Managing the Early Onset of Foliar Diseases in Corn

- Early scouting and correctly identifying an infection are key for determining the status, progression, and best management practices for foliar diseases.

All plant diseases require three components for an infection to occur: the pathogen must be present, the environment must be suitable for the pathogen, and a susceptible host plant must be available. Many sources can lead to a pathogen becoming present in a field. Depending on the disease, some pathogens may survive the winter on previously infected crop residue (e.g., northern corn leaf blight, tar spot) and some may be moved into northern growing areas on winds from southern locations (e.g., southern corn rust). For a suitable environment, many foliar diseases need warm, humid, and wet conditions to propagate. Fungal diseases (e.g., grey leaf spot) can infect and penetrate plant tissue without a wound. However, bacterial diseases (e.g., Goss's wilt) can only infect and penetrate plant tissue via a wound to the plant. Finally, in terms of susceptibility, many Bayer seed products have been bred to have genetic resistances to many common plant diseases. Your seed provider can provide information on a corn hybrid's susceptibility levels to many of the common foliar diseases.

When to Scout

Depending on the disease, field history, and the susceptibility of the corn product, scouting should start at the whorl or tasseling stage (Table 1). If a susceptible corn product is planted in an area with a history of foliar disease, that area should be scouted prior to tasseling to determine the presence and severity of the disease.

Managing the Early Onset of Foliar Diseases in Corn

Table 1. Suggested sampling window, favorable environmental conditions, and management options for common foliar diseases of corn.

Disease	Sampling Window	Favorable Environment	Management Options	In-season Management
Fungal Pathogens				
Leaf anthracnose[1]	Knee-high to whorl stage	Warm temperatures and prolonged wet weather	Resistant corn products, tillage to bury residue, crop rotation	None
Northern corn leaf blight[2]	Whorl through dent stage (R5)	Warm temperatures (65 to 80 °F) and extended leaf wetness	Resistant corn products, fungicides, tillage to bury residue, crop rotation	If the disease is present on 50% or more of the plants in a susceptible hybrid and warm, wet weather is forecasted, consider a foliar fungicide application.
Grey leaf spot[3]	Tasseling to maturity (R6)	Warm temperatures (75 to 85 °F) and relative humidity greater than 90%	Resistant corn products, fungicides, tillage to bury residue, crop rotation	Fungicide applications made in the very early stages of disease development (few lesions in the lower canopy) are more effective at slowing disease development and protecting yield than later applications.
Physoderma brown spot[3]	V12 through R1 stages	Warm (75 to 85 °F) and excessively wet conditions which result in water pooling in the whorl during the V3-V9 stages	Resistant corn products	None
Eyespot[4]	Whorl through R1 stages	Cool and wet conditions	Resistant corn products, fungicides, tillage to bury residue, crop rotation	If infection occurs early in development, the corn product is very susceptible, and the forecast is for prolonged cool and wet conditions, then a fungicide should be considered.
Common rust and southern rust[5]	Whorl through dent stage	Common rust: temperature range of 61 to 77 °F and at least 6 hours of concurrent dew; Southern rust: temperature range of 77 to 88 °F	Both: resistant corn products, fungicides	Common rust: scout corn regularly to detect the disease early. If the disease progresses and weather is conducive to its spread, a fungicide application may be considered. Southern rust: early and frequent scouting of fields is beneficial if corn rust is found nearby, because the disease can spread rapidly. A fungicide application should be considered if weather is conducive to the spread of the disease.
Tar spot[6]	VT through maturity	Cool conditions (59 to 70 °F), 85% relative humidity, and 7 or more hours of leaf wetness	Plant less susceptible corn products, tillage, crop rotation, fungicides	The Tar Spotter application (https://ipcm.wisc.edu/apps/tarspotter/) is a useful tool for recognizing conditions conducive to tar spot development. In most cases, an application of a mixed-mode-of-action fungicide product between the VT (tassel emergence) and R2 (blister) stages is most effective for controlling tar spot.
Bacterial Pathogens				
Goss's wilt[8]	V7 through maturity	Enters through wounds on plant surfaces, wind-blown rain can spread disease	Plant less susceptible corn products, tillage, crop rotation	None
Bacterial leaf streak[9]	Late vegetative stages through maturity	Assume that the disease is spread through irrigation and rain, and wounds are necessary for infection	Consult seed producer for susceptibility ratings of corn products	None

Managing the Early Onset of Foliar Diseases in Corn

Impact on Yield and Standability

Corn foliar diseases are a concern when they develop early and progress up the plant before grain fill is complete. Disease development in corn around the tasseling stage can result in yield loss, particularly if favorable environmental conditions support the continued infection and the top 8 to 9 leaves above the ear become infected, as the photosynthetic capacity of these leaves provides at least 75% of the carbohydrates needed to complete ear fill.[10] Studies conducted at Iowa State University demonstrated that when grey leaf spot and common rust were controlled using a fungicide, the incidence of stalk lodging was reduced.[11]

Figure 1. Anthracnose leaf blight.

Figure 2. Northern corn leaf blight.

Figure 3. Grey leaf spot.

Common Corn Foliar Diseases

Anthracnose leaf blight. This disease is very common in fields that are in a continuous corn cropping system. Anthracnose leaf blight spores are spread primarily by splashing water from the crop residue onto the corn leaf. The disease develops soon after planting and continues to develop until canopy closure. Plants develop oval- or spindle-shaped lesions that are brown with very dark-brown or purple margins (Figure 1). Lesions can coalesce to create larger areas of dead tissue, and leaves may die. Spores formed on the dead tissue will look spiny under magnification, much like a sea urchin.

Northern corn leaf blight (NCLB). Typical symptoms of NCLB are large (1 to 6 inches long), cigar-shaped lesions (Figure 2). Lesions are initially grey green with a water-soaked appearance and turn tan to brown as infected tissues die. A distinct margin between the infected and healthy tissue is often apparent. Distinct dark areas of fungal sporulation develop within necrotic lesions when weather is humid. Mature NCLB symptoms can look similar to the leaf blight phase of Goss's wilt or to drought/heat stress.

Grey leaf spot. This disease causes grey to tan, rectangular lesions on leaf, sheath, or husk tissue (Figure 3). The spots are opaque and long (up to 2 inches). Lower leaves are affected first, usually after silking. Lesions may have a grey, downy appearance on the underside of leaves where the fungus sporulates. Grey leaf spot has become more prevalent with increased use of reduced tillage and continuous corn.

Managing the Early Onset of Foliar Diseases in Corn

***Physoderma* brown spot.** The symptoms of this disease include very small (approximately ¼ inch in diameter), round- to oval-shaped lesions that are yellowish brown in color, occur in high numbers, and appear in broad bands across the leaves (Figure 4). In addition, dark purple to black spots occur on the midrib. The midrib lesions help distinguish this disease from other diseases such as eyespot and southern rust. The infection requires a combination of light, free water, and warm temperatures during the whorl stages, which results in the commonly seen alternating bands of infected and non-infected tissues on the plant. Symptoms may also appear on the stalk, leaf sheath, and husk.

Figure 4. Physoderma brown spot.

Eyespot. This disease causes small (about 1/16 of an inch), circular, translucent lesions surrounded by yellow to purple margins that give them a halo effect (Figure 5). Lesions occur on leaves (most commonly as plants approach maturity), sheaths, and husks. The disease is favored by cool, moist weather.

Common rust. Infections begin as light-green to yellow spots on leaves and develop into circular or elongated, small (2-10 mm long), reddish-brown, raised pustules.[6] Pustules rupture the leaf epidermis and contain small, cinnamon-brown, powdery spores that can become darker brown to black later in the season (Figure 6). Pustules are often found in bands or patches, indicating that infection occurred while the leaf was in the whorl. Pustules can form on the upper and lower leaf surfaces. Severely infected plants may have issues with water balance and show symptoms of moisture stress during hot, dry weather, even when soil moisture is adequate.

Figure 5. Corn eyespot.

Figure 6. Common rust pustules on the underside of a corn leaf.

Managing the Early Onset of Foliar Diseases in Corn

Southern rust. Early symptoms of southern corn rust are small, circular- to oval-shaped lesions, which are often accompanied by a light-green to yellow halo. Unlike common rust, the lesions are almost exclusively located on the upper leaf surface. Within the lesions are light-orange to cinnamon-red pustules, which are unique to this disease and key to identification (Figure 7). Southern rust pustules tend to be smaller, have a more circular shape, and are more densely packed than common rust pustules. Also, unlike common rust, the lesions can develop on tissues other than the leaves, including the stalk, husk, and leaf sheath.

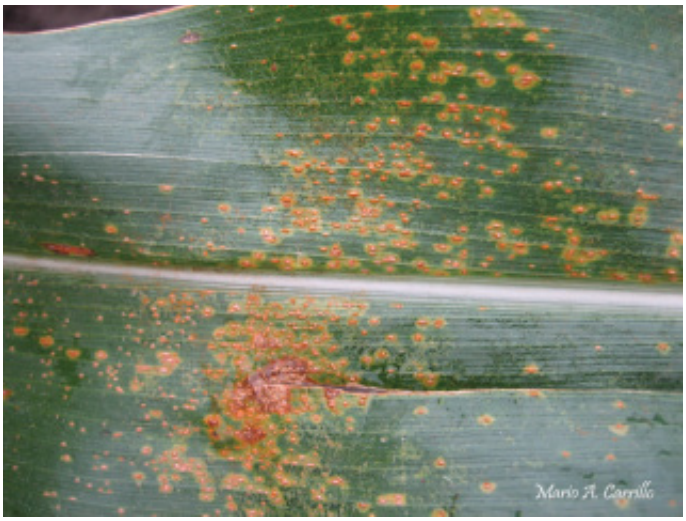

Figure 7. Southern rust on corn.

Tar spot. A preliminary identification of tar spot can be done in the field, but a laboratory diagnosis is required to definitively distinguish this disease from other pathogens. Leaves with tar spot have small, raised, black, circular spots, which are called stromata (Figure 8). Stromata can be present on the healthy or dead tissue of leaf sheaths, stalks, and husks, and can be surrounded by a narrow, tan halo. The stromata are raised, bumpy, and vary in shape from small, pinhead structures to more elongated structures. Tar spot stromata can be easily confused with structures associated with other fungal diseases, such as the black pustules produced by the corn rust pathogen as it ages. Tar spot can also be easily confused with the black saprophytic organisms that grow on dead leaf tissue. However, saprophytes can be rubbed off, whereas stromata cannot.

Figure 8. Tar spot of corn.

Goss's wilt. The leaf blight symptoms of Goss's wilt usually appear as long, grey-green to black, water-soaked streaks extending along leaf veins. Small, dark, water-soaked flecks referred to as "freckles" often occur inside larger lesions and at the edges of lesions where symptoms are advancing. Leaf freckles are luminous when lighted from behind, such as when the sun is used as backlighting. Bacterial cells may ooze from infected leaves and dry on leaf surfaces, forming a shellac-like sheen. As lesions mature, large areas of tan to brown, dead leaf tissues become visible (Figure 9).

Figure 9. Goss's wilt of corn.

Managing the Early Onset of Foliar Diseases in Corn

Bacterial leaf streak. Disease symptoms have been observed in corn as early as the V7 growth stage, in which lesions first appear on the lower leaves (Figure 10). Incidences of bacterial leaf streak are more common under continuous corn production, overhead irrigation, or rainfall during hot weather. Symptoms in the upper canopy are more common when the disease occurs after tasseling. It can be confused with grey leaf spot and common rust, so a laboratory test is often needed to confirm if an infection really is bacterial leaf streak.

Figure 10. Bacterial leaf streak on corn.

Fungicide Considerations[12]

While fungicides can help reduce the incidence of fungal diseases, they will have no effect on the bacterial diseases that infect corn. Triazole and strobilurin fungicides are labeled for corn to help manage foliar fungal diseases. Triazole fungicides interfere with fungal membrane structure and function, and must be applied preventatively or in the early stages of infection. Following application, the active ingredients in triazole fungicides move locally into the leaves on which they were applied, but they are not necessarily transported to other leaves. Strobilurin fungicides inhibit fungal respiration and should be applied preventively or as early as possible in the disease cycle. They are absorbed into the leaf and have some upward movement in the xylem. Most triazoles and strobilurins have some residual activity based on the rate of application, coverage, and environmental conditions. Consult individual product labels for harvest interval and other restrictions for use.

In most cases, fungicides should be applied at or after tasseling. For example, a fungicide has been shown to be most effective for northern corn leaf blight and grey leaf spot when applied between two weeks prior to tasseling and two weeks after tasseling.[13] Follow all individual product label instructions for proper application timing, application volume, application equipment, and environmental and harvest interval precautions.

Making an Application Decision

There are many factors to consider when determining if a fungicide application is warranted. Prior to making an application, evaluate each field for the susceptibility of the corn products to the diseases, the current yield potential of each field, disease severity, and corn stage of development. Then check the weather forecast to evaluate if upcoming conditions will continue to promote disease development. Finally, consider the cost of treatment and corn price to determine if an application is likely to provide an economical return in each field.

Managing the Early Onset of Foliar Diseases in Corn

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