TAR SPOT IDENTIFICATION AND SYMPTOMS

In part 2 of this series, learn how to identify, manage or treat tar spot

Tar spot *(Phyllachora maydis)* 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 (Figures 1 and 2). Tar spot spreads from the lowest leaves to the upper leaves, leaf sheathes, and eventually the husks of the developing ears.[1] Under a microscope, *P. maydis* spores can be distinguished by the presence of eight ascospores inside an elongated ascus, resembling a pod containing eight seeds.

Figure 1. A corn leaf with tar spot symptoms.

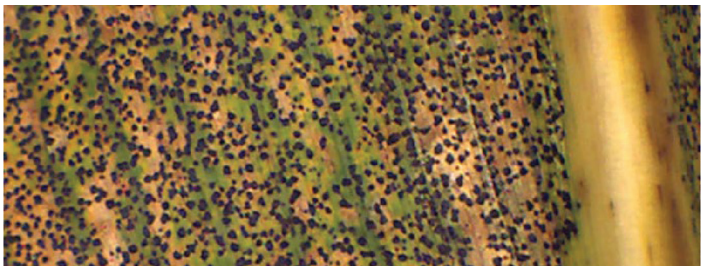

Figure 2. Corn leaf under magnification showing dense coverage with tar spot ascomata.

Tar spot lookalikes

Common rust (*Puccinia sorghi*) and southern rust (*Puccinia polysora*) can both be mistaken for tar spot, particularly late in the growing season when pustules on the leaves produce black teliospores (Figure 3a). Rust pustules can be distinguished from tar spot ascomata by their jagged edges caused by the spores breaking through the epidermis of the leaf (Figure 3b). Rust spores can be scraped off the leaf surface with a fingernail, while tar spot cannot. Saprophytic fungi growing on senesced leaf tissue can also be mistaken for tar spot.

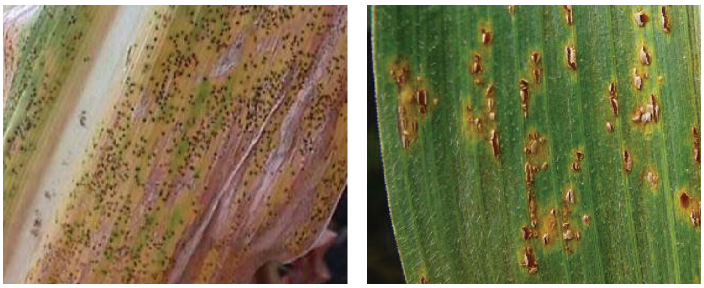

Figure 3a. Southern rust in the teliospore stage late in the season, which can resemble tar spot (left). **Figure 3b.** Corn leaf with common rust spores showing jagged edges around the pustules (right).

MANAGEMENT CONSIDERATIONS

Yield impact

2018 was the first time that corn yield reductions associated with tar spot were documented in the U.S. University corn hybrid trials conducted in 2018 suggested potential yield losses of up to 39 bu/acre under heavy infestations.[2]

Differences in hybrid response

Observations in hybrid trials have shown that hybrids differ in susceptibility to tar spot.[3] Tar spot affects yield by reducing the photosynthetic capacity of leaves and causing rapid premature leaf senescence. Longer maturity hybrids for a given location have been shown to have a greater risk of yield loss from tar spot than shorter maturity hybrids.[2] Genetic resistance to tar spot should be the number one consideration when seeking to manage this disease, as it appears to have a greater impact on symptoms and yield loss than either cultural or chemical management practices.

Stalk quality

Severe tar spot infestations have been associated with reduced stalk quality. Stress factors that reduce the amount of photosynthetically functioning leaf area during grain fill can increase the plant's reliance on resources remobilized from the stalk and roots to complete kernel fill. Remobilizing carbohydrates from the stalk reduces its ability to defend against soil-borne pathogens, which can lead to stalk rots and lodging.

Tar spot seems to be particularly adept at causing stalk quality issues due to the speed with which it can infest the corn canopy, causing the crop to senesce prematurely. If foliar symptoms are present, stalk quality should be monitored carefully to determine harvest timing.

Fungicide treatments

Research has shown that fungicide treatments can be effective against tar spot.[1] Specific management recommendations for the use of fungicides in managing tar spot in the Midwestern U.S. are still in development as more research is done.

University trials conducted in 2018 in locations where tar spot was present provided evidence that fungicides can reduce tar spot symptoms and potentially help protect yield. However, initial work also suggested that tar spot may be challenging to control with a single fungicide application due to its rapid reinfection cycle, particularly in irrigated corn.

A 2019 Purdue University study compared single-pass and two-pass treatments for tar spot control using Aproach® (picoxystrobin) and Aproach® Prima (picoxystrobin + cyproconazole) fungicides under moderate to high tar spot severity.[4] Fungicide treatments were applied at the VT (August 8) and R2 stages (August 22), and disease symptoms were assessed on September 30. Results showed that all treatments significantly reduced tar spot symptoms relative to the nontreated check, with Aproach Prima fungicide applied at VT and two-pass treatments at VT and R2 providing the greatest reduction in tar spot stroma and associated chlorosis and necrosis on the ear leaf (Figure 4).

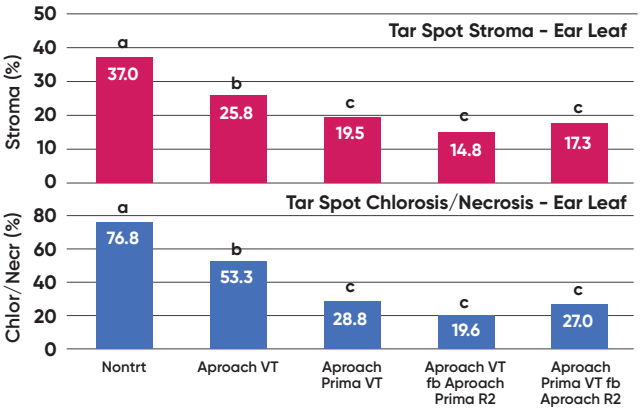

Figure 4. Fungicide treatment effects on tar spot symptoms in a 2019 Purdue University study. Visually assessed tar spot stroma and chlorosis/necrosis (0-100%) on the ear leaf.

Means followed by the same letter are not significantly different based on Fisher's Least Significant Difference test (LSD; **α**=0.05).

Aproach Prima fungicide applied at VT and the two-pass treatments all significantly increased yield relative to the nontreated check. Aproach Prima fungicide applied at VT followed by Aproach fungicide at R2 had the greatest yield, although it was not significantly greater than Aproach followed by Aproach Prima (Figure 5).

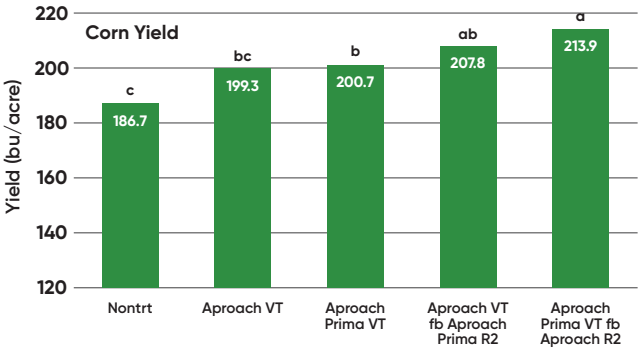

Figure 5. Fungicide treatment effects on corn yield in a 2019 Purdue University study.

Means followed by the same letter are not significantly different based on Fisher's Least Significant Difference test (LSD; **α**=0.05).

On-farm fungicide trials conducted in 2021 appeared to confirm concerns that the rapid reinfection rate of tar spot would make it difficult to control with a single pass fungicide treatment. Precise application timing was often critical, and two applications were necessary in some cases to provide adequate tar spot control. Disease forecasting models such as Tarspotter, developed at the University of Wisconsin, may be helpful in optimizing timing of fungicide applications. Tarspotter uses several variables including weather to forecast the risk of tar spot fungus being present in a corn field. https://ipcm.wisc.edu/apps/tarspotter/

Several foliar fungicide products are available for management of tar spot in corn. Aproach and Aproach Prima fungicides have both received FIFRA 2(ee) recommendations for control/suppression of tar spot of corn.

Agronomic 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 feet, so any benefit from rotation or tillage practices that reduce corn residue in a field may be negated by spores moving in from neighboring fields. Evidence so far suggests that rotation and tillage probably have little effect on tar spot severity. Agronomists have noted that infestation may occur earlier in corn following corn fields, where infection proceeds in a "bottom-up" manner from inoculum present in the soil, in contrast to rotated fields that more commonly exhibit "top-down" pattern of infection from spores blowing in from other fields.

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.[5]

HOW FAR WILL TAR SPOT SPREAD?

Climate modeling based on long-term temperature and rainfall data was used to predict areas at risk of tar spot infection based on the similarity of climate to the current area of infestation.[6] Model forecasts indicated the areas beyond the then-current range of infestation at highest risk for spread of tar spot were central Iowa and northwest Ohio. Observations in recent growing seasons have been consistent with model predictions, with further spread of tar spot to the east in Ohio, Ontario and Pennsylvania and a dramatic expansion of tar spot across Iowa and into parts of Minnesota and Missouri. Results indicated the potential for further expansion to the north and south but primarily to the east and west, including corn production areas of New York, Pennsylvania, Ohio, Missouri, Nebraska, South Dakota, eastern Kansas and southern Minnesota.

[1] Bajet, Narceo, B.L. Renfro, and Jorge M. Valdez Carrasco. 1994. "Control of tar spot of maize and its effect on yield." *International Journal of Pest Management*, 40 (1994):121-125.

[2] Telenko, Darcy., Martin Chilvers, Nathan Kleczewski, Damon Smith, Adam Byrne, Phil Devillez, Thierno Diallo, et al. "How tar spot of corn impacted hybrid yields during the 2018 Midwest epidemic." Crop Protection Network. July 29, 2019. https://cropprotectionnetwork.org/publications/how-tar-spot-of-corn-impacted-hybrid-yields-during-the-2018-midwest-epidemic.

[3] Kleczewski, Nathan, and Damon Smith. "Corn Hybrid Response to Tar Spot." *The Bulletin*, September 7, 2018. University of Illinois Extension. http://bulletin.ipm.illinois.edu/?p=4341.

[4] Da Silva, Camila da Rocco, Darcy Telenko, Jeffrey Ravellette, and Su Shim. "Evaluation of a fungicide programs for tar spot in corn in northwestern Indiana, 2019" (COR19-23. PPAC). *In Applied Research in Field Crop Pathology for Indiana*-2019, BP-205-W by Darcy Telenko, 50-51. Purdue University Extension, 2019.

[5] Kleczewski, Nathan. "What do low tar spot disease levels and prevent plant acres mean for 2020 corn crop?" *Illinois Field Crop Disease Hub*, 2019. University of Illinois Extension. http://cropdisease.cropsciences.illinois.edu/?p=992.

[6] Mottaleb, K.A., A. Loladze, K. Sonder, G. Kruseman, and F. San Vicente. 2018. "Threats of tar spot complex disease of maize in the United States of America and its global consequences." *Mitigation and Adaptation Strategies for Global Change*. Springer Link. May 3, 2018. https://link.springer.com/article/10.1007/s11027-018-9812-1