



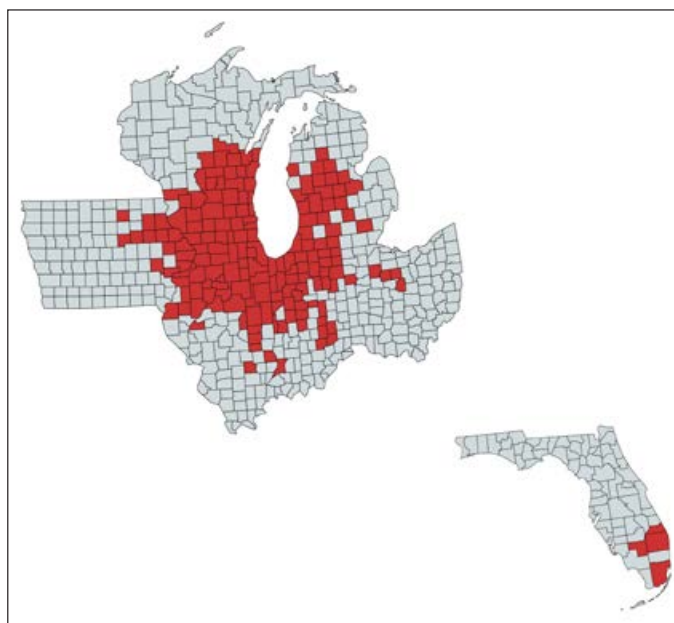
## Tar Spot

Tar spot is a foliar disease of corn that commonly occurs throughout Mexico, Central America, South America, and the Caribbean. The disease was identified in the United States for the first time in 2015 in northern Illinois and Indiana. As of 2018, it has been confirmed in Iowa, Michigan, Wisconsin, Ohio, and Florida (Figure 1).

During the 2018 growing season, the prevalence and severity of the disease increased dramatically, and in some areas tar spot caused substantial yield losses. This publication discusses our current knowledge of tar spot, describes diseases commonly confused with the disease, and offers basic management practices.

### Symptoms and Signs

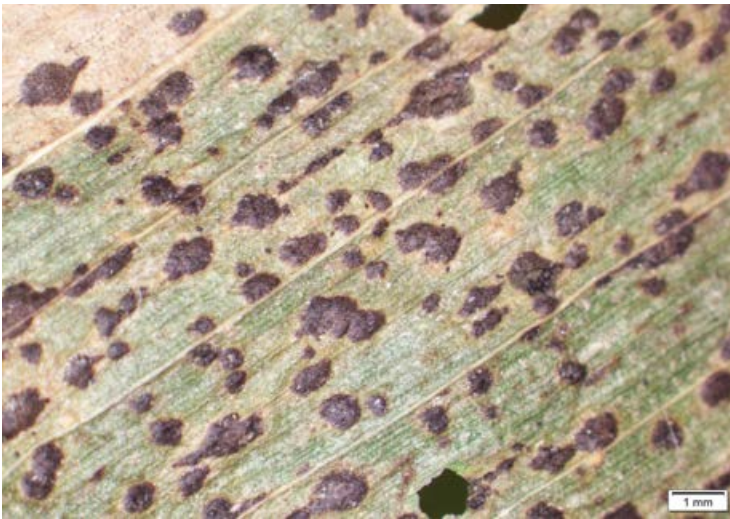
In the United States, tar spot of corn is caused by the fungus *Phyllachora maydis*. The fungus produces small (0.2-0.8 inch), round to semi-circular, raised black structures called *stromata*. The structures form on both the upper and lower surfaces of corn leaves (Figure 2, page 2). In severe cases, stromata may also be observed on leaf sheaths and husks. Occasionally, stromata may coalesce and form small lines or striations across the leaf surface.



**Figure 1.** This map shows areas where tar spot infections have been confirmed in the United States as of 2018.

Tar spot severity on ear leaves at growth stage R5 (dent stage) can exceed 50 percent in susceptible hybrids when conditions are favorable for the disease (Figure 3, page 2). After observing the disease, corn pathologists at U.S.





**Figure 2.** *Phyllachora maydis*, the fungus that causes tar spot, produces stromata that are raised, black, and often found on leaves and husks of affected corn plants.

universities in Illinois, Indiana, and Wisconsin have suggested that the leaves of infected plants prematurely senesce when ear leaf severity is greater than 30 percent. Occasionally, tan to brown lesions with dark borders can develop that surround the stromata (Figure 3). These are known as fisheye lesions because of their appearance. Fisheye lesions are frequently observed in areas of Latin America where corn tar spot is more common. When fisheye lesions occur in Latin America, the disease is called tar spot complex, because a second fungus (*Monographella maydis*), is often associated with these lesions.

Although fisheye lesions have been observed in the United States, *M. maydis* has not been confirmed. Fisheye lesions may potentially be related to hybrid genetics, the genetics of the tar spot fungus, the environment, a different agent forming a complex with *P. maydis*, or some yet unknown factor. In any case, the cause of fisheye lesions observed in North American tar spot outbreaks is currently unknown; however, research on this disease is ongoing.

## Disease Cycle

The tar spot fungus (*P. maydis*) is an obligate pathogen, which means that it requires a living host to grow and reproduce. Although many *Phyllachora* species infect grasses, only *P. maydis* is known to infect corn. While there is much about the *P. maydis* life cycle that is currently unknown, we do know that related fungi



**Figure 3.** In susceptible hybrids, tar spot can approach 50-percent leaf infection. This image shows fisheye lesions, which are stromata surrounded by brown, necrotic tissue.

in this genus overwinter as the stromata (black structures).

After rain or periods of high humidity, the stromata extrude spores (ascospores and conidia), which accumulate in a gelatinous mass on the stromata (Figure 4). In turn, rain splash and wind disperse these spores. Only ascospores appear to infect corn. The role of conidia is unknown.

According to data from Latin America, ascospores are released as single spores or in bunches. They can travel up to 80 yards and infect healthy corn plants. After infection, new stromata form within infected tissue in 12 to 15 days. The stromata can produce ascospores soon



**Figure 4.** Under wet and humid conditions, *Phyllachora maydis* stromata extrude spores, which form a gelatinous mass.

thereafter. When conditions are favorable, multiple cycles of spore release can occur in this way during the growing season.

Corn at any developmental stage is susceptible to infection by the tar spot fungus when conditions are favorable. Disease symptoms have been observed as early as the third-leaf (V3) growth stage in the United States. *P. maydis* overwinters on infested corn residue on the soil surface, which serves as a source of inoculum for the subsequent growing season. It is not known if *P. maydis* overwinters on or infects any other plant hosts in the United States.

## Conditions that Favor Disease

In Latin America, cool temperatures (60-70°F) and high relative humidity (greater than 75 percent) favor tar spot development. In addition, disease incidence increases when there is at least seven hours of free moisture on the leaves due to rain, fog, or high relative humidity.

However, it is not currently known what conditions favor the disease in the United States. In both 2015 and 2018, warm weather and periods of persistent rain and high humidity during the growing season likely favored the development and spread of the disease.

In Latin America, continuous corn cultivation with minimum tillage practices, and high application rates of nitrogen fertilizer are also positively correlated with

increased disease. Although corn lines have been identified in Latin America that have resistance to tar spot complex, U.S. observations indicate that most hybrids grown in the North Central region are susceptible to *P. maydis* (although they differ in susceptibility).

## Yield Losses and Impact

Preliminary data from the Midwest indicate that severe tar spot outbreaks can reduce yield by more than 30 bushels per acre. Yield losses are a function of reduced ear weight, poor kernel fill, loose kernels, and vivipary (a condition in which the seed germinates while still on the cob). Observations also suggest that stalk rot and lodging are increased when tar spot severity is high. Severe tar spot also reduces forage quality.

## Diagnosis

You can diagnose corn tar spot in the field by examining corn leaves for the presence of black, tar-like spots. To date, tar spot has been observed most often during mid- to late grain fill (growth stages R3-R6) and usually on leaves below or near the ear leaf. You can observe stomata in green and senesced tissues. Occasionally, you may also observe necrotic brown tissue surrounding the black structures, which produces a fisheye appearance. If you suspect tar spot, send a sample to your state diagnostic lab to confirm the diagnosis.

## Diseases with Similar Symptoms

### Common and Southern Rusts (*Puccinia* spp.)

Usually, lesions from rust diseases are initially bright orange or red, but as the season progresses lesions may turn dark brown or black and can be mistaken for tar spot.

#### How to distinguish corn rusts from tar spot:

Use a 10x hand lens to examine the lesion. Rust lesions erupt through the leaf surface and you can rub off the spores. Tar spots are raised and black, and do not leave a smudge when you rub them with your finger.

**Figure 5.** Southern rust (left) and common rust pustules erupt through leaf surfaces, and you can rub off the spores.





### Physoderma Brown Spot (*Physoderma maydis*)

Physoderma brown spot forms purple-to-brown circular spots along the leaf midrib and small, light-brown to orange circular spots in the leaf tissue.

#### How to distinguish Physoderma brown spot from tar spot:

Tar spots are raised, while Physoderma spots are embedded in the plant tissue. Physoderma brown spot symptoms are often observed near the base of the leaf, while tar spot symptoms usually occur from the middle toward the tip the leaf blade.

**Figure 6.** Physoderma brown spot lesions are embedded in leaf tissue while tar spots are raised.



## Management

Most of what we know about tar spot has originated from Mexico and Central America. However, differences in the environments, fungal populations, hybrid genetics, and cropping systems may influence disease development in different areas. Our understanding of this disease in the United States is limited because of its very recent history.

However, several management practices may help reduce tar spot development and severity.

- 1. Manage residue.** Tilling fields buries infected residue and encourages it to decompose, which may help reduce the amount of overwintering tar spot inoculum.
- 2. Rotate to other crops.** This will allow residue to decompose and reduce the primary inoculum. It is not yet known how many years it may take to sufficiently reduce inoculum.
- 3. Avoid highly susceptible hybrids.**
- 4. Investigate fungicides.** Some fungicides may reduce tar spot, and there are several fungicides with 2ee labels that can be used to manage tar spot. However, we have little data about application timing that will provide an effective and economical response. Efforts are underway to understand the biology and epidemiology of this disease, which may help formulate fungicide application decisions in the future.

## Find Out More

Other publications in the *Corn Disease Management* series are available on the Crop Protection Network website ([cropprotectionnetwork.org](http://cropprotectionnetwork.org)).

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