Chapter 11

Managing Late-Season Soybean Diseases and Soybean Rust: A Southern Perspective

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Prior to the arrival of soybean rust in North America in late 2004, the use of fungicides to control late-season fungal diseases of soybean in the southern United States was variable. For example, in Alabama and Georgia, where the combined soybean acreage is less than 400,000 acres, fungicides were typically used on less than 5 percent of the acreage. Applications were usually limited to fields with high yield potential, where soybean was grown under irrigation, and/or where frogeye leaf spot was a significant production risk. In contrast, fungicide use in Louisiana and Mississippi, where combined soybean acreage exceeds 2.5 million acres, has been routine for control of a range of late-season fungal diseases.

The occurrence of soybean rust in North America has ushered in an era of heightened interest in the use of foliar fungicides to control not only soybean rust, but other late-season diseases as well. This has complicated matters because the decision to apply a fungicide to manage soybean rust may not result in optimal control of late-season diseases, and vice versa. Soybean producers need fungicide programs that are effective against soybean rust *and* other late-season fungal diseases.

Fungal diseases other than soybean rust are a common problem in soybean produced in the southern United States. If left unmanaged, these diseases can reduce both grain yield and quality. Cercospora leaf blight, frogeye leaf spot, aerial (web) blight, pod and stem blight, and anthracnose are the predominant foliar diseases affecting soybean in the South. Currently, Cercospora leaf blight is the most prevalent and destructive disease in the Mid-South. Thousands of soybean acres were abandoned in Louisiana in 2006 because of this disease. Cercospora leaf blight not only causes direct yield loss, but it also results in indirect losses associated with green stem syndrome *(i.e.*, pods and seeds mature, but stems remain green). In this situation, producers are forced to use a harvest aid (desiccant) prior to harvest.

Pod and stem diseases also frequent producer fields and can impact seed quality if conditions remain conducive for disease development. Aerial blight is limited to production areas that experience extended periods of high relative humidity and moderate temperatures. Under the right conditions, this disease can be as devastating as soybean rust. The most effective and economical method for managing diseases is genetic resistance; however, agronomically acceptable, disease-resistant soybean varieties are not generally available. Therefore, producers have managed late-season diseases using fungicides and cultural practices.

Fungicides differ both in the range and degree of disease control efficacy, and not all are effective against soybean rust and other late-season diseases. Thus, fungicide use decisions are now more complicated in light of the soybean rust threat. Historically, fungicides in the strobilurin and benzimidazole classes have been used to control late-season fungal diseases in the southern United States. Unfortunately, strobilurins, while excellent for combating late-season diseases, are not the most effective products for managing soybean rust. Moreover, thiophanate-methyl, while being moderately effective against Cercospora leaf blight and other late-season diseases, is ineffective against soybean rust.

Triazole fungicides have proved to be effective for managing soybean rust, but their efficacy against common late-season diseases of soybean in the United States is largely unknown. Thus, triazoles may result in poor control of other diseases unless applied as a mixture with a strobilurin. The current trend is to apply a mix of a strobilurin and a triazole if both soybean rust and other late-season diseases threaten production. Unfortunately, these mixtures are significantly more expensive than products applied by themselves, and under certain circumstances, obtaining acceptable control of late-season diseases may be difficult.

Other concerns are the number and timing of fungicide applications needed for managing late-season diseases on a regular basis and soybean rust, periodically. Prior to soybean rust, a single fungicide application made between R3 and R5 was the most common system used by producers. However, because soybean rust epidemics have the potential to initiate at stages earlier than R3, applications made with late-season disease control as a target may be too late to provide effective control of soybean rust. Conversely, applications made earlier to control soybean rust may result in poor control of late-season diseases because of insufficient residual activity. Thus, multiple applications may be needed if soybean rust develops before the R3 stage.

A real-world situation that illustrates these disease management complexities developed in southern Louisiana early in the 2007 season. Soybeans in this area are typically sprayed with a strobilurin *(e.g.,* Quadris) at R3 for the control of late-season pod and stem diseases. This treatment is very effective for preserving grain quality and yield. In addition, if there is a threat of Cercospora leaf blight, which generally occurs later in the season, thiophanate-methyl *(i.e.,* Topsin M) may be applied at R5. In late May 2007, soybeans were at the R2 stage of development and not showing any symptoms of soybean rust;

kudzu in the immediate area was heavily infected with rust. The question at this juncture was whether or not to spray for the control of rust, which was probably in its latent (pre-symptomatic) phase, and at the same time consider that late-season diseases would need to be controlled.

A strobilurin applied at that time would have protected plants from new rust infections for 21 to 28 days, but it would have been ineffective against existing infections. In addition, the treatment would not have sufficient residual activity to control late-season diseases. A triazole applied at R2 would have activity against existing rust infections and would provide a window of protection against new infections, but like the strobilurin, it would be ineffective against late-season diseases. Applying a strobilurin + triazole at R2 would have slightly increased the effective period for protection against new rust infections compared to triazole alone, and the triazole in the mix would have helped with existing rust infections, but the predicted lack of activity against late-season diseases (due to the early application date) and the considerably higher cost of a mix treatment, made this option unacceptable.

Finally, the risk of waiting until R3 to apply a strobilurin + triazole mixture was deemed to be too great given the explosive nature of rust and the rust-favorable conditions that existed at that time. Therefore, the decision was made to apply a triazole at R2 for soybean rust control, realizing that late-season disease control would be compromised unless a later application of Topsin-M was made.

This real-world disease management scenario illustrates severe gaps in our knowledge. We must determine if there is an extended latent period following early infection, and if so, how much residual activity can we expect from a fungicide applied at this very early stage of reproductive growth. In addition, we must determine how early various fungicides can be applied and still give acceptable control of late-season diseases. Lastly, we must conduct more studies to determine the effectiveness of properly timed applications of triazoles and strobilurin + triazole mixtures for controlling late-season pod and stem diseases.

While Southern soybean growers are accustomed to applying fungicides for the control of late-season foliar and stem diseases, the need to protect leaves from rust in the lower canopy is a new challenge with many unknowns. Adequate control of both soybean rust and late-season diseases may necessitate the use of higher volumes of water and possibly different spray boom and nozzle configurations. Aerial

application of pesticides, including fungicides, with two to five gallons of water per acre is currently very popular in the South. However, this technology needs to be thoroughly evaluated under heavy soybean rust pressure, in combination with different row spacings, to determine if current fungicide application technology is acceptable or if modifications to the system are in order.

Table 11-1. Comparisons of Chemical Classes of Fungicides with Regard to Management of Soybean Rust (SBR), Cercospora Leaf Blight (CLB), and Other Diseases.

Chemical Class	Examples	Comments
Chlorothalonil	Bravo, Echo, Equus	Extensively tested in 1970s and 1980s. Not very effective against most diseases and probably will not play a role in the Mid-South.
Strobilurins (QoI)	Azoxystrobin (Quadris)	This is a core fungicide for Mid-South producers. Efficacious against aerial blight, anthracnose, and pod and stem blight; suppresses Cercospora leaf blight and frogeye; not very effective against soybean rust. Will not be recommended as a stand-alone product for soybean rust, but it does have a place as a tank mix with a triazole.
	Pyraclostrobin (Headline)	Similar to Quadris in its activity against diseases other than soybean rust, although it is more efficacious against CLB. However, it is very effective against soybean rust when applied prior to infection. It probably will not be recommended as a stand-alone material, but it is a core fungicide in the Mid-South when tank mixed with a triazole.
Triazoles	Cyproconazole (Alto) Flusilazole (Punch) Flutriafol (TopGuard) Metconazole (Caramba) Myclobutanil (Laredo) Tebuconazole (Folicur and others) Tetraconazole (Domark)	In general, these materials are very effective against soybean rust, but there are limited data with regard to control of Cercospora leaf blight, aerial blight, frogeye leaf spot, and pod and stem diseases. More research is needed on this class of fungicides with regard to timing, rates, concentrations, and combinations with other fungicide classes.
	Propiconazole (Tilt and others)	Not as effective as the other triazoles against soybean rust.
Triazoles + QoI Fungicides	Cyproconazole + azoxystrobin (Quadris Xtra) Flusilazole + famoxadone (Charisma) Metconazole + pyraclostrobin (Headline Caramba copack)	In general, these materials offer the best option for managing soybean rust and other foliar and pod and stem diseases in the South. Additional research is needed on application timing and rates with regard to managing soybean rust as compared to other diseases.
	Propiconazole + trifloxystrobin (Stratego) Propiconazole + azoxystrobin (Quilt)	These materials are not as effective as the other combination products against soybean rust, but they may have a place for managing other diseases.
	Tebuconazole + trifloxystrobin (Absolute)	There is not enough information on this material to substantiate recommendations.

Table 11.2. Estimation of Effectiveness of Fungicides on Rust and Other Diseases of Soybeans. Rust Ratings Are Based Upon Limited Testing During 2006 and 2007 and Are Subject to Change.

Active Ingredient	Trade Names	Soybean Rust	Frogeye Leaf Spot	Cercospora Leaf Blight
chlorothalonil	Echo, Bravo, Equus	P	G	F
azoxystrobin	Quadris	F	G	F
pyraclostrobin	Headline	G/F	G	F
cyproconazole	Alto	G	P	F
flutriafol	Topguard	G	F	F
metconazole	Caramba	G	P	F
myclobutanil	Laredo	G	P	P
propiconazole	Tilt, PropiMax, Bumper	G	P	P
tebuconazole	Folicur, Orius, Uppercut	G	P	P
tetraconazole	Domark	G	F	F
trifloxistrobin	Absolute	G	G/F	P
flusiazole	Punch	G	P	P
prothiconazole	Proline	G	P	P
flusizole	Charisma	G	P	P
Thiophanate methyl	Topsin M	P	G	F

P = Poor; little to no activity.
F = Fair; some activity but does not provide complete control.
G = Good; good activity, timing of fungicide application is critical for success.

Note: These ratings are based upon one or two applications. Trials were conducted in southern states — Dr. Mel Newman, University of Tennessee; Dr. Raymond Schneider, Louisiana State University-Ag Center; Dr. Boyd Padgett, Louisiana State University. Cooperative Extension publications in each state should be consulted for specific recommendations. Reference to commercial products or trade names is made with the understanding that no discrimination is intended for those products that may not be listed and no endorsement of particular products is implied.