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Plant Pathology Fact Sheet

Soybean Foliar Spots and Blights

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Soybean foliage is susceptible to a number of fungal and bacterial pathogens. These pathogens cause leaf spots and blights and are generally common in Kentucky; however, few fields in any given year are seriously damaged by foliar diseases. Crop rotation and weather that is unfavorable to disease typically keeps foliar diseases at low levels. Occasionally an extended period of wet and humid weather in July to early August will result in significant amounts of foliar disease and yields may be seriously affected. However, this scenario is relatively uncommon in Kentucky.

Please do not assume that the overall lack of foliar spots and blights also means that seed quality problems related to fungi are also uncommon. Just the opposite is true. Seed quality problems are not the rule, but they are fairly common when soybean matures during wet, warm weather. Reduced seed quality due to fungal infections is most common in early-maturing varieties or in all varieties harvested late.

The following foliar diseases are most frequently encountered in Kentucky.

Brown Spot

Brown spot is caused by the fungus *Septoria glycines* and is present to some extent in every field, every year. The fungus survives primarily on infested soybean residue from previous crops and on seed. Symptoms of brown spot include dark brown, angular spots ranging in size from minute specks to ¼-inch diameter. It is common for adjacent lesions to grow together and form large, irregular-shaped leaf blotches. The causal fungus induces plants to produce ethylene, a common plant defense mechanism. As a result, in infected leaves rapidly turn yellow and drop from plants.

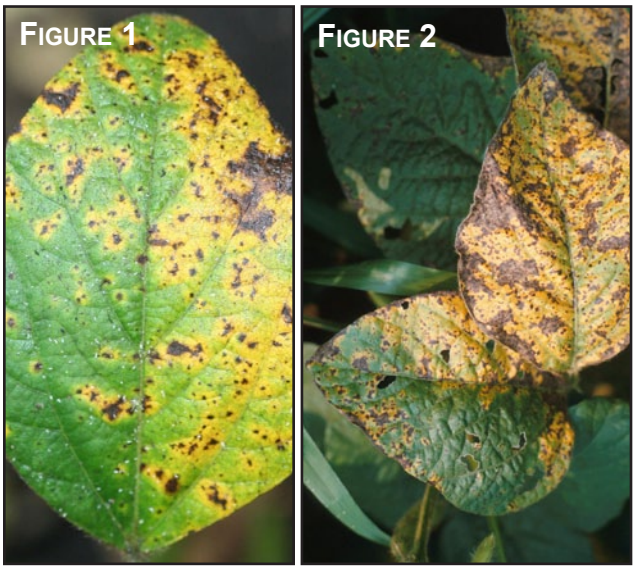

Figure 1. Brown spot develops initially on unifoliate leaves. **Figure 2**. Brown spot may later become re-established on mature leaves. (Photos: DE Hershman, UK)

Brown spot is extremely common on seed leaves (unifoliolate leaves) of very young crops and during the first month following planting (FIGURE 1). In most years this will be the extent of the brown spot problem and no permanent damage will be done. However, in years where August is wetter than average, or in fields subject to extended dew periods and/or fogs, symptoms may become re-established on mature foliage (FIGURE 2) during pod fill and yields can be substantially reduced as a result of premature defoliation.

DISEASE MANAGEMENT

- No varieties are resistant to brown spot.
- Crop rotation for a year or two away from soybean may help moderate disease. However, the spores of the fungus are widespread and wind-borne so significant infection is likely to occur regardless of cropping history or production practices during wet seasons.
- Numerous foliar fungicides are available for the control of brown spot, but applications need to be made before symptom development is extensive. Generally, a single application made at the R3 (beginning pod) stage will result in acceptable control of late-season brown spot.

CERCOSPORA LEAF BLIGHT

Cercospora leaf blight (CLB) is caused by the fungus, *Cercospora kikuchii*. In Kentucky, CLB usually becomes evident in mid- to late August in the upper canopy. Affected leaves develop a bronzing/purpling discoloration (FIGURE 3), which is the plant's response to the toxin, cercosporin. Cercosporin is produced by the fungus in a multitude of very small reddish-maroon, irregular spots that are pinpoint to 1-cm in diameter (FIGURE 4). Symptoms can form on all aboveground plant parts, but are most common on leaves. Spots coalesce over time and blight foliage, causing premature defoliation. CLB is most extensive in wet seasons, especially when harvest is delayed.

C. kikuchii also causes a purple seed stain symptom (FIGURE 5). This phase of the *C. kikuchii* infection causes a pink to purple blotching of the seed coat. Purple seed stain does not adversely affect yield, but seed quality can be reduced. In addition, some markets will not accept seed lots with visually significant purple seed stain.

DISEASE MANAGEMENT

- Few varieties are available with known resistance to *C. kikuchii*. However, based on random observations where severe CLB occurred in variety test plot locations, it appears that many commercially available varieties

FIGURE 3. CERCOSPORA LEAF BLIGHT RESULTS IN A BRONZING DISCOLORATION OF FOLIAGE. (PHOTO: XB YANG, IOWA STATE) **FIGURE 4**. LEAF SPOTTING DUE TO CERCOSPORA LEAF BLIGHT. (PHOTO: DE HERSHMAN, UK) **FIGURE 5**. THE CERCOSPORA LEAF BLIGHT FUNGUS ALSO CAUSES PURPLE SEED STAIN, WHICH REDUCES SEED QUALITY. (Photo: Clemson University-USDA CES, Bugwood.org)

possess some degree of CLB resistance. It is rare for breeders to work specifically with this disease, so it is likely that most existing resistance to *C. kikuchii*, especially in maturity group III and IV soybeans, has been introduced into the soybean gene pool inadvertently during plant breeding activities.

- Crop production practices do not have a great deal of impact on the development of CLB because of the widespread occurrence of spores of the fungus.
- Fungicidal control of CLB is hampered by the lack of highly effective products. Still, in a wet year, applying a fungicide at the R3 growth stage and, perhaps, at the R5 (beginning seed) stage may provide economical results if crop prices are high.

FIGURE 6. DOWNY MILDEW SPOTS ARE PALE YELLOW ON THE UPPER LEAF SURFACE (Photo: Daren Mueller, Iowa State, Bugwood.org)

DOWNY MILDEW

Downy mildew is an extremely common fungal disease, but it is almost never causes yield losses in Kentucky. Affected leaves will show small, diffuse pale-yellow spots on the upper leaf surface (FIGURE 6) from mid-season on. When these spots are examined on the lower leaf surface, an off-white to light gray downy growth is evident.

DISEASE MANAGEMENT

- No control measures are needed or recommended.

FROGEYE LEAF SPOT

Frogeye leaf spot (FLS) is caused by the fungus, *Cercospora sojina*. The primary symptom of the disease is spots 1 to 5 mm in diameter with ash-gray centers and maroon borders (FIGURE 7). Over time, the centers of spots may fall away due to weathering processes, leaving a "shot hole" effect (FIGURE 8). FLS is prevalent in wet years when it can cause serious yield losses. Seriously diseased fields can occur throughout west and central Kentucky, but this is a rare event. Because of the ability of soybean to compensate for foliar damage, frogeye leaf spot levels must be very high (e.g., 20% to 40% leaf surface area diseased) prior to pod fill for significant yield loss to occur. Soybean leaves are mainly susceptible to infection by the FLS fungus as the leaf tissue is expanding, or as leaves begin to senesce in late summer/early fall.

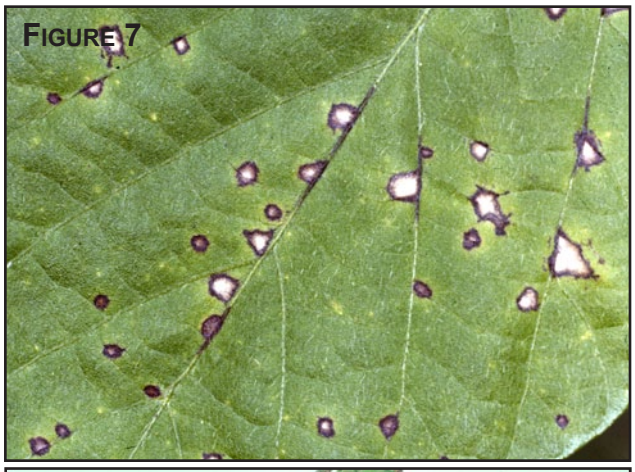

FIGURE 7. ASH GRAY SPOTS WITH MAROON BORDERS ARE TYPICAL OF FROGEYE LEAF SPOT (Photo: Clemson University-USDA CES, Bugwood.org) **FIGURE 8**. FROGEYE LEAF SPOT CENTERS FALL AWAY DUE TO WEATHERING PROCESSES. (Photo: DE Hershman, UK)

Disease Management

- Unless a particular farm has a history of extensive FLS, it is not generally recommended that FLS-resistant soybean varieties be sought out and planted in Kentucky. This is because *Cercospora sojina* exists as a number of different races and these races determine the success or failure of specific soybean varieties that resist FLS.
- FLS responds very well to fungicide applications applied at the R3 growth stage, but strobilurin-resistant strains of *C. sojina* have been reported in Kentucky since 2010. A survey of 85 isolates collected from west and central Kentucky during 2011/2012 revealed that strobilurin-resistant isolates of *C. sojina* comprised more than 50% of the fungal isolates collected. Thus, if it is ever deemed appropriate to spray a crop for FLS control, it would be best to use one of the available triazole fungicide products or a combination pre-mix fungicide that includes a triazole and a strobilurin. The main goal is to avoid applying a solo strobilurin product (e.g., Aftershock®, Aproach®, Evito®, Headline®, Quadris®) since these products will have reduced efficacy if a strobilurin-resistant strain of *C. sojina* is present.

Figure 9. Small irregular necrotic spots with a yellow halo develop after intection by the bacterial blight pathogen. (Photo: DE Hershman, UK)

Bacterial Blight

Bacterial blight is a foliar disease caused by the bacterium *Pseudomonas syringae* pv. *glycinea*. Bacterial blight usually shows up in Kentucky following humid, rainy periods in late July and August. Small, irregular-shaped brown lesions with yellow halos appear a day or two after a hard rainstorm (Figure 9). Unlike fungal pathogens that enter leaves directly during the infection process, the bacterial blight pathogen cannot infect soybean leaves directly. Rather, bacteria can only enter plant tissues via wounds or natural openings.

Disease management

- Control measures are not necessary.

Soybean Rust

Soybean rust (SBR) is a potentially devastating disease of soybean that can result in 80% or more yield loss when disease pressure is high and the disease inadequately controlled (Figure 9). SBR was first found in Kentucky in late 2005, but the disease has yet to cause any yield damage in Kentucky or anywhere outside of the deep South. Nonetheless, it is just a matter of time until the proper requirements are met for significant disease development during the critical grain fill period in the Soybean Belt (including Kentucky).

Figure 10. Soybean rust has the potential to cause large scale yield losses. (Photo: Joe Omielan, UK)

SBR can infect all aboveground plant parts, but it is primarily a foliar disease. The causal fungus, *Phakopsora pachyrhizi,* can infect seedlings, but is more commonly first detected in the lower and middle crop canopy during the reproductive stages. Clusters of very small

FIGURE 11. SMALL LESIONS WITH CLUSTERS OF FUNGAL PUSTULES ARE TYPICAL OF SOYBEAN RUST. (Photo: Daren Mueller, Iowa State, Bugwood.org) **FIGURE 12**. AS SEEN UNDER THE MICROSCOPE, MASSES OF SPORES ARE PRODUCED IN SOYBEAN RUST LESIONS (Photo: JT Yorinori)

raised pustules form in small lesions with irregular margins, primarily on the undersides of fully expanded leaves (FIGURE 11). Early on, pustules are very difficult to confirm under field conditions, even using a 30X hand lens. Young lesions and pustules are easily confused with early symptoms of several diseases, including brown spot and downy mildew. However, under moist conditions, pustules produce masses of spores (FIGURE 12) which greatly aid in disease identification. Many lesions with pustules will eventually cause leaves to die prematurely and drop off the plant. Yield loss is the result of both lesion formation and premature defoliation.

Phakopsora pachyrhizi overwinters in kudzu along the Gulf Coast where it eventually moves into adjacent soybean fields. The disease then moves north over time, but the timing and extent of movement is greatly dependent on weather conditions. Specifically, disease is favored by wet weather and moderate temperatures. Very long-distance movement of viable spores usually only occurs within mid-latitude or tropical weather systems covering hundreds or even thousands of miles over a short period of time. Disease progress is temporarily halted when temperatures are above 90° F.

DISEASE MANAGEMENT

- Should SBR control ever become necessary, there are numerous fungicides that provide excellent control of the disease. However, application MUST be made before significant infection has occurred.
- A yield loss prediction tool is available that can help growers determine if spraying for SBR will be economical.
- Visit the UK Soybean Rust Yield Loss Prediction Tool Web site for more information. SBR development in the United States and risk information can be obtained by visiting the national ipmPIPE Soybean Rust Web site.

OTHER DISEASES

There are a great number of other disease organisms and diseases that manifest symptoms on soybean foliage that are not discussed here. For example, many root and stem diseases ultimately cause foliar symptoms to be expressed, but the pathogens that cause those diseases do not infect foliage directly. Rather, symptoms are usually the result of imbalances in nutrients and water in foliage. Soybean cyst nematode and stem canker are examples. In the case of soybean sudden death syndrome, foliar symptoms are the result of one or more foliar toxins that are produced by the causal fungus as it grows in diseased root tissue.

Virus diseases, such as soybean mosaic and bean pod mottle, reproduce systemically and, thus, can readily be found throughout infected foliage with the aid of an electron microscope. The principal symptoms of virus diseases are expressed in crop foliage.

ADDITIONAL RESOURCES

- Assessing Foliar Diseases of Corn, Soybeans, and Wheat —Principles and Practices, PPFS-MISC-06 (2011) http://www.ca.uky.edu/agcollege/plantpathology/ext_files/PPFShtml/PPFS-MISC-6.pdf

- Australasian Soybean Rust: An Exotic Pest Threat, PPFS-AG-S-21
http://www.ca.uky.edu/agcollege/plantpathology/ext_files/PPFShtml/ppfsags21.pdf
- Brown Spot of Soybean, PPFS-AG-S-01
http://www.ca.uky.edu/agcollege/plantpathology/ext_files/PPFShtml/ppfsags1.pdf
- Cercospora Leaf Blight in Kentucky, PPFS-AG-S-20
http://www.ca.uky.edu/agcollege/plantpathology/ext_files/PPFShtml/ppfsags20.pdf
- Downy Mildew of Soybean, PPFS-AG-S-03
http://www.ca.uky.edu/agcollege/plantpathology/ext_files/PPFShtml/ppfsags3.pdf
- Foliar Fungicide Use in Corn and Soybeans, PPFS-MISC-05
http://www.ca.uky.edu/agcollege/plantpathology/ext_files/PPFShtml/PPFS-MISC-5.pdf
- Kentucky Integrated Crop Management Manual for Field Crops: Soybeans, IPM-3
http://www.uky.edu/Ag/IPM/manuals/ipm3soy.pdf
- Soybean Diseases Control Series: Are We Missing Opportunities? PART 4: Foliar Diseases Caused by Bacteria and Fungi. PPFS-AG-S-16
http://www.ca.uky.edu/agcollege/plantpathology/ext_files/PPFShtml/ppfsags16.pdf
- Soybean Diseases Control Series: Are We Missing Opportunities? PART 5: Virus Diseases of Soybean, PPFS-AG-S-17
http://www.ca.uky.edu/agcollege/plantpathology/ext_files/PPFShtml/ppfsags17.pdf
- Soybean Rust (ipmPIPE)
http://sbr.ipmpipe.org/cgi-bin/sbr/public.cgi
- Soybean Rust Yield Loss Prediction Tool (University of Kentucky)
http://dept.ca.uky.edu/sbrtool/

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