust infection levels. Both rusts thrive on moist conditions, but stripe rust is a cool weather disease, and occurs earlier in the growing season than leaf rust. Stripe rust thrives in temperatures of 50°f to 60°F, whereas, leaf rust development is optimized by temperatures of 60° to 70°.

Leaf Rust (*Puccinia recondita)*

Plant breeding for stripe rust resistance is the best strategy to manage this disease. ***We do not recommend planting wheat varieties that are susceptible to stripe rust.*** Foliar fungicides are effective in controlling this pest, but application timing is difficult. Stripe rust spreads rapidly during cool, rainy conditions- periods when field access with ground or aerial application equipment is difficult or impossible. The only way to consistently control this disease with foliar fungicides is to spray at the first sign of stripe rust in the field. Also, since stripe rust can occur so early in the growing season in this region (prior to flag leaf emergence), a single fungicide application often will not persist long enough to protect the plants against later occurring leaf rust and glume blotch infections.

Leaf rust is the most widespread foliar disease in the United States, and the primary emphasis of plant breeding programs is resistance to this pest. Many high yielding varieties with good resistance are available to wheat producers in this region. Foliar fungicides can be used to supplement genetic resistance when leaf rust races mutate, which can change resistant varieties into susceptible ones.

Glume blotch *(Stagonospora nodorum)*

Glume blotch is not a commonly occurring disease in Northeast Texas. It has been observed at damaging levels only four or five times in the past thirty years. However, when it does occur, it can cause yield losses of 10 to 20 percent. Glume blotch spores are spread by splashing raindrops, and damaging infections spread during warm and rainy conditions during the grain filling period. The grain fill is impaired, causing shriveled grain and reduced bushel weights. Some varieties appear to be more susceptible to this disease than others, but none of our locally adapted varieties are resistant to this disease. The only effective strategy to control glume blotch in this region is a foliar fungicide applied after heading.

Powdery mildew (*Erysiphe graminis)*

Powdery mildew is a cool weather disease that infects the leaves in the lower canopy during the late fall and early winter months in this region. The best way to manage it is to plant resistant varieties. Foliar fungicides will provide suppression of this disease, but are not as cost effective as planting resistant varieties.

CULTURAL CONTROL

Variety Selection

The best way to minimize the threat of leaf and stripe rust is to plant several resistant varieties of soft red winter wheat. Rust races change from year to year, and planting multiple resistant varieties is a time proven strategy to protect your investment. In the event of a rust race change, it is not likely that all of our locally adapted varieties will become susceptible at the same time. Planting multiple varieties of differing maturities will also hedge your risk from other environmental variables such as a late spring freeze.

Timely Planting

Thirty years of local research has shown the best time to plant wheat for grain in Northeast Texas is October 25 to November 10. Earlier planting exposes the crop to more damage from foliar diseases, and increases the risk to infestations of Hessian fly and aphids. Mid to late November planting will reduce threats from foliar diseases and insects, but it shortens the tillering time and can potentially reduce yields.

Fertility

Manage wheat for high yields. Sixty to eighty bushel wheat is a realistic goal in Northeast Texas, and the required amount of N, P and K to achieve these levels is warranted. Nitrogen fertilization should be timed to provide the greatest amount of nitrogen to the plants just prior to jointing in the spring. Excessive fall nitrogen is detrimental, unless grazing is the primary objective because it encourages early foliar disease development. Phosphorus is more efficient applied in the row, and we can produce more wheat with less fertilizer by placing the phosphate in the row at planting.

CHEMICAL CONTROL

Foliar Fungicides

Foliar fungicides have proven to be an effective tool to manage foliar diseases in this region. They are very effective against leaf rust, stripe rust, and glume blotch. Following is a discussion of our local applied research over almost thirty years.

Foliar fungicides do not enhance yields- they can only protect potential yields from loss to the rusts or glume blotch. Consequently, they are not profitable in the absence of disease.

Our early work was focused on evaluating the performance of foliar fungicides on varieties that were highly susceptible to leaf and stripe rust. As would be expected, a fungicide application on susceptible varieties was almost always profitable when disease was present. Our most recent work concentrated on evaluating the performance of foliar fungicides on commercially planted varieties – wheat varieties with at least some level of resistance to the rusts. What we found was the results were quite different than our early work with susceptible varieties.

Over the past four years, we conducted a study on the profitability of an inexpensive foliar fungicide (tebuconazole) on four commercially planted varieties with good resistance to both leaf and stripe rust. The varieties included Syngenta Magnolia, Syngenta Coker 9553, Pioneer 25R47, and Terral LA 841.

We selected tebuconazole because it was as effective as any wheat fungicide on the market, at a fraction of the cost of the others.

The tables below compare the yield response of these four locally adapted varieties to a single application of tebuconazole. The numbers represent the bushel per acre change we observed by applying a foliar fungicide. Most of the values we observed by applying a foliar fungicide were not statistically different from the untreated checks (statistical differences are denoted by an asterisk*). The negative numbers do not indicate that we produced less grain by spraying the fungicide, but are just a reflection of random variation in the experiment. But they clearly show there was no advantage to the fungicide application in that instance.

Table 1 Number of Bushels Required to Breakeven with Tebuconazole

Year	Fungicide Cost/Acre	Application Cost	Wheat Price $/Bushel	Breakeven Bushel Increase Per Acre
2009	4.00	5.00	5.25	1.7
2010	4.00	5.00	5.25	1.7
2011	2.50	5.00	6.00	1.3
2012	2.00	5.00	6.00	1.2

Table 2 Yield Increases (Bu/A) Obtained with a Single Application of Tebuconazole

Variety	Royse City 2009	Leonard 2009	Average (All Locations)
Terral LA 841	+9.6*	+2.9	+6.3
Magnolia	-1.4	+0.8	-0.3
Pioneer 25R47	+11.0*	+0.6	+5.8
Coker 9553	+2.3	-4.5	-1.1

Table 3 **Yield Increases (Bu/A) Obtained with a Single Application of Tebuconazole**

Variety	Royse City 2010	Howe 2010	Average (All Locations)
Terral LA 841	+3.1	+2.8	+3.0
Magnolia	-2.5	+4.0	+0.8
Pioneer 25R47	+2.8	+3.7	+3.3
Coker 9553	-1.2	+4.0	+1.4

Table 4 **Yield Increases (Bu/A) Obtained by a Single Application of Tebuconazole**

Variety	Royse City 2011	Leonard 2011	Howe 2011	Average (All Locations)
Terral LA 841	+0.2	+1.9	+1.0	+1.0
Magnolia	+2.8	-2.4	+3.1	+1.2
Pioneer 25R47	-3.8	+1.3	+0.4	-0.7
Coker 9553	+1.6	+2.7	+1.5	+1.9

Table 5 **Yield Increases (Bu/A) Obtained with a Single Application of Tebuconazole**

Variety	Royse City 2012	Leonard 2012	Howe 2012	Average (All Locations)
Terral LA 841	+5.1	+4.3	+13.8*	+7.7
Magnolia	+6.2	+6.6	+19.7*	+10.8
Pioneer 25R47	+0.8	-1.8	+9.7*	+2.9
Coker 9553	+6.9	+3.8	+4.5	+5.1

Table 6 **Breakeven Bushels Per Acre at Varying Wheat and Fungicide Costs**[2]

Wheat $/Bushel	Fungicide Cost/Acre (Including Application)								
	$7.00	**$9.00**	**$11.00**	**$13.00**	**$15.00**	**$17.00**	**$19.00**	**$21.00**	**$23.00**	**$25.00**
4.00	1.8	2.3	2.8	3.3	3.8	4.3	4.8	5.3	5.8	6.3
4.50	1.6	2.0	2.4	2.9	3.3	3.8	4.2	4.7	5.1	5.6
5.00	1.4	1.8	2.2	2.6	3.0	3.4	3.8	4.2	4.6	5.0
5.50	1.3	1.6	2.0	2.4	2.7	3.1	3.5	3.8	4.2	4.5
6.00	1.2	1.5	1.8	2.2	2.5	2.8	3.2	3.5	3.8	4.2
6.50	1.1	1.4	1.7	2.0	2.3	2.6	2.9	3.2	3.5	3.8
7.00	1.0	1.3	1.6	1.9	2.1	2.4	2.7	3.0	3.3	3.5
7.50	.9	1.2	1.5	1.7	2.0	2.3	2.5	2.8	3.1	3.3
8.00	.9	1.1	1.4	1.6	1.9	2.1	2.4	2.6	2.9	3.4

Fungicide Research Summary

Return on investment by spraying tebuconazole for leaf rust in 2009, 2010, and 2011 on these four varieties was marginal at best (Tables 2, 3, and 4). Leaf rust pressure on all of these varieties was very low. The positive returns we observed on Terral LA 841 and Pioneer 25R47 in 2009 were achieved by controlling glume blotch, not leaf rust.

Leaf rust pressure was also very low in 2012. However, we did experience a damaging glume blotch infection across the region, and spraying tebuconazole provided a very good return on investment at the Howe location (Table 5).

Over the period from 2009-2011, tebuconazole did not provide a positive return on investment in 13 out of 28 observations, even though the breakeven cost of this application was just a little over a bushel per acre. With a few exceptions, this was a measure of the value of controlling leaf rust in Terral LA 841, Magnolia, Pioneer 25R47, and Coker 9553. Control of glume blotch was the reason we saw a positive return on investment with tebuconazole with these varieties in 2009 in Royse City and 2012 in Howe.

These data demonstrate the fact that a grower cannot afford to spend very much money on a foliar fungicide to spray commercial varieties with some level of rust resistance. If we had used a $16.00

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[2] Assumes a ground application cost of $5.00/acre

fungicide instead of tebuconazole from 2009-2011, the breakeven would have been 3.5 bushels per acre, and the fungicide would have only been profitable 5 out of 28 times (Table 6). Rust pressure is usually too low on these varieties to damage them, and a fungicide will not consistently provide a positive return on investment. The decision to use a fungicide on varieties resistant or moderately resistant to leaf rust should be based primarily on the threat of glume blotch.

CONCLUSIONS

The formula for success in growing wheat in Northeast Texas is quite simple. Plant several high yielding resistant varieties in a timely manner, manage for optimum yet realistic yields, and use an inexpensive foliar fungicide to protect yourself against a leaf rust race change or late season glume blotch infection.