

# DISEASES OF SOYBEAN

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## Frogeye Leaf Spot

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**F**rogeye leaf spot is an important foliar disease in hot, humid regions of the United States. It has been a problem in southern states for several years. Typically, the disease occurs sporadically in Indiana and other central states, but its prevalence and severity have increased markedly in these areas in the last five years. In Indiana, frogeye leaf spot is encountered more often in the south, but can occur farther north when weather is favorable for disease development.

### Symptoms

Infection can occur at any stage of soybean development, but most often occurs after flowering. The most common initial symptoms are small, yellow spots on the leaves. These spots eventually enlarge to a diameter of about  $\frac{1}{4}$  inch. The centers of these lesions become gray to brown and have reddish purple margins (Figure 1). These leaf spots are diagnostic symptoms but are often mistaken for herbicide drift or other leaf diseases. When infections are numerous, spots coalesce to create irregular patterns.

Although less frequent, lesions also develop on stems and pods. These lesions are less diagnostic than leaf lesions. Stem lesions are somewhat red when young, and darken with age (Figure 2). They lack the characteristic tan center and reddish purple border of leaf lesions. Pod lesions are circular or oblong, reddish-brown, and slightly sunken (Figure 3). Under humid conditions, lesions on any part of the plant may develop dark centers when the fungus is producing spores. The fungus that causes the disease may grow through the pod walls and invade seed. Infected



Figure 1. Leaf symptoms of frogeye leaf spot.



Figure 2. Soybean stem lesions caused by the frogeye leaf spot pathogen.



Figure 3. Soybean pod lesions caused by the frogeye leaf spot pathogen.



**Figure 4.** Seed damaged by frogeye leaf spot and other pathogens.

seeds may show a range of symptoms (Figure 4). They may have no symptoms, or they may appear dark, shriveled, and may have a cracked seed coat.

### Causal Agent

*Cercospora sojina* causes frogeye leaf spot. This fungus produces long, narrow spores that arise in clusters from dark cushions at the centers of lesions during warm, humid weather. When inspecting lesions with a good hand lens, it is possible to see black dots with masses of long, silvery spores in a lesion's center. A related fungus, *Cercospora kikuchii*, causes Cercospora leaf spot and purple seed stain, but its spores are much longer than those of *Cercospora sojina*.

### Disease Cycle

*Cercospora sojina* survives in infected seed and plant debris from an infected crop. Infected seed may germinate poorly, and plants that do emerge from infected seed are often stunted and may have lesions on the cotyledons. These lesions produce spores that can be inoculum for leaf infections.

The fungus can also produce spores on the residue of a previous soybean crop. Although most soybean is grown in rotation with corn (meaning there is little soybean residue in newly planted soybean fields), enough soybean residue can remain to supply spores to begin an epidemic.

Wind readily transports the spores of *Cercospora sojina* (whether these have been produced on residue or new lesions) from one field to another.

Spore production and infection requires warm, humid weather. Leaves are most susceptible to infection when they are just emerging and become less susceptible

as they mature. This range of susceptibility can lead to a layered occurrence of disease in the plant canopy, depending on how conducive conditions were as each leaf layer emerged.

Frogeye leaf spot is a polycyclic disease, meaning that the number of lesions on the plant will continue to increase as long as the weather is favorable for infection. The greater the number of lesions, the greater the reduction of green leaf area, and the greater the reduction in yield. If favorable conditions for infection persist until late in the season, the fungus will infect pods and seeds.

### Management

Frogeye leaf spot can cause significant yield losses. Management practices are aimed at reducing the amount of inoculum available for infection in the field and protecting plants from infection.

#### Planting

Plant clean, pathogen-free seed. The relative contribution of primary inoculum (the spores that initiate disease in the crop) in infected seed versus crop residue is not known. It is believed that residue may be a more significant source of inoculum than infected seed, but infected seed may establish the fungus in new areas.

#### Tillage

Burying infected soybean residue will help reduce the inoculum in a field. Many growers use fairly clean tillage prior to planting corn, which destroys and buries soybean residue in the soybean-corn rotation, which may explain why frogeye leaf spot has not been a serious problem in Indiana for many years. However, severe frogeye leaf spot outbreaks in several Indiana areas in 2005 indicate that the disease is capable of establishing itself here under current tillage practices.

#### Rotation

Rotating out of infected soybean for at least two years will help reduce the frogeye leaf spot risk.

#### Resistant Varieties

Several different genes for frogeye leaf spot resistance have been discovered and described in soybean. Because the disease is a more chronic problem in the southern United States, resistance is more commonly available in varieties of maturity group V and higher. Resistance is available in some, perhaps many, varieties adapted to Indiana. However, some varieties were clearly very susceptible to frogeye leaf spot during 2005.

*Rcs1*, *Rcs2*, and *Rcs3* are three named genes for frogeye leaf spot resistance, and additional sources of resistance have been reported. There are several races of the pathogen, which are distinguished by their

ability to infect soybean varieties with different genes for resistance. A soybean variety with one particular gene for resistance will be resistant to some races of the pathogen, but not others. Apparently, the *Rcs3* gene confers resistance to all races that occur in Indiana, but the information about the races here is very limited.

### **Chemical Control**

Fungicide seed treatments can reduce the risk of infection. Spray applications of fungicides after growth stage R1 can reduce disease severity. But applications made at stage R3 are considered most effective in southern states.

Frogeye leaf spot has caused only limited problems in Indiana in recent years. But with the arrival of Asian soybean rust and the increased awareness of leaf diseases in soybean, frogeye leaf spot will probably be given more attention than in the past.

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*Figure 4 courtesy of Gail Ruhl. All other photos by the authors.*

