

## Frogeye Leaf Spot of Soybean

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Frogeye leaf spot (also called *Cercospora* leaf spot) is a fungal disease that develops on soybean worldwide. This disease can cause over 40% yield loss when the weather conditions are conducive and when the planted soybean variety is susceptible. Frogeye leaf spot is usually a minor disease in South Dakota, but in the recent years, this disease has reached yield-reducing levels in few fields (Figure 1).



Figure 1. A soybean field with severe frogeye leaf spot. Heavy infestation can lead to premature leaf defoliation and hence significant yield loss.

### Symptoms

Frogeye leaf spot symptoms start to develop on upper leaves usually after soybean flowering. Lesions start as dark water-soaked spots that develop into circular to angular brownish spots 1-5 mm in diameter. Mature lesions are surrounded by narrow reddish-brown margins (Figure 2). Later, the central portion of the lesions turn to ash gray – light brown. Lesions may coalesce to form larger spots and continued disease development will lead to premature leaf fall. Older soybean leaves are less susceptible. Frogeye leaf spot symptoms can also develop on pods and stems. On stems, lesions are elongated and appear

sunken. Lesions on pods are sunken reddish brown circular to elongate spots (Figure 3). Pod infections may lead to seed infections (Figure 4). Infected seeds are discolored but seeds can also be infected without showing any symptoms.



Figure 2. A soybean leaf with frogeye leaf spot symptoms. Mature lesions have ash-gray color in the center surrounded by a dark brown margin. Young lesions are dark brown without distinct margins.



Figure 3. Frogeye leaf spot symptoms on the pods.



Figure 4. Frog-eye leaf spot symptoms on a soybean pod. Notice the discolored portion of the seed due to frog-eye leaf spot pathogen infection.

Frog-eye leaf spot symptoms can be confused with post emergence herbicide injury especially the protoporphyrinogen oxidase (PPO) and Paraquat herbicides. Herbicide injured leaves are usually the lower leaves while newer top leaves will not have herbicide injury. Paraquat injury will also affect other plant species in the same field such as weeds and may have a drift gradient from the field edge. Frog-eye leaf spot symptoms appear on the top canopy and will not develop on weeds in the same field.

### Causal organism and disease cycle

Frog-eye leaf spot is caused by a fungus called *Cercospora sojina*. This fungus survives as mycelia in infested soybean residue. The fungus can also survive on infected seed but the main source of inoculum is infested residue. Under persistent warm and humid weather (frequent rains with overcast weather after soybean flowering), the fungus produces spores that are rain splashed or carried by wind to short distances onto the young soybean leaves (Figure 5).

### Management

For fields with a history of frog-eye leaf spot, proactive management practices need to be implemented to reduce the risk for this disease to develop. While in-season management option of applying a well-timed fungicide can be effective, fungicide resistance for the frog-eye leaf spot fungus has been reported in South Dakota. Therefore, pre-planting management is important to manage frog-eye leaf spot.

**Plant clean certified seed.** The frog-eye leaf spot fungus can survive on seed, though this source of inoculum is not considered important. However, to avoid chances of introducing the pathogen to the field, use disease free seed.

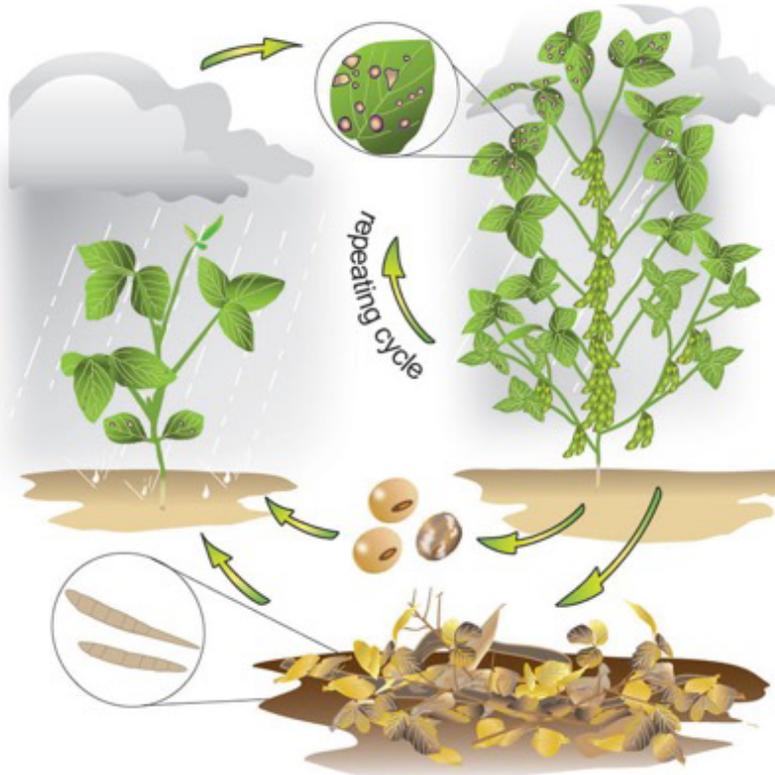


Figure 5. Disease cycle of frog-eye leaf spot (courtesy of Iowa State University Extension)

**Plant resistant varieties.** Seed catalogues do provide resistance levels for soybean cultivars. Select cultivars with high rating for disease tolerance. The frogeye leaf spot fungus is highly variable, therefore some cultivars marketed as resistant or tolerant may still develop some symptoms when the pathogen race changes.

**Practice crop rotation and tillage.** Crop rotation helps break the disease cycle. The frogeye leaf spot fungus can survive on soybean residue for more than two years. Therefore, fields with a history of this disease should have longer rotations for the soybean residue to breakdown. Tillage reduces the amount of infested soybean residue on the soil surface and also encourages faster residue breakdown. However, this practice should be weighed against soil and moisture conservation.

**Apply a well-timed foliar fungicide.** The best timing for a foliar fungicide against frogeye leaf spot is between R3 (beginning pod) to R5 (full pod) since this disease tends to be a mid-to late season disease. Most fungicides are rated “very good” for frogeye leaf spot management. A list of fungicides effective against frogeye leaf spot is published annually by the North Central Soybean Disease Working group and can be found on this link - <https://cropprotectionnetwork.org/resources/publications/fungicide-efficacy-for-control-of-soybean-foliar-diseases>. Consider the field history, susceptibility of the cultivar planted, level of disease starting to develop, and forecasted weather conditions at full bloom to aid decisions for the need for a fungicide to manage frogeye leaf spot.

## **A caution about fungicide resistance.**

Frogeye leaf spot fungal isolates resistant to fungicides with the quinone-outside inhibiting mode of action (QoIs/strobilurins) were confirmed in South Dakota in 2018. This does not mean that every soybean field in the state has fungicide resistant isolates but it does indicate that there is a risk for resistance to develop across the state. Resistance to QoI fungicides has been reported also in neighboring states (e.g. Iowa). Steps that can be taken to avoid or delay fungicide resistance from developing include

- Rotating fungicide modes of action
- Using pre-mixed modes of action fungicides
- Applying a fungicide when it is warranted
- Avoiding applying a fungicide when it is too late (when severe symptoms have already developed)

To determine if a field may have fungicide resistance, scout two weeks after the fungicide application and assess the level of disease development. Continued disease development after a fungicide application may indicate fungicide resistance once other factors that affect fungicide efficacy (such as blocked nozzles, under rate application, low coverage) have been ruled out. Fungicide resistance can only be confirmed through a lab test. Samples from fields suspected to have fungicide resistance should be sent to the SDSU Plant Disease Diagnostic Clinic (Plant Science Building RM 153, Jackrabbit Dr, Brookings SD 57007) for confirmation.