Microbial allies may help turn tables on tar spot fungus in corn

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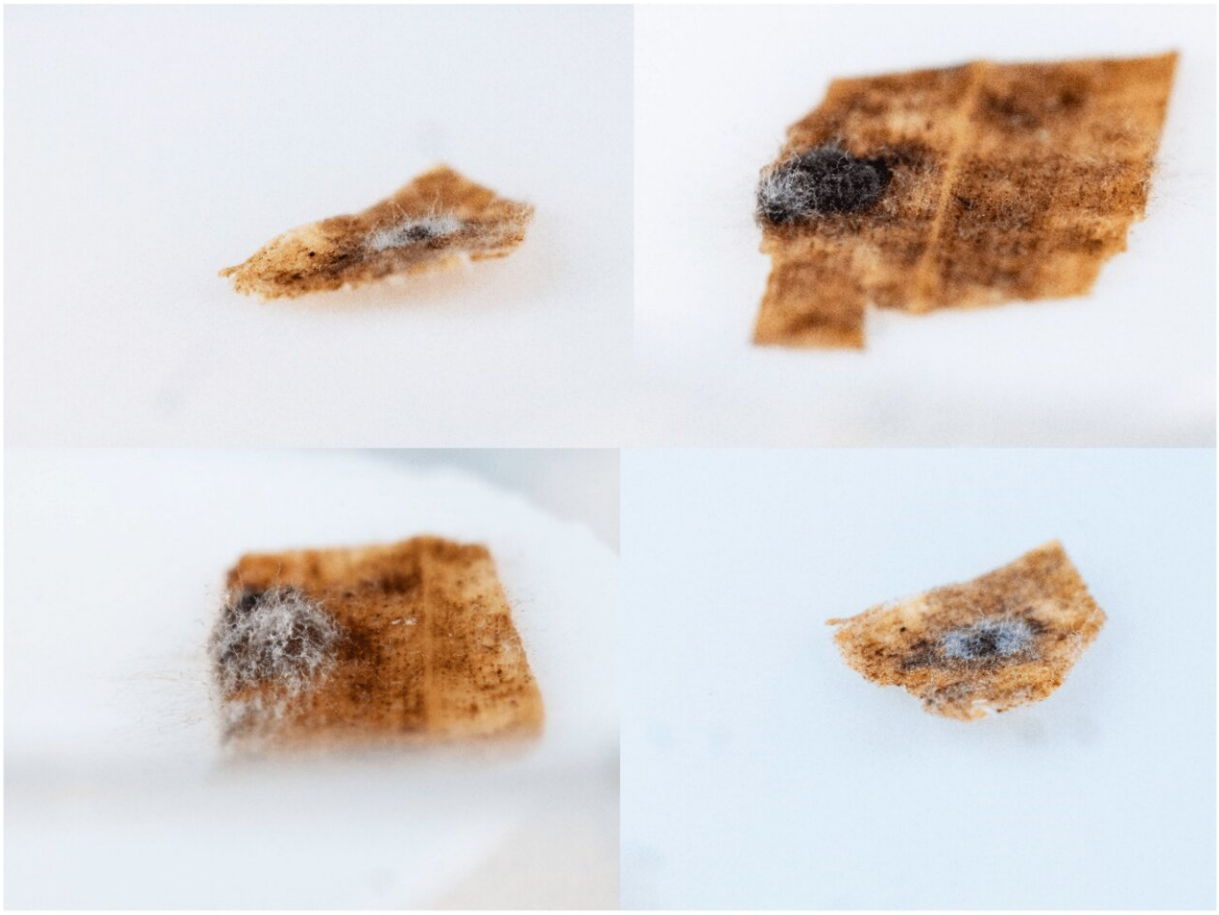

Several examples of a possible biological control organism emerging from P. maydis overwintered stromata. Credit: *Microorganisms* (2023). DOI: 10.3390/microorganisms11061550

Agricultural Research Service (ARS) scientists are leaving no stone—or rather, leaf—unturned in their search for new ways to counter the fungus that causes tar spot, a yield-robbing disease of field corn in the midwestern United States.

First reported in Illinois and Indiana in 2015, tar spot has now expanded to include other nearby states, as well as Florida and Canada. The disease manifests as raised black spots that mottle the leaves, husks and stalks of susceptible corn varieties, diminishing their photosynthetic ability and, in severe cases, killing the plants and inflicting grain yield losses of 20 to 60 bushels an acre.

Now, however, those same spots may reveal a hidden foe of the fungus that causes tar spot, Phyllachora maydis. The spots, called stromata, are a tough, structural form of the fungus that enables it to survive the winter and release a bevy of spores the following spring that infect the next corn crop.

But a team of sharp-eyed scientists with ARS's National Center for Agricultural Utilization Research in Peoria, Illinois, observed that some stromata specimens they collected failed to germinate—the "handiwork" of other fungi and bacteria that parasitize the tar spot fungus, potentially opening the door to a biologically based approach to controlling it.

The scientists' observation came while inspecting a research plot of corn near the ARS center in April 2022. Mild outbreaks of tar spot can generally be reduced with synthetic fungicide applications and corn varieties that can tolerate some damage from the fungus. But under the right weather conditions, severe outbreaks can overwhelm these defenses, exacting a costly toll on farmer profits and underscoring the need for additional countermeasures that can be deployed.

Fortunately, nature, with its system of checks and balances, offered

several different species of fungi and bacteria that grow and reproduce on or inside the fungus's stromata—some of which appeared as a whitish fuzz on the stromata when researchers examined them under a microscope in the laboratory.

The researchers' use of DNA-based identification methods revealed that some of the fungi and bacteria were known biological control agents of diseases affecting other crops. In trials, for example, exposure to spores of Gliocladium catenulatum (a commercially available biocontrol fungus) prevented 88 percent of the tar spot fungus' stromata from germinating. An Alternaria fungus isolated from a tar spot stroma prevented about 45 percent of stromata from germinating.

Several research studies have demonstrated that some strains of Alternaria alternataare effective biocontrol organisms that can reduce the damage caused by plant pathogens, said Eric Johnson, a research molecular biologist with the ARS center's Crop Bioprotection Research Unit in Peoria.

Additionally, laboratory assays indicated that the Alternaria strain tested did not cause disease in a susceptible variety of corn when added to damaged portions of leaves. It may be additionally useful in killing overwintering tar spot stromata given that the tested strain grew well at cold temperatures, Johnson added.

The scientists' studies are in the early stages and more research will be necessary to fully ascertain the fungi and bacteria's potential to biologically control tar spot in commercial fields when applied during the growing season or to kill overwintering. In the meantime, other approaches for managing the disease are also being explored, both in Peoria and at ARS's Crop Production and Pest Control Research Unit in West Lafayette, Indiana. These include:

- Examining the basic biology and genetic underpinnings of the tar spot fungus for clues to new ways of controlling it.
- Developing molecular markers to speed the search for new sources of tar spot resistance in corn.
- Exploring strategies to make better use of fungicides registered for use against tar spot in corn as part of an integrated approach to managing the disease.

Details on the biocontrol potential of the tar spot fungus's natural rivals were published in the June 2023 issue of the journal *Microorganisms* by Johnson and co-authors Pat Dowd, Jose Ramirez and Robert Behle—all with the ARS center's Crop Bioprotection Research Unit in Peoria.

More information: Eric T. Johnson et al, Potential Biocontrol Agents of Corn Tar Spot Disease Isolated from Overwintered Phyllachora maydis Stromata, *Microorganisms* (2023). DOI: 10.3390/microorganisms11061550

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