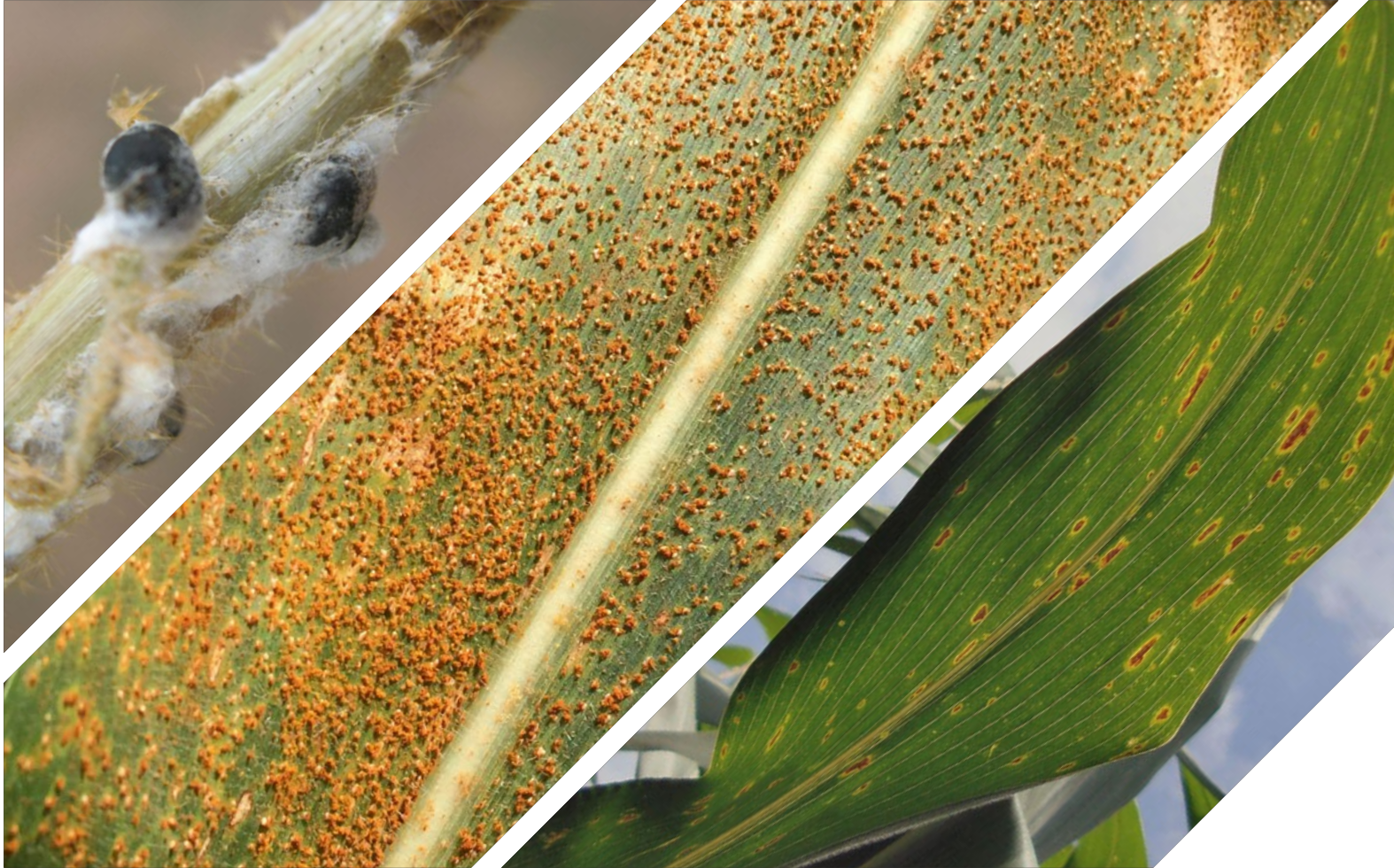


Corn & Soybean Disease ID Guide



Disease ID Guide

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Corn



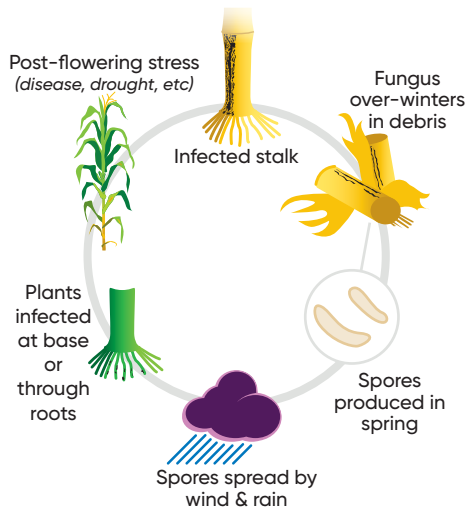
Anthracnose leaf blight

Anthracnose is a fungal disease that infects corn, grain sorghum and small grains.

Anthracnose has both a leaf and a stalk phase in corn. The infection can spread from leaves to stalk, or the stalk may be infected through the roots or base of the plant.

Timing

Anthracnose leaf blight is common early in the season in fields where diseased crop residue was left on the soil. Infection develops when disease spores are splashed onto seedling plants by rain.



Management tips

- Plant well-adapted, disease/stress resistant hybrids
- Practice balanced soil fertility
- Reduce crop stress through proper plant populations, irrigation, soil management and foliar disease and weed control
- Control insects
- Manage corn residue
- Scout fields prior to crop maturity and harvest fields based on crop condition

Impact on yield

Careful scouting and harvesting fields according to crop conditions can help prevent field losses due to stalk rot. Corn loss potential should be weighed just as heavily as grain moisture in deciding which fields to harvest first. Scouting fields approximately two to three weeks prior to the expected harvest date can identify fields with weak stalks predisposed to lodging. Fields with high lodging potential should be slated for early harvest.

Symptoms

Upon infection, small round to irregular water-soaked spots appear and later turn yellow and then brown with reddish-brown borders. The leaf spots may enlarge to one-half inch long and coalesce (join together). In severe cases, the leaf tips or entire leaves may turn yellow.



Anthracnose. (left) - Note black “specks” in center of lesion on seedling leaf (magnified). (right) - Lesions coalesced on mature leaf.

Though anthracnose is common in seedlings, plants appear to resist the leaf blight phase during vigorous vegetative development. However, during the ear-fill stage, plants often become susceptible to the top dieback and/or stalk phase of the disease.

Conditions for development

The pathogen overwinters in diseased leaves and stalks and produces spores when the weather warms in the spring. Spores are spread by wind and rain; infection is favored by warm temperatures (70-80°F) and high humidity.

Common Rust

Common rust is a fungal disease caused by *Puccinia sorghi* pathogen that spreads by windblown spores from southern corn growing areas. It is less likely than southern rust to cause significant yield loss to hybrid corn.

Timing

Common rust typically progresses as corn matures in late summer if conditions are persistently wet and cool.

Management tips

Plan to scout corn to detect common rust early. Monitor disease development, crop growth stage and weather forecast. Disease is wind-borne and does not overwinter in U.S.; therefore, rotation and tillage are not effective.

Apply a foliar fungicide if:

- Rust is spreading rapidly or likely to spread and yield may be affected
- Disease exceeds threshold established by your state extension plant pathologist

	Common Rust	Southern Rust
Ideal Environment	Cool to warm & moist: 60 - 77° F	Warm to hot & moist: 77°+ F
Appearance of Pustules	Large, circular to elongated	Small circular, pinhead appearance
Pustule (spore) Color	Brown to cinnamon brown	Reddish orange
Location of Pustules	Upper & lower leaf surfaces. Infects leaves only.	Upper leaf surface. May also infect husks.

Impact on yield

Yield losses may result from poorly filled kernels and lodging-induced harvest losses. Significant damage to upper leaves early in the life of the hybrid results in higher yield losses. If damage is confined to lower leaves or occurs after corn is well-dented, yield losses are lower.



Symptoms

Lesions begin as flecks on leaves that develop into small tan spots. Spots turn into elongated brick-red to cinnamon-brown pustules with jagged appearance. Symptoms of Common Rust are found on both upper AND lower leaf surfaces (unlike Southern rust). Occurs on leaf only, NOT on sheaths, stalks, ear shanks and husk leaves.

Conditions for development

Favored by moist, cool conditions (temps in the 60s and 70s). Conversely, hot, dry conditions typically slow or stop development.

Eyespot

Eyespot is a residue-borne, fungal disease that occasionally reaches severity levels that can cause yield loss in susceptible hybrids. It is most common across the northern areas of the Midwest.

Timing

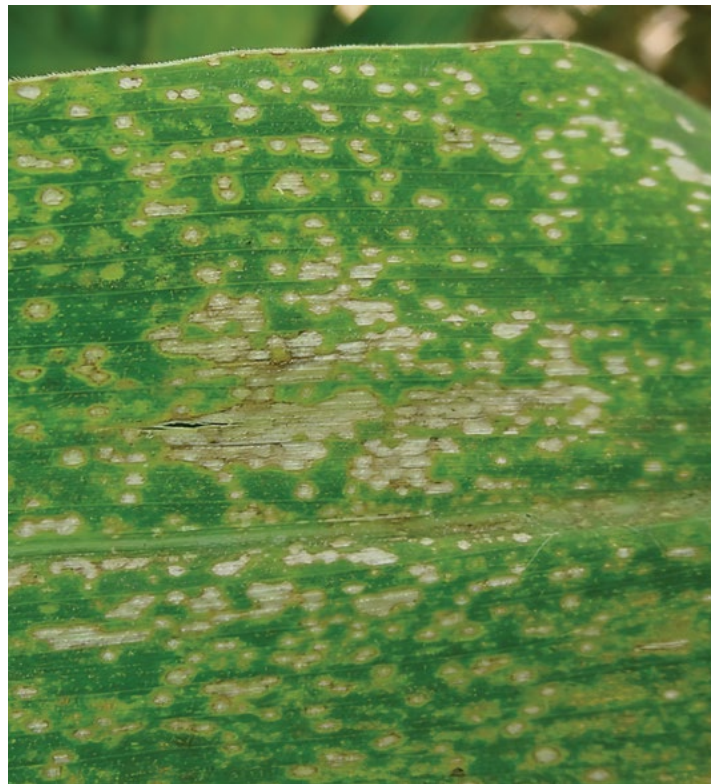
The fungus overwinters and survives between corn crops on residue left on the soil surface. In the spring, the fungus produces spores that are carried to the new corn crop. The fungus may also be seed-borne, but this source of fungal inoculum is insignificant when compared to the number of spores produced on infested crop residues.

Management tips

Plant corn hybrids that have some resistance to eyespot. Crop rotation and clean plow down of corn residues will help reduce the amount of surviving fungus and limit early season disease spread.

Impact on yield

High disease levels that can result in yield loss usually occur in seed production fields, under no-till conditions, and when corn is planted sequentially for two or more years.



Symptoms

Affected leaves are covered with numerous small round spots. Spots are about 1/8 inch in diameter, oval to circular and initially appear water soaked. The central area of the spot soon dies, leaving a tan center surrounded by a distinct brown to purple border. The border is frequently encircled by a yellow halo.

Conditions for development

Eyespot is favored by long periods of cool, wet weather during the growing season and is more of a problem in the northern regions of the Corn Belt

Gray leaf spot

Gray leaf spot is an annual threat in cornfields from the Midwest to the Atlantic Coast that has been developing into new areas in recent years. All corn hybrids in this region, regardless of type, have some susceptibility.

In addition to geography, there are many factors that contribute to the risk of gray leaf spot damage in corn. Climate, moisture, cropping system, weed pressure, timing and tillage practices are other considerations to take into account when assessing fields for disease risk.

Timing

Late-planted corn is exposed to disease at vulnerable early growth stages and can suffer higher levels of infection. Significant yield loss can occur if leaf area is destroyed before grain fill is complete. Early infection also allows more time for secondary outbreaks, disease spread and leaf damage — resulting in even greater yield losses.

Management tips

In its early stages, gray leaf spot symptoms may be confused with other foliar fungal diseases, including anthracnose leaf blight, eyespot and common rust. To verify, hold a leaf up to the light and look for a yellow halo around pinpoint lesions.

Hybrids with partial gray leaf spot resistance may restrict lesion growth, displaying small lesions with round or jagged shapes instead of the long, rectangular lesions on more susceptible hybrids.

Impact on yield

The disease appears in cornfields most growing seasons without significant effect on yield. If conditions favoring the disease are especially persistent, then yield losses in excess of 50% can occur if left untreated.



Symptoms

Long, thin, rectangular lesions, up to 2 inches in length, appear on leaves. The lesions start out tan and usually turn gray.

Conditions for development

Warm temperatures and high humidity create an optimal environment for gray leaf spot. Periods of fog can trap moisture in the canopy, sparking an outbreak. Heavy wind and rain aid spread of disease from soil to and among developing plants.

Infection requires leaf surfaces to be wet for 11 to 13 hours and relative humidity in the leaf canopy to be at least 90 percent for 12 to 13 consecutive hours.

Gray leaf spot fungus overwinters in corn residues, making the threat of infection greater with continuous corn.

Weeds block air movement through the canopy, holding humidity and preventing leaf surfaces from drying, which increases disease risk.

Northern corn leaf blight

Northern corn leaf blight is an annual threat in cornfields from the Midwest to the Atlantic Coast, wherever environmental conditions are met. It spreads quickly from south to north, riding hurricane winds to infect new areas.

Many factors contribute to the risk of northern corn leaf blight damage. Climate, moisture, cropping system, timing, tillage practices and soil content should be taken into account when assessing fields for disease risk.

Timing

Late-planted corn is exposed to disease at vulnerable early growth stages and can suffer higher levels of infection. Significant yield loss can occur if leaf area is destroyed before grain fill is complete. Early infection allows secondary outbreaks, disease spread and leaf damage to create even greater yield losses.

Management tips

Hybrids with partial resistance to northern corn leaf blight typically produce fewer, smaller lesions and fewer fungal spores. Hybrids with race-specific resistance display small yellow lesions and produce no spores. Lesions may appear on leaf sheaths and husks of susceptible hybrids.

Choose resistant corn varieties with your retailer, rotate crops, till fields to encourage decomposition of infected residue, and apply a fungicide preventively or, if necessary, curatively.

Impact on yield

Early season infection can have a serious impact on yield, with losses up to 30%.



Symptoms

Elliptical, gray to tan lesions on leaves. Lesions can be anywhere from 1 to 6 inches long. Symptoms tend to start on lower leaves.

Under high humidity, spores coating the lesions turn olive-green or black, giving leaves a dark or dirty appearance.

Conditions for development

- Moderate temperatures (65 F to 80 F), precipitation and high humidity create the optimal environment for northern corn leaf blight. Long periods of dew and overcast days can trap moisture in the crop canopy, encouraging infection. Strong winds and rain spread disease from soil to and among developing plants.
- Infection requires leaf surfaces to be wet for 6 to 18 hours.
- According to the University of Illinois, high nitrogen levels in the soil increase the risk of northern corn leaf blight.

Southern rust in corn

Southern rust (also known as Polysora rust) is favored by high relative humidity and high temperatures and therefore tends to be confined to tropical and subtropical regions more than common rust. In seasons with higher than average temperatures, southern rust can spread into temperate regions where it can impact corn yield.

Timing

In North America, southern rust usually occurs later in the growing season and is more prevalent in the southern states. Southern rust does not occur as often from year to year as common rust, but it is usually more severe when it does occur.

Management tips

If applied properly and in a timely manner, fungicide treatments can be effective in protecting corn leaves from foliar diseases. Whether the treatment will provide an economic return is often difficult to predict. To help with this decision, the University of Illinois gives the following fungicide treatment guidelines for rust and other foliar diseases (Bissonnette, 2000):

- Scout for fungal leaf diseases 2 weeks before tasseling to 2 weeks after tasseling.
- At that point, at least a 15% whole-plant infection is needed to justify a fungicide treatment.
- Also consider these factors to make a reasonable decision:
 - » First, consider the weather. Fungi in general and rusts in particular need free water (on the leaves) and continued wet weather to continue to flourish.
 - » Next, consider the probability of other fungal leaf blights developing in the field and in your particular hybrid. Cropping history and corn residue levels can affect development of diseases such as gray leaf spot.
 - » Consider the price of corn and cost per application.



Photo from Eric Alinger, Pioneer Field Agronomist

Impact on yield

Both rust diseases of corn can cause substantial yield losses under severe disease pressure; however, southern rust generally poses a greater risk to corn yield than common rust. Yield loss due to rust depends on timing of infection, amount of leaf area damaged, and location of damaged leaves on the plant. If significant damage to upper leaves occurs early in the life of the hybrid, yield losses will be higher. If damage is confined to lower leaves of the corn plant or occurs in the later reproductive stages of development, little economic loss would be expected. Consequently, the latest-planted corn in an area is at higher risk for yield loss due to leaf diseases.

Common rust usually does not reach levels in the Corn Belt that would justify a fungicide application; however, severe infections can occur under conditions favorable for disease development. Such conditions were experienced in several Midwestern states in 2009, a growing season that was characterized by lower than normal temperatures throughout much of July and August (Lutt et al., 2016). Pioneer fungicide research trial locations in Illinois and Indiana experienced intense common rust pressure in 2009. At one research location in Indiana, the average yield response to fungicide treatment was over 22 bu/acre (Jeschke, 2017). Yield response to fungicide treatment varied greatly with common rust pressure at the research locations and hybrid genetic resistance to common rust



Photo from Eric Alinger, Pioneer Field Agronomist

Symptoms

Southern rust looks very similar to common rust, but several characteristics distinguish the two. Southern rust pustules are usually confined to the upper leaf surface, while common rust is found on both upper and lower surfaces. Southern rust is more orange or reddish-orange in appearance, while common rust is red or cinnamon-brown. Southern rust pustules have a circular appearance, while those of common rust have an elongated, jagged appearance.

Conditions for development

The disease can develop very rapidly during warm, humid conditions.

Tar spot

Tar spot is a foliar disease of corn that has recently emerged as an economic concern for corn production in the Midwestern U.S. It is not a new disease, having been first identified in 1904 in high valleys in Mexico. Historically, tar spot's range was limited to high elevations in cool, humid areas in Latin America, but it has now spread to South American tropics and parts of North America. It first appeared in the U.S. in 2015. During the first few years of its presence in the U.S., tar spot appeared to be a minor cosmetic disease that was not likely to affect corn yield. However, widespread outbreaks of severe tar spot in multiple states in 2018 proved that it has the potential to cause a significant economic impact.



Photo from Mark Jeschke, Pioneer Agronomy Manager

Management tips

With its very limited history in the U.S., much remains to be learned about the long-term economic importance of this disease and best management practices. The pathogen that causes tar spot overwinters in corn residue but to what extent the amount of residue on the soil surface in a field affects disease severity the following year is unknown. Spores are known to disperse up to 800 ft, so rotation or tillage practices that reduce corn residue in a field may be negated by spores moving in from neighboring fields. Observations so far suggest that rotation and tillage probably have little effect on tar spot severity.

Duration of leaf surface wetness appears to be a key factor in the development and spread of tar spot. Farmers with irrigated corn in areas affected by tar spot have experimented with irrigating at night to reduce the duration of leaf wetness, although the potential effectiveness of this practice to reduce tar spot has not yet been determined.

Yield potential of a field appears to be positively correlated with tar spot risk, with high productivity, high nitrogen fertility fields seeming to experience the greatest disease severity in affected areas. Research on *P. maydis* in Latin America has also suggested a correlation between high nitrogen application rates and tar spot severity.

Impact on yield

Commercial corn hybrids vary widely in their susceptibility to tar spot. Hybrid selection should be a primary consideration in managing for tar spot.



Symptoms

Tar spot is the physical manifestation of fungal fruiting bodies, the ascomata, developing on the leaf. The ascomata look like spots of tar, developing black oval or circular lesions on the corn leaf (Figure 1). The texture of the leaf becomes bumpy and uneven when the fruiting bodies are present. These black structures can densely cover the leaf and may resemble the pustules of rust fungi (Figure 1 and Figure 2). Tar spot spreads from the lowest leaves to the upper leaves, leaf sheathes, and eventually the husks of the developing ears.

Timing/Conditions for development

Tar spot is favored by cool temperatures (60-70 °F, 16-20 °C), high relative humidity (>75%), frequent cloudy days, and 7+ hours of dew at night. Tar spot is polycyclic and can continue to produce spores and spread to new plants as long as environmental conditions are favorable.



Photos from Mark Jeschke, Pioneer Agronomy Manager

Soybean



Anthracnose of soybean

Anthracnose is a fungal disease of soybean that occurs worldwide wherever soybean is grown. Anthracnose in soybean is primarily caused by the fungal species *Colletotrichum truncatum* in the Midwestern U.S. but may also be caused by several related species. *Colletotrichum* species that infect soybeans have a wide host range, including alfalfa, velvetleaf, and ragweed; however, anthracnose of corn is caused by a different pathogen. Anthracnose can infect stems, leaves, and pods of soybean and is generally present in soybean fields to some degree every season.

Timing

Anthracnose is favored by warm, humid, and wet environments and can cause severe yield reductions under these conditions.

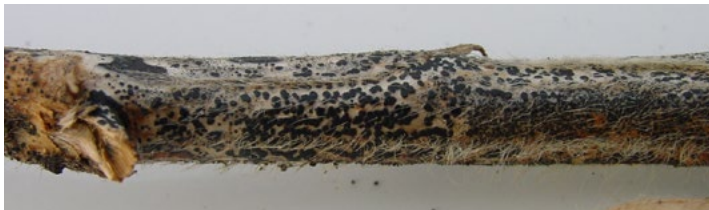
Management tips

Rotation to non-host crops is a proven strategy to reduce anthracnose inoculum in a field. As soybean residue breaks down over time, it deprives the pathogen of its survival host.

Tillage that buries or shreds crop residue, enhancing its breakdown in the soil, is beneficial in reducing anthracnose inoculum in prior fields of soybeans or other host crops.

Impact on yield

Significant yield reductions are rare in the Midwestern U.S., but they are more common in the South.



Symptoms

Symptoms appear on stems, pods, and leaf petioles as irregularly-shaped brown blotches. Severe symptoms may include leaf rolling, premature defoliation, and stunted plants. Pods may be shriveled and contain less seed, moldy seed, or no seed. In some cases, pods can be diseased, and the seed may be infected but without symptoms in the seed.

Conditions for development

Soybeans are susceptible to infection at all stages of development. Plants and seed may be infected. If infected seed is planted, early disease development may result in damping off (seed or seedling rot causing plant death). Dark brown lesions develop on cotyledons, stem may collapse, and seedling may die under severe infection. More commonly, plants become infected during bloom and podfill (reproductive stages) due to spores spread from infected plant residue.

Cercospora leaf blight

Cercospora leaf blight is caused by a fungal pathogen, *Cercospora kikuchii*. It can develop throughout the U.S. and Canada. The disease is becoming more common in the Midwest.

Timing

Generally occurs during pod-filling stages (August), affecting both leaves and seeds of soybeans.

Management tips

A one- to two-year rotation to corn or small grains will reduce inoculum levels. Other legumes should not be included in the rotation. Tillage, where practical, can be used to incorporate and hasten the decomposition of crop residue on which *Cercospora* pathogen survives.

Genetic Resistance Soybean varieties vary in their response to *Cercospora*, but a high level of resistance is not currently available. Nevertheless, many commercial varieties demonstrate at least some degree of tolerance.

Impact on yield

Plants infected early from diseased seed may lose their cotyledons, become stunted, or die. Loss of leaf tissue or entire leaves may occur. Extensive blighting of fields is common with severe infections. Defoliation may reduce yield if disease occurs early relative to pod fill. Significant yield loss is more common in southern states than in northern and central states.



Photo from Eric Alinger, Pioneer Field Agronomist

Symptoms

The *Cercospora* leaf blight phase generally begins in August at the start of pod fill on late-planted soybeans. Sun-exposed leaves on the upper part of the plant develop a bronze to reddish-purple discoloration. Discoloration results from numerous irregular-shaped lesions that range from small specks to 1/2-inch spots, and may extend to the upper stems, petioles and pods.

Lesions form large necrotic blotches as the disease progresses and lesions merge. As plants mature, infected leaves develop a leathery appearance. The disease severely affected upper leaves may drop but the petioles remain on the plant; lower leaves of the plant remain green and attached. Infection sites on petioles and stems are sunken red lesions that can be up to 1/4 inch in length.

Conditions for development

Infection is favored by humid conditions and temperatures of 75 to 80 degrees F or higher.

Frogeye leaf spot

Frogeye leaf spot is a perennial threat in much of the United States, especially in the South and Mid-South. It can appear in any season when conditions are right for development.

Diligent scouting and appropriate, preventive action or treatment when needed will help prevent disease losses due to frogeye leaf spot. Risk factors include summer climate, geography, soybean variety, fungicide resistance, field history and planting practices.

Timing

Frogeye leaf spot can occur at any time, so watch for signs early and often, especially 7 to 14 days after periods of rain or fog followed by warm weather. Signs may appear on upper or lower leaf surfaces, stems, and pods. Diseased plants are usually widespread within a field.

Management tips

Infection risk is increased by:

- Conservation tillage
- Continuous soybean production
- Overreliance on a single fungicide mode of action

Risk factors related to planting include:

- Narrow rows
- High seeding density
- Heavy surface residue

Impact on yield

Some high-yielding varieties are susceptible, and the American Phytopathological Society, the University of Nebraska and Kansas State University report yield losses of up to 20 percent when frogeye leaf spot infects susceptible varieties



Photos from Eric Alinger, Pioneer Field Agronomist

Symptoms

Frogeye leaf spot is caused by the fungus *Cercospora sojina*. Unlike other soybean diseases, it produces disease on younger upper foliage, rather than older foliage at the base of plants. Diseased plants tend to have a layered appearance because infection is more severe on young leaves.

The first sign of frogeye leaf spot usually occurs after flowering, but can occur at any stage. Check tops and undersides of leaves for tan-brown elliptical lesions with brown to purple borders. Under humid conditions, inspection with a hand lens may reveal long, silver, spore-bearing hyphae extending from black dots on the underside of leaves.

The most common initial signs are small, yellow spots on leaves. The spots enlarge to a diameter of about ¼ inch. Lesion centers become gray to brown and have reddish purple margins, and are often mistaken for herbicide drift or other leaf diseases. Under severe disease pressure, lesions can coalesce into irregular shapes and cause leaf drop.



Photos from Eric Alinger, Pioneer Field Agronomist

Stem lesions are somewhat red when young and darken with age. They lack the characteristic tan center and reddish purple border of leaf lesions. Pod lesions are circular or oblong, reddish-brown and slightly sunken. Infected beans may appear shriveled and may have cracked seed coats.

Under humid conditions, lesions on any part of the plant may develop dark centers when the fungus is producing spores.

Conditions for development

Frog-eye leaf spot was first reported in the U.S. in 1924. Though a bigger problem in the South and the Mississippi River Valley, the disease can cause problems in Nebraska and Kansas during periods of high heat and humidity. Strobilurin-resistant frog-eye leaf spot has been confirmed in Illinois, Missouri and most Southern soybean growing states.

Warm, wet conditions favor frog-eye leaf spot infection. Watch for:

- Temperatures of 77 F to 85 F
- Frequent rain
- High relative humidity (>90 percent)

Septoria brown spot

Septoria brown spot is a foliar disease of soybeans caused by the fungal pathogen *Septoria glycines*. The first occurrence of *Septoria glycines* in the United States was documented in South Carolina in 1923. Today, Septoria brown spot is widely distributed across the country and is especially prevalent in agricultural systems in which soybeans are grown continuously. Although it is the most common foliar disease of soybean, Septoria rarely causes significant yield loss. Septoria *glycines* primarily infects legumes, but can use velvetleaf as an alternate host.

Management tips

The potential effect on yield can be estimated by assessing the severity of infection during podfill, particularly at R6. There is no variety that is completely resistant to Septoria brown spot, but partial resistance does exist. Rotating to a non-host crop outside of leguminous species is effective at decreasing the inoculum in the field. Tillage can effectively bury crop debris and cause a rapid decay of the fungus. Foliar fungicides applied from R3-R6 can slow the development of *Septoria glycines* through the middle to upper canopy during podfill.

Impact on yield

Under severe disease pressure, yield losses up to 9% may occur.



Symptoms

Septoria brown spot overwinters on infected soybean residue and infects new seedlings around V2 after spores are splashed from the soil surface. Lesions appear as small brown flecks with indefinite margins, typically paired with chlorotic regions. Lesion coloration can range from rusty brown to brown with a purple hue. When lesions enlarge, they coalesce into irregularly-shaped brown areas. Infected leaves can become chlorotic and drop off of the plant; this typically happens in the lower to mid canopy. If rainfall is heavy and frequent later in the season, there is a potential that *Septoria glycines* can move to the upper canopy.

Conditions for development

Warm temperatures (60–85 °F) and humid conditions promote conidia sporulation of *Septoria glycines*. Extended periods of leaf wetness are conducive for disease development. Conidia are spread throughout the canopy via wind or rain splash. Soybean monoculture, or rotation with other legumes, allows the pathogen to overwinter in crop debris

Soybean rust

Soybean rust is a disease caused by the fungus *Phakopsora pachyrhizi* and has been identified in Australia, Africa, Asia, South America and most recently in North America. Soybean rust is an airborne fungal disease that causes lesions on the leaves, stem and pods, premature defoliation, fewer pods, lighter seeds and poor seed quality. Lesions appear as irregularly shaped spots that develop spore-containing pustules. These lesions, usually confined to the veins or close to the veins, gradually increase in size and turn brown or reddish as the disease progresses.

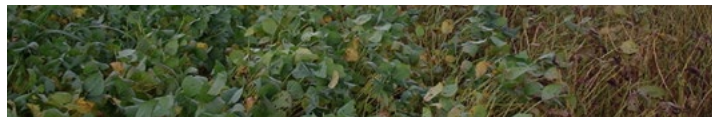
Timing

Rust spores typically cannot survive cold winters, but would likely overwinter in the southern U.S. and spread north with weather systems in the spring.

Management tips

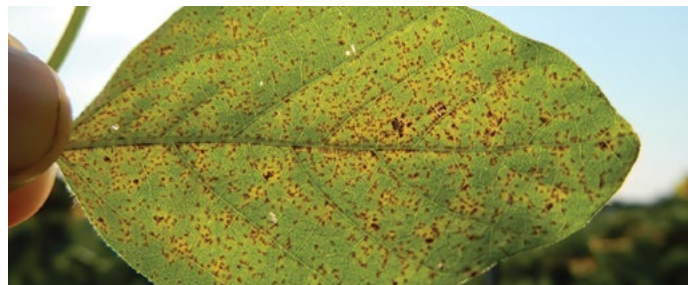
Low Pressure: Vigilance is imperative. Warning systems and systematic scouting programs should be used to stay on top of the disease. Based upon the information from these two sources, fungicides may be applied as a preventive measure or for management when there is at least 10% incidence of the disease in a field.

High Pressure: Carefully timed preventive measures are essential. Cultural practices such as alternate host elimination can contribute to disease prevention, but chemical control will also be necessary. Two to seven fungicide applications should be applied at regular intervals (14-21 days) at or before the R1 growth stage. Because of the frequent need to apply fungicides, measures should be taken to manage resistance development.



Impact on yield

Yield loss due to rust depends on timing of infection, amount of leaf area damaged, and location of damaged leaves on the plant. If significant damage to upper leaves occurs early in the life of the hybrid, yield losses will be higher. If damage is confined to lower leaves of the corn plant or occurs in the later reproductive stages of development, little economic loss would be expected.



Symptoms

Soybean rust affects the plant leaves, in some cases symptoms can appear on the petioles. Visible symptoms appear as reddish-brown pustules on the upper and lower leaf surface.

The disease is difficult to detect as it commonly develops in the shaded, moist conditions of the lower canopy. Detection involves being vigilant for hotspots, or clumps of diseased plants, and systematic field scouting.

Conditions for development

Soybean rust develops and spreads aggressively, with pustules producing spores for periods up to 21 days, in environments with the following conditions:

Moisture: 3-6 continuous hours of leaf wetness; humidity of at least 75-80%

Temperature: Ideal range is 13-26°C (55-79° F)

Solar Radiation: Low solar irradiation (i.e., cloudy conditions, thick upper leaf canopy)

Target spot

Target spot is a foliar disease that has been reported in all soybean growing regions of the U.S. Target spot is caused by the fungus *Corynespora cassiicola* that overwinters on crop debris.

Timing

Generally occurs late in growing season and affects lower canopy.

Management tips

Typically, this disease is managed by using high-yielding soybean cultivars, managing surface crop residue, and avoiding soybean monoculture.

Impact on yield

Yield losses of 18 to 32% have been reported on susceptible cultivars in some areas of the country when conditions favored disease for a prolonged period of time.



Symptoms

Leaf lesions are reddish-brown round to irregularly-shaped spots that range in size from 3/8 to 5/8 in. in diameter. Lesions are frequently surrounded by a yellowish green halo. Larger spots on leaves often develop diagnostic zonate patterns, hence the common name target spot (Fig. 1). Infected areas on stems and petiole are dark brown and range from specks to elongated lesions. Lesions on pods are typically small (1/32 in.), circular purple or black spots with brown margins.

Conditions for development

Initial infections require high humidity (> 80%) or free moisture. Dry weather conditions will suppress disease development.

White mold

Soybean white mold is an annual threat in the northern United States (north of Interstate 70) from Nebraska to the Atlantic Coast, though it may appear anywhere when conditions are right.

Timely, preventive action is necessary to maximize yield in the presence of white mold. Geographic location is only one piece of the puzzle. Also consider spring climate, planting practices, soybean variety, microclimate and field history when weighing the potential of white mold development.

Timing

Cool, wet conditions during spring flowering (R1) are ideal for white mold growth. These conditions that increase disease risk include:

- Temperatures below 85 F
- Frequent rain
- High relative humidity

Management tips

Most severe infestations are found in denser, faster-closing varieties. While no variety has absolute resistance, some varieties offer varying levels of resistance to white mold.

Practices that accelerate canopy development and enhance yield potential can increase risk of infection, including:

- Early planting
- Narrow rows
- High seeding densities
- High soil fertility

Impact on yield

Harvest on or near infected fields with care, since white mold is easily spread. Sclerotia form within and on the outside of plant stems, then drop to the soil surface during harvest. They can be present in harvested soybeans, but are not toxic to livestock and the fungus should be killed during the roasting process.

Because sclerotia are released during the harvesting process, they can easily be spread to new fields. Harvest infected fields last and thoroughly clean equipment when leaving infected fields.

Under ideal disease conditions, it only takes one soybean crop to jump from 5 or 10 percent infected soybean plants in a field to 50 percent the following season. Correct disease diagnosis and implementing an effective management strategy before harvest will help minimize the spread of sclerotia and reduce the risk of severe disease in subsequent years.



Symptoms white mold disease cycle:

Sclerotia

Sclerotia are dark, irregularly shaped white mold survival structures. Resembling mouse droppings, they function much like seeds, protecting the organism until conditions allow it to germinate.

About $\frac{1}{4}$ to $\frac{1}{2}$ inch long, sclerotia form within the white, cottony growth inside and outside soybean stems. Within these structures, the disease survives in soil for up to 10 years.

Only sclerotia within 2 inches of the soil surface can germinate.

Tilling infected fields can bring deeper sclerotia to the surface and propagate the disease.

When conditions are right, sclerotia germinate and produce apothecia.



When conditions favor white mold development, a small number of apothecia can infect a relatively significant number of soybean plants as they release airborne spores.

Spores

Spores are produced under the cap of apothecia. Each apothecium can release more than 10 million microscopic spores over several days, which are carried by the wind to surrounding plants. After release, spores survive for only a few days.

Spores land on senescing soybean blossoms and are able to germinate within soybean plants during a period of prolonged leaf wetness (16 to 48 hours).

Apothecia

Apothecia are tan, spongy, mushroom-like structures that grow from sclerotia. At full maturity, they reach $\frac{1}{4}$ to $\frac{1}{2}$ inch in length. They can be found beneath soybean canopies on or just below the soil surface when soil is moist and dim light reaches through the canopy.

The quantity of apothecia is relative to the number of sclerotia near the soil surface when necessary environmental conditions are met. Apothecia can form under the canopies of non-host plants, such as corn, small grains and forage legumes.

Many other mushrooms grow in soybean fields, including birdnest mushroom. Correct diagnosis is critical to implementing an effective management program.





Soybean plants

Soybean plants are most vulnerable to white mold infection during bloom phase. With adequate moisture, airborne spores that land on surrounding plants use senescing petals as the gateway to infecting the plant. Plant-to-plant infection is possible, but not common.

Once fungal spores germinate on petals, the infection is able to spread throughout the plant to pods, nodes and stems.

Infection

Infection signs are not immediately visible. The obvious signs may be apparent within 3 to 4 weeks of infection, but generally go unnoticed for another week or more.

Check stems of potentially infected plants to diagnose white mold. The first signs are gray to white lesions at nodes. Lesions rapidly spread above and below infected nodes and are often covered in fluffy, white growths.

Diagnosing white mold by foliar damage is not reliable. Wilted leaves die and turn brown, but often remain attached to the stem past maturity.

These signs of foliar damage are similar to other diseases, including stem rot, Phytophthora root rot, sudden death syndrome and stem canker. Stems should be inspected to confirm white mold diagnosis

Resources



Corn fungicide attributes & control ratings

Fungicide (common & trade names)	Active ingredients	FRAC group	Company	Corn								
				Anthracnose leaf blight	Common rust	Eyespot	Grey leaf spot	Northern leaf blight	Southern rust	Tar spot	Harvest Restrictions (days)	
Approach® fungicide	Picoxystrobin	11	Corteva Agriscience	●	●	●	●	●	●	●	7	
Approach® Prima fungicide	Picoxystrobin Cyproconazole	11 3	Corteva Agriscience	●	●	●	●	●	●	●	30	
Headline AMP fungicide	Pyraclostrobin Metconazole	11 3	BASF	●	●	●	●	●	●	●	20	
Priaxor fungicide	Fluxapyroxad Pyraclostrobin	7 11	BASF	●	●	●	●	●	●	●	21	
Revytek fungicide 12	Mefentrifluconazole Fluxapyroxad Pyraclostrobin	3 7 11	BASF	●	●	●	●	●	●	●	21	
Veltyma fungicide	Mefentrifluconazole Pyraclostrobin	3 11	BASF	●	●	●	●	●	●	●	21	
Stratego YLD Fungicide 10	Prothioconazole Trifloxystrobin	3 11	Bayer	●	●	●	●	●	●	●	14	
Delaro Fungicide	Prothioconazole Trifloxystrobin	3 11	Bayer	●	●	●	●	●	●	●	14	
Lucento fungicide	Bixafen Flutriafol	7 3	FMC	●	●	●	●	●	●	●	R4	
Trivapro fungicide	Propiconazole Benzovindiflupyr Azoxystrobin	3 7 11	Syngenta	●	●	●	●	●	●	●	30	
Miravis Neo fungicide	Pydiflumetofen Propiconazole Azoxystrobin	3 7 11	Syngenta	●	●	●	●	●	●	●	30	
Quilt XCEL fungicide	Propiconazole Azoxystrobin	3 11	Syngenta	●	●	●	●	●	●	●	30	

● Excellent ● Good ● Poor ● Not labeled
● Very Good ● Fair ● Unknown

¹ 2(ee) recommendation available: use in a two pass program with Approach Prima for best results.
 Rating sources: DuPont Crop Protection trial data; Crop Protection Network – 2020 ratings.

Soybean fungicide attributes & control ratings

Fungicide (common & trade names)	Active ingredients	FRAC group	Company		Anthraconse	Brown spot	Cercospora leaf blight	Frogeye leaf spot	Septoria brown spot	Soybean rust	Target spot	White mold	Harvest restrictions (days)	
Approach® fungicide	Picoxystrobin	11	Corteva Agriscience	Soybean	●	●	●	●	●	●	●	●	14	
Approach® Prima fungicide	Picoxystrobin Cyproconazole	11 3	Corteva Agriscience		●	●	●	●	●	●	●	●	●	14
Headline AMP fungicide	Pyraclostrobin Metconazole	11 3	BASF		●	●	●	●	●	●	●	●	●	-
Priaxor fungicide	Fluxapyroxad Pyraclostrobin	7 11	BASF		●	●	●	●	●	●	●	●	●	21
Revytek fungicide 12	Mefentrifluconazole Fluxapyroxad Pyraclostrobin	3 7 11	BASF		●	●	●	●	●	●	●	●	●	21
Veltyma fungicide	Mefentrifluconazole Pyraclostrobin	3 11	BASF		●	●	●	●	●	●	●	●	●	-
Stratego YLD Fungicide 10	Prothioconazole Trifloxystrobin	3 11	Bayer		●	●	●	●	●	●	●	●	●	21
Delaro Fungicide	Prothioconazole Trifloxystrobin	3 11	Bayer		●	●	●	●	●	●	●	●	●	21
Lucento fungicide	Bixafen Flutriafol	7 3	FMC		●	●	●	●	●	●	●	●	●	21
Trivapro fungicide	Propiconazole Benzovindiflupyr Azoxystrobin	3 7 11	Syngenta		●	●	●	●	●	●	●	●	●	14
Miravis Neo fungicide	Pydiflumetofen Propiconazole Azoxystrobin	3 7 11	Syngenta		●	●	●	●	●	●	●	●	●	14
Quilt XCEL fungicide	Propiconazole Azoxystrobin	3 11	Syngenta		●	●	●	●	●	●	●	●	●	R6

● Excellent ● Good ● Poor ● Not labeled
● Very Good ● Fair ● Unknown

Corn recommendations

Aproach[®]

Onmira™ active

FUNGICIDE

Diseases Controlled	
Anthracnose leaf blight and stalk rot	Northern corn leaf spot
Eye spot	Physoderma brown spot
Gray leaf spot	Rust, common
Leaf spots	Rust, southern
Northern corn leaf blight	Southern corn leaf blight
	Tar spot
	Yellow leaf blight
Rate (fl oz/A)	Treatment Instructions
3 - 6	Make a single 3-6 fl oz application between V3 - V12 for early season disease control/suppression. On susceptible inbreds or hybrids, for early season disease control of Northern corn leaf spot, Northern corn leaf blight, Gray leaf spot, or Common Rust, use the 6 fl oz rate. For continued control through the season, a planned program should be followed.
6 - 12	Make 6 to 12 fl oz applications at 7 to 14-day intervals. For best results apply between V10 to R3 and make applications prior to disease development. Use the higher rate and shorter interval when disease pressure is high.

- Make no more than 2 sequential applications of Aproach[®] fungicide before switching to a fungicide with a different mode of action
- Do not tank mix Aproach with an adjuvant or crop oil when spraying corn between the V8 and VT stages of growth
- The minimum pre-harvest interval (PHI) between the last application and harvest for grain or ear is 7-days and for forage or grazing is 0-days
- Do not exceed 36 fluid ounces per acre per crop

Aproach[®] Prima

Onmira™ active

FUNGICIDE

Diseases Controlled	
Anthracnose leaf blight and stalk rot	Physoderma brown spot
Eye spot	Rust, common
Gray leaf spot	Rust, southern
Leaf spots	Southern corn leaf blight
Northern corn leaf blight	Tar spot
Northern corn leaf spot	Yellow leaf blight
Rate (fl oz/A)	Treatment Instructions
6.8	Apply (V10-R3) for preventative disease management. Begin application prior to disease development for best results. Monitor fields 14 - 21 days after application to determine whether additional treatments should be made.

- Apply no more than two sequential applications of a picoxystrobin-containing product before switching to a fungicide with a different mode of action. The minimum retreatment interval in corn for Aproach[®] Prima fungicide is 7 days.
- Do not tank mix Aproach Prima with an adjuvant or crop oil when spraying corn between the V8 and VT stages of growth.
- Minimum time between the last application and harvest (PHI) is 30 days for grain or ear and 21 days for silage.
- Do not exceed 6.8 fluid ounces per acre per crop.
- When applied alone or in combination with other products containing picoxystrobin, do not apply more than 0.585 pounds of picoxystrobin active ingredient per acre per year to corn.
- When applied alone or in combination with other products containing cyproconazole, do not apply more than 0.036 pounds of active ingredient cyproconazole per acre per year to corn.

Soybean recommendations

Aproach[®]

Onmira™ active

FUNGICIDE

Diseases Controlled	
Aerial web blight	Frogeye leafspot
Anthracnose	Pod and stem blight
Alternaria leaf spot	Powdery mildew
Brown Spot	Rust
Cercospora blight and leaf spot, purple seed stain	Target Spot (Corynespora cassiicola)
Downy mildew	
Rate (fl oz/A)	Treatment Instructions
6 – 12	Begin applications prior to disease development and continue on a 7 - 14-day interval. Use higher rate and shorter interval when disease pressure is high. Application window (R1 - R3)
Diseases Controlled	
Sclerotinia stem rot (White Mold)	
Rate (fl oz/A)	Treatment Instructions
9 – 12	For white mold: make initial preventive application at 100% bloom (1 flower blooming on all plants) and follow with 2nd application 10 - 14 days later.

- Make no more than 2 sequential applications of Aproach before switching to a fungicide with a different mode of action
- The minimum pre-harvest interval (PHI) between last application and harvest of grain, forage, and hay is 14-days
- Do not exceed 12 fluid ounces per acre per crop if grown for forage & hay
- Do not exceed 36 fluid ounces per acre per crop if grown for grain (seed)

Aproach[®] Prima

Onmira™ active

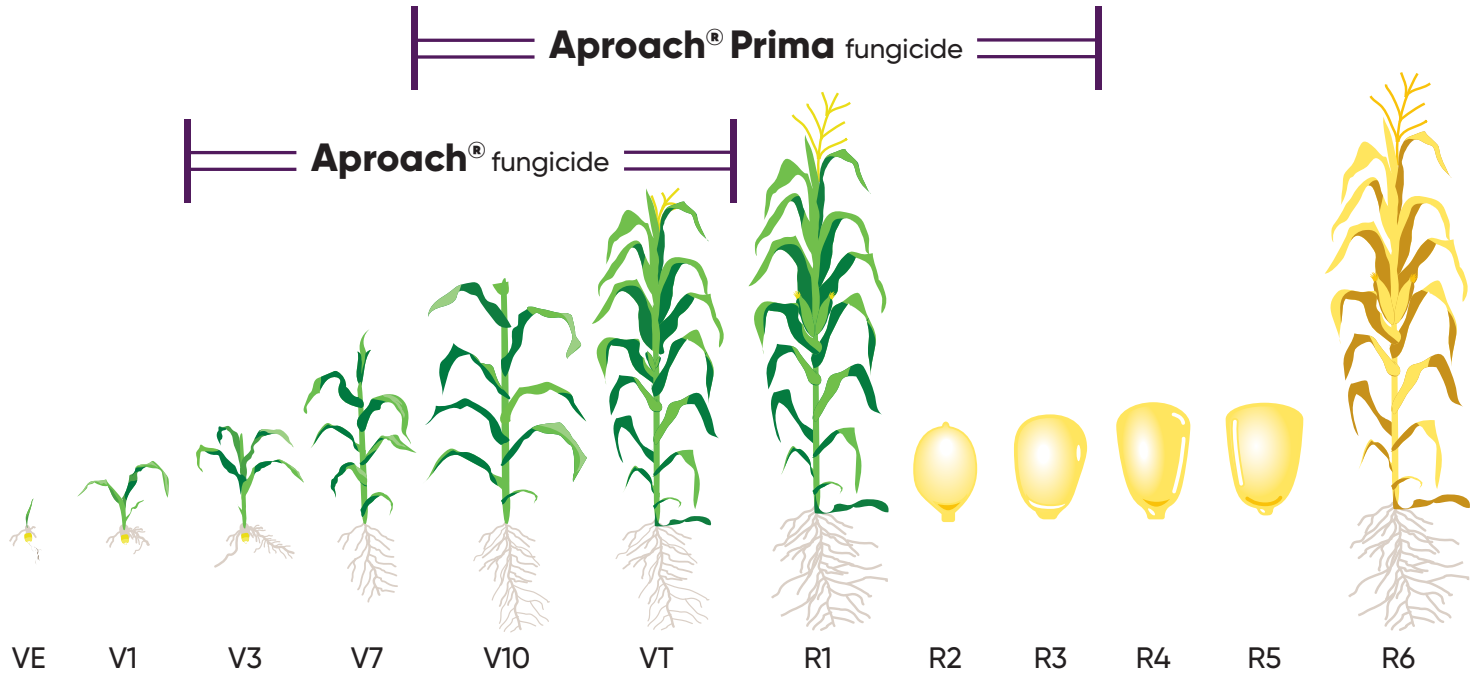
FUNGICIDE

Diseases Controlled	
Aerial web blight	Downy mildew
Anthracnose	Frogeye leafspot
Alternaria leaf spot	Pod and stem blight
Brown Spot	Powdery mildew
Cercospora blight and leaf spot, purple seed stain	Rust
	Target Spot
Rate (fl oz/A)	Treatment Instructions
6.8	Begin applications prior to disease development (R1 - R3) and continue on a 14 to 28-day interval. Use shorter interval when disease pressure is high.

- Make no more than two sequential applications of a picoxystrobin containing product before switching to a fungicide with a different mode of action. The minimum re-treatment interval in soybeans for Aproach Prima is 14 days.
- Minimum time (PHI) between last application and harvest of grain is 30-days, forage, and hay is 14-days.
- Do not exceed 13.6 fluid ounces product per acre per crop.
- Do not use soybean forage or hay as livestock feed if making more than one application at 6.8 fluid ounces product per acre.
- When applied alone or in combination with other products containing picoxystrobin, do not apply more than 0.585 pounds of picoxystrobin active ingredient per acre per year to soybean. Do not apply more than 0.195 lb of picoxystrobin active ingredient per acre per year to soybean if forage or hay are fed to livestock.
- When applied alone or in combination with other products containing cyproconazole, do not apply more than 0.072 pounds of active ingredient cyproconazole per acre per year to soybean. Do not apply more than 0.036 pounds of cyproconazole active ingredient per acre per year to soybean if forage or hay are fed to livestock.

Corn optimal timing

Approach® fungicide (V3 - V12) | Approach® Prima fungicide (V10 - R3)

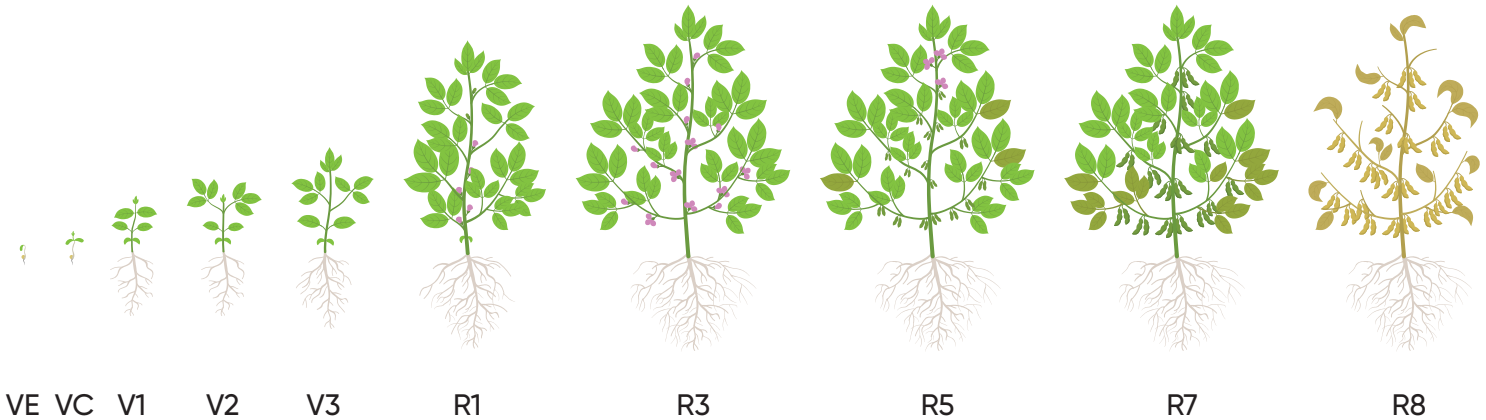


Soybean optimal timing

Aproach® fungicide and Aproach® Prima fungicide (R1 - R3)

Aproach® Prima
fungicide

Aproach®
fungicide



Sources:

DuPont Crop Protection training material
Pioneer Agronomy Library
University of Minnesota- Extension
University of Arkansas Department of
Agriculture Research & Extension



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