CORN DISEASE MANAGEMENT

CPN-2012-W

Tar Spot

Tar spot is a foliar disease of corn that commonly occurs throughout the Caribbean, Central America, Mexico, and South America. Tar spot was identified in the United States for the first time in 2015, in northern Illinois and Indiana. As of 2019, tar spot has also been confirmed in Florida, Iowa, Michigan, Minnesota, Missouri, Ohio, and Wisconsin (Figure 1).

During the 2018 and 2019 growing seasons, the distribution, prevalence, and severity of tar spot increased dramatically, and in some areas caused substantial yield losses. This publication discusses our knowledge of tar spot, describes diseases commonly confused with tar spot, and offers basic management guidelines.

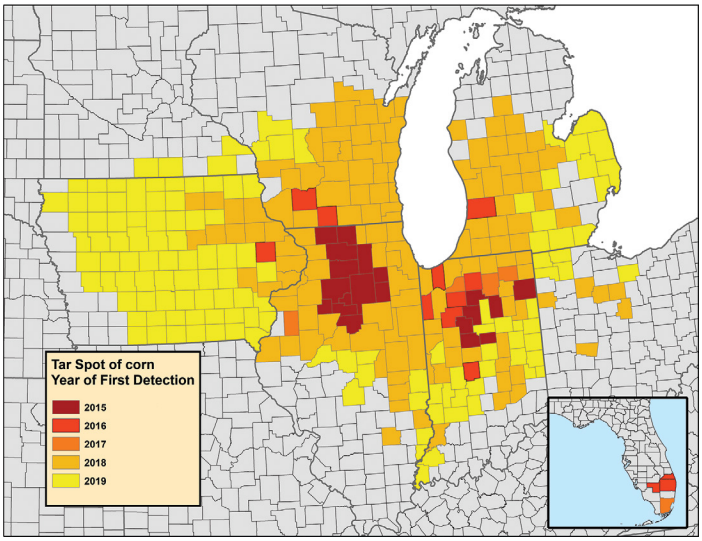

Figure 1. Areas where tar spot has been confirmed in the United States since 2015.

Symptoms and Signs

In the United States, tar spot of corn is caused by the fungus *Phyllachora maydis*. The fungus produces small (1/16-3/4 inch), round to irregular diamond-shaped, raised black structures called stromata. These structures form on both the upper and lower surfaces of corn leaves (Figure 2). In severe cases, stromata may also be observed on leaf sheaths, husks, and tassels.

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 development. Leaves of infected plants prematurely die when severity is approximately 30 percent or more.

Occasionally, tan to brown lesions with dark borders can develop around the stromata (Figure 3). The lesions are referred to as fisheye lesions because of their appearance. Fisheye lesions are frequently observed in areas of Mexico and Central America. When fisheye lesions occur in these areas, the disease is called tar spot complex, because a second fungus (*Monographella maydis*) is thought to be associated with these lesions.

Although fisheye lesions have been observed in the United States, *M. maydis* has not been detected. Fisheye lesions could potentially be related to hybrid genetics, the genetics of the tar spot fungus, the environment, a different microbe forming a complex with *P. maydis*, or some unknown factor. In any case, the cause of fisheye lesions observed in United States tar spot outbreaks is currently unknown.

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 there are many species of *Phyllachora* that infect various grass species, *P. maydis* is only known to infect corn. *Phyllachora maydis* can overwinter in Midwestern states where the disease has been confirmed. Spring ascospore viability can range from as low as 2.5 percent to as high as 25 percent on corn leaves that overwinter in Midwest U.S. fields. Rain and high humidity cause the stromata to release spores (ascospores and conidia; Figure 4) that are dispersed by rain splash or wind. Spores can be dispersed in-field and locally.

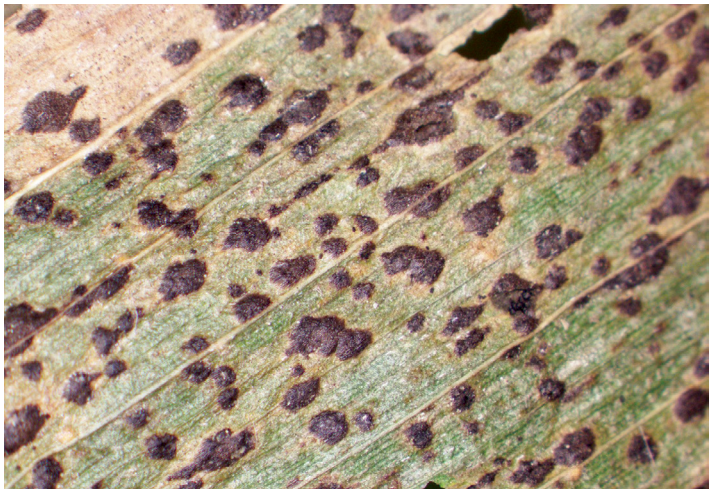

Figure 2. *Phyllachora maydis*, the fungus that causes tar spot, produces stromata that can be slightly raised, black, and often observed on leaves of affected corn plants.

Figure 3. Tar spot stromata surrounded by brown, necrotic tissue producing a fisheye appearance.

According to data from Central America, ascospores are released as single spores or in bunches. After infection, new stromata form within infected tissue in 12-15 days. The stromata can produce spores soon thereafter. When conditions are favorable, multiple spore release events and infection cycles can occur during the growing season. Corn is susceptible to infection at any developmental stage.

Conditions that Favor Disease

In Central America, cool temperatures 60-70°F (16-21°C) and high relative humidity (greater than 75 percent) favor tar spot development. In addition, disease increases when there is at least seven hours of free moisture on the leaves due to rain, fog, or high relative humidity. Corn production under irrigation is at a much greater risk to yield losses compared to non-irrigated corn. Overhead irrigation can increase leaf wetness duration, thereby making conditions more conducive for disease development and spread.

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

Yield Losses and Impact

Yield losses due to tar spot can be variable, depending on the time of disease onset, weather conditions, and hybrid susceptibility. Losses can be minimal to none, and in severe cases, losses of 50 bushels per acre or more have been observed. Yield losses are a function of reduced ear weight, poor kernel fill, and vivipary (a condition in which the seed germinates while still on the cob). Stalk rot and lodging may increase when tar spot severity is high. Severe tar spot also reduces silage corn feed quality by reducing moisture, decreasing digestible components and reducing energy. No associated mycotoxins have been reported for this disease.

Diagnosis

You can diagnose corn tar spot in the field by examining corn leaves for the presence of circular to diamond-shaped, black, tar-like spots, which may have a slightly raised appearance and feel bumpy to the touch. Tar spot stromata cannot be wiped off the leaf. Tar spot has been observed most often in the United States during or after silking through to late grain fill (growth stages R1-R6), but may appear earlier. Initial stromata can form on lower or upper leaves depending on the onset of disease development, and have been observed on green and senesced tissues. Occasionally, necrotic brown tissue may surround the black stomata, which produces a fisheye appearance. If you suspect tar spot, send a sample to your state diagnostic lab or contact your extension state specialist to confirm the diagnosis.

Diseases with Similar Symptoms

How to distinguish Common and Southern Rust (*Puccinia spp.*) from tar spot

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

How to distinguish corn rusts from tar spot:
Use magnification (e.g., hand lens or microscope for phone) to examine the lesion. Rust lesions erupt through the leaf surface causing small tears in the leaf epidermis, and you can rub off the spores. Tar spots are raised and black, and cannot be rubbed off with your finger.

Figure 5. Southern rust (left) and common rust pustules erupt through leaf surfaces.

Physoderma Brown Spot (*Physoderma maydis*)

Physoderma brown spot forms purple-to-brown circular spots along the leaf midrib and leaf sheath, and small, light-brown to orange circular spots that often occur in bands within the leaf tissue.

How to distinguish Physoderma brown spot from tar spot:

Tar spots are often slightly raised or feel bumpy when touched, 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 stromata usually occur from the middle toward the tip of the leaf blade.

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

Insect Frass and Soil

How to distinguish insect frass and soil from tar spot:

Insect frass and soil will rub off the corn leaf. Tar spot stromata are embedded in the leaf tissue and will not rub off the leaf surface.

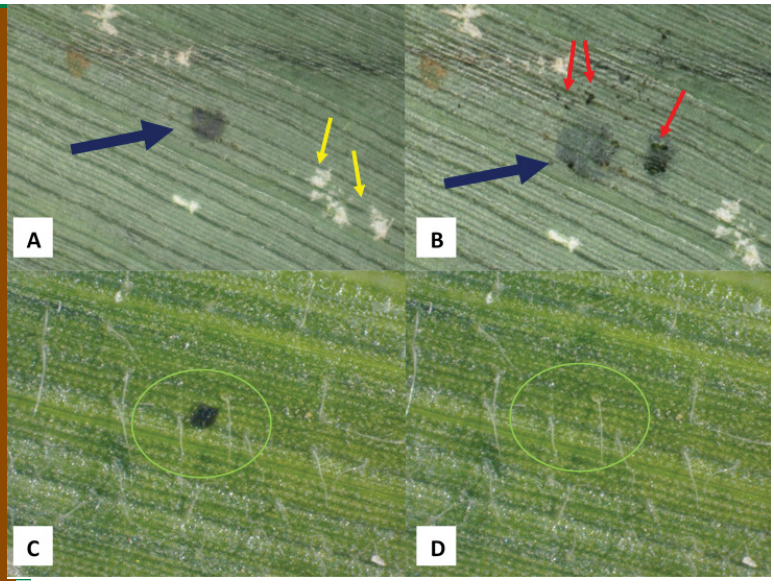

Figure 7. Insect frass can be rubbed off the corn leaf, while tar spot lesions cannot. The dark markings on the leaf in (A) have been rubbed off, as compared to the original in (B). The dark mark in (C) has been removed in (D).

Management

Our understanding of this disease in the United States is limited because of its recent establishment. Most of what we know about tar spot has originated from Mexico and Central America; however, differences in regional environments, fungal populations, hybrid genetics, and cropping systems may influence disease development and management practices.

Several management practices may help reduce tar spot development and severity.

1. **Avoid highly susceptible hybrids.** Speak to your seed dealer or crop adviser and check university corn performance trial data. Due to the recent establishment of tar spot, there have been limited opportunities to screen hybrids and breeding material for resistance to tar spot. To date, all hybrids have some level of susceptibility to tar spot, though some are less susceptible than others.

2. **Consider fungicides.** Some fungicides may reduce tar spot, and there are several fungicides with 2ee labels that can be used to manage tar spot. While fungicides have shown efficacy in managing tar spot, timing of fungicide applications is important in successfully managing this disease. We have little consistent data regarding the optimal time to apply fungicides for tar spot management. Determining the optimum timing has been difficult due to year-to-year variability in disease onset and severity observed thus far. Efforts are underway to understand the biology and epidemiology of this disease, which may help to develop better fungicide application timing recommendations. For more information on fungicides available for tar spot management consult CPN-2011 Fungicide Efficacy for Control of Corn Diseases (doi.org/10.31274/cpn-20190620-002).

3. **Manage irrigation.** Reducing the frequency and duration of leaf wetness may reduce disease. Anecdotal evidence indicates that excessive irrigation or frequent, light irrigation events may increase disease. However, there is limited research on the impact of irrigation on tar spot, and farmers who rely on irrigation should consult a local extension specialist to determine how irrigation may influence disease development.

4. **Rotate to other crops.** Crop rotation seems to only play a minor role in reducing risk of tar spot. However, this practice will allow residue to decompose and reduce the primary inoculum. At present, it is not yet known how many years of rotation away from corn are needed to reduce inoculum.

5. **Manage residue.** Tillage appears to only play a minor role in reducing risk of tar spot. Tilling fields buries infected residue and increases the rate of decomposition, which may help reduce the amount of overwintering tar spot inoculum in a field, but will not reduce the risk of infection from locally dispersed inoculum.

6. **Scout for tar spot** and be prepared to harvest heavily diseased fields early if push tests indicate that stalk integrity is impacted to avoid lodging. In-season confirmations of tar spot can be monitored at https://corn.ipmpipe.org/tarspot.

Find Out More

Other publications in the Corn Disease Management series are available on the Crop Protection Network website (www.cropprotectionnetwork.org).

Authors

Darcy Telenko, Purdue University
Martin Chilvers, Michigan State University
Nathan Kleczewski, University of Illinois
Daren Mueller, Iowa State University
Diane Plewa, University of Illinois
Alison Robertson, Iowa State University
Damon Smith, University of Wisconsin
Albert Tenuta, Ontario Ministry of Agriculture, Food and Rural Affairs
Kiersten Wise, University of Kentucky

Reviewers

Tom Allen, Mississippi State University
Gary Bergstrom, Cornell University
Kaitlyn Bissonnette, University of Missouri
Carl Bradley, University of Kentucky
Emmanuel Byamukama, South Dakota State University
Alyssa Collins, Pennsylvania State University
Nicholas Dufault, University of Florida
Paul Esker, Pennsylvania State University
Travis Faske, University of Arkansas
Andrew Friskop, North Dakota State University
Tamra Jackson-Ziems, University of Nebraska
Doug Jardine, Kansas State University
Alyssa Koehler, University of Delaware
Dean Malvick, University of Minnesota
Hillary Mehl, Virginia Tech University
Pierce Anderson Paul, The Ohio State University
Trey Price, LSU AgCenter
Richard Raid, University of Florida
Ed Sikora, Auburn University
Adam Sisson, Iowa State University
Lindsey Thiessen, North Carolina State University
Heather Young-Kelly, University of Tennessee

Photo Credits

All photos were provided by and are property of the authors and contributors, except Figure 2, by Edward Zaworski, Iowa State University.

Acknowledgments

This publication was developed by the Crop Protection Network, a multi-state and international collaboration of university/provincial extension specialists and public/private professionals that provides unbiased, research-based information to farmers and agricultural personnel. The authors thank the Grain Farmers of Ontario for their support.

May 2020

We Are Extension
Grain Farmers of Ontario
Crop Protection Network
A Product of Land Grant Universities
USDA
United States Department of Agriculture
National Institute of Food and Agriculture