1000 Piece Dollar Spot Puzzle

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Winter is upon us (or at least it feels like winter to me) and you are probably wondering why I am writing about dollar spot. Well there is a good reason. I thought it would be good to tell you about the goals of my program with respect to dollar spot. This article is going to start with a review of the dollar spot pathosystem, during which I will point out discrepancies that need to be more carefully studied. Then the article will finish with our research plans with dollar spot.

Sclerotinia homoeocarpa was first reported as a pathogen of turfgrass in 1937 by F.T. Bennet. Although this particular name is still used, the taxonomy of this fungus is still undecided to this day. It is well known that the dollar spot pathogen is not a true *Sclerotinia* because it does not produce true sclerotia (survival structure); rather the dollar spot pathogen produces a flat stroma (Fig. 1). Identification of fungi is largely based on asexual and sexual spore morphology and to our knowledge the dollar spot pathogen produces neither. Therefore we are reliant on DNA techniques to properly classify this organism. So why has this work not been done? DNA work is expensive and requires a lot of time. For example, to conduct a project to properly classify this organism solely with DNA techniques, hundreds if not thousands of dollar spot isolates would need to be collected. Then three or four different genes would have to be sequenced, which equates to three or four years of work. On top of that time commitment, DNA work is tricky and may not work. Yet, people are doing this as we speak, or at least they are attempting to do this. Hopefully we can provide an update in the near future on this part of the dollar spot puzzle.

Okay we got the boring stuff out of the way; let's talk about the more practical aspect of the dollar spot pathosystem, the disease

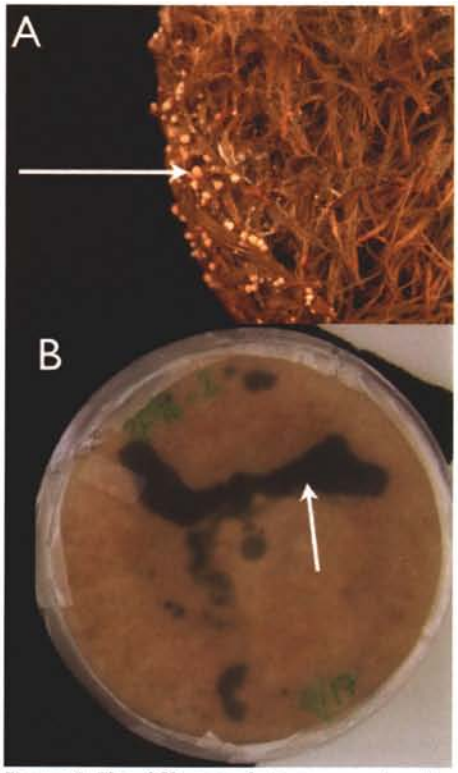

Figure 1. The difference between a sclerotia and a stroma. A) A true sclerotia that is produced by the turfgrass pathogen *Sclerotium rolfsii*. The white arrow indicates the sclerotium. *S. rolfsii* is a totally different fungus than a *Sclerotinia*, but it illustrates a true sclerotium very well. B) The white arrow points to the flat stroma that the dollar spot pathogen produces.

cycle. The dollar spot pathogen is thought to survive in the form of dormant mycelium and stroma in and on plant tissue. Then when conditions are favorable to the pathogen, the stroma or mycelium becomes active. The pathogen would then infect turfgrass leaves. As infection progresses to colonization we start to see symptoms characteristic of dollar spot. Once temperatures cool down in the spring the pathogen goes into survival mode again (Fig 2). One big caveat, this is a theoretical disease cycle. In other words no one has done the research to outline any of the dollar spot disease cycle.

Why it is important to understand the disease cycle? Well a basic understanding of the interaction between the dollar spot pathogen and its host is crucial for timing fungicide applications, cultural practices, fertilizer applications, etc. For example, a key component to the dollar spot pathosystem is how does the fungus survive. If we knew that we might be able to lower inoculum levels by lowering the survival rate of the fungus. Another key component that we do not understand is how temperature affects infection of turfgrasses by the dollar spot pathogen. These are all things that the turfgrass pathology program aims to address.

Dollar Spot Epidemiology:

The turfgrass pathology program will examine the effect of soil temperature on pathogen growth; determine the optimal temperature for infection of turfgrasses by the dollar spot pathogen; attempt to transform the dollar spot fungus with green fluorescent protein (GFP) in order to carefully study the interaction between the pathogen and it's host; and finally build and validate a "new" forecasting model for dollar spot.

For the first objective, the dollar spot pathogen will be grown on the surface of a native soil and USGA specification sand and exposed to temperatures ranging from 52 to 90°F. We will then measure the diameter of the fungus to get an idea of growth rate in soil in response to temperature. In conjunction with this experiment, we

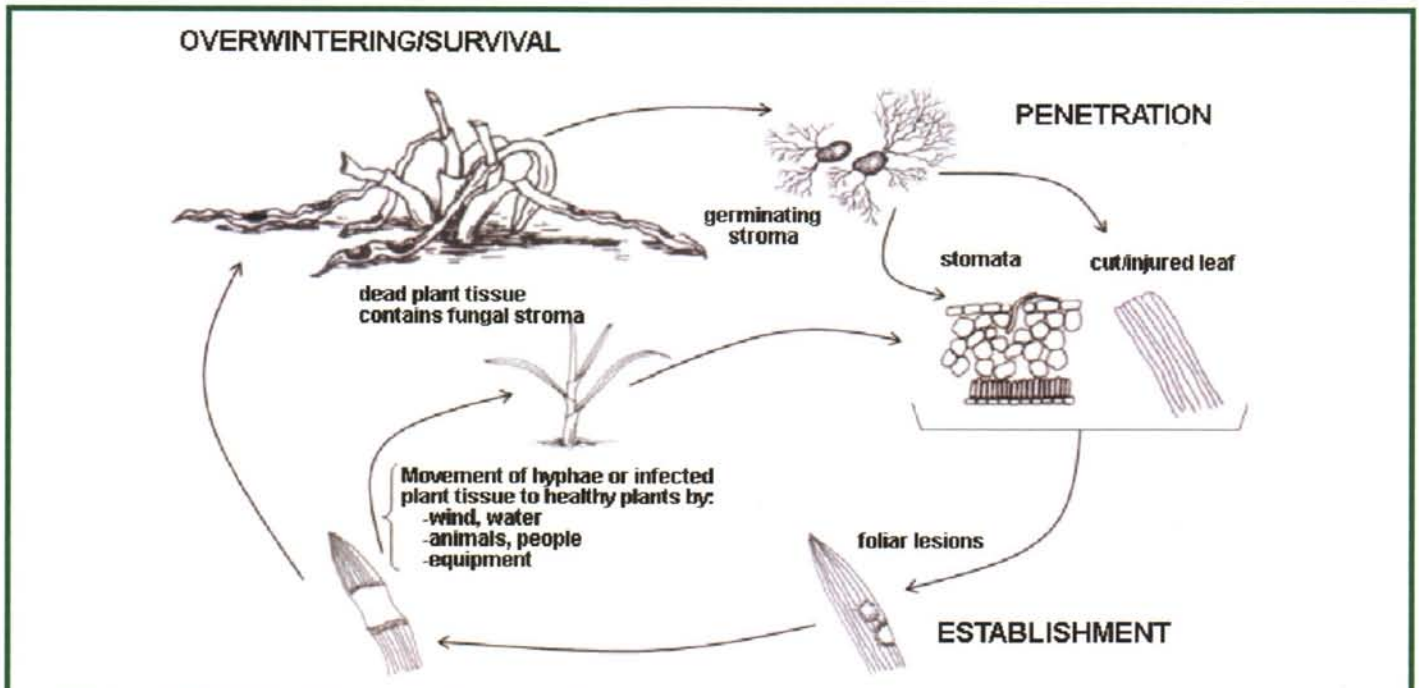

Figure 2. The dollar spot disease cycle. Figure was adapted from the American Phytopathological Society's learning and teaching tool on dollar spot of turfgrasses-www.apsnet.org/education/LessonsPlantPath/dollarspot/default.htm.

will also examine the influence of temperature on infection of creeping bentgrass by the dollar spot pathogen. This will be done in growth chambers so we can precisely control the temperature treatments. We will evaluate infection by quantifying the level of disease within each temperature treatment (Fig 3).

We are going to attempt to insert a gene into the dollar spot pathogen that will cause the pathogen to glow green under fluorescent light. This will allow us to accurately determine when and where the dollar spot pathogen infects turfgrass plants. This molecular tool will also allow us to monitor pathogen survival and colonization. This tool has been used extensively with pathogens of various field crops and has also been used for the spring dead spot pathogens of bermudagrass (Fig 4).

Finally, we are working with Dr. Damon Smith at Oklahoma State University to develop a dollar spot-forecasting model. Forecasting models for dollar spot have been developed in the past, but had little success in predicting dollar spot epidemics. However, newer statistical tools are available that facilitate the development of extremely powerful models for disease forecasting. Dr. Smith developed a model and spray advisory for Sclerotinia blight of Peanut that accu-

Figure 3. Example of how temperature treatments will be evaluated in growth chambers with respect to dollar spot development. This is picture depicting the influence of soil temperature on infection of creeping bentgrass roots by a Pythium root dysfunction pathogen.

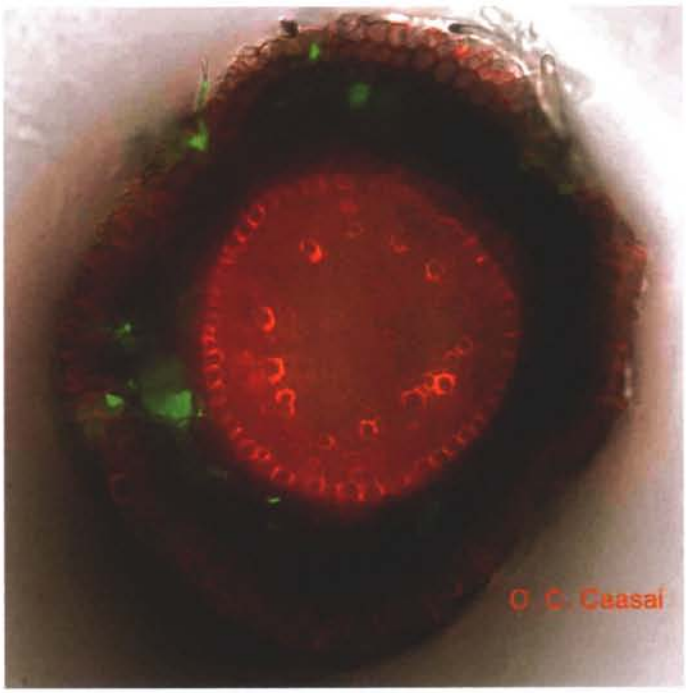

Figure 4. At Oklahoma State University, transgenetic isolates of O. herpotricha expressing green fluorescent protein (GFP) are being used to monitor the infection process. Here the pathogen can be seen colonizing the root epidermis and cortex, but is not present in the vascular cylinder. Figure was adapted from American Phytopathological Society's feature article section. www.apsnet.org/online/feature/view.aspx?ID=931

rately predicted epidemics and cut fungicide application in half. In order to do this, we will have to collect at least two years of weather data along with quantifying the amount of spots that appear. Spots will be counted daily once the epidemic begins. Then we can correlate the weather parameters to the amount of disease to determine which weather parameters influence dollar spot epidemics the most. Then we can construct a forecasting model that we can build into a computer program. The overall goal is to have an algorithm that will provide a spray advisory.

This work will be conducted be a graduate student from the department of plant pathology that will be starting in January of 2009. Our department recruits a group of students to pursue their PhD, and then during their first semester they rotate through different faculty member's labs. By the end of the first semester they are placed in someone's lab. Currently, we do not know who that student is going to be.

Integration of Dollar Spot and Snow Mold Control:

Paul Koch is going to pursue his PhD with me as well. Part of his project is going to expand on the early season dollar spot work presented in the last issue of Grassroots. Basically, Paul is going to evaluate more applications in the fall and spring and compare those to a traditional fungicide program. Applications will be conducted 1) once in fall; 2) twice in fall; 3) once in the spring; 4) twice in the spring; 5) once in the fall and once in the spring; and 6) twice in the fall and spring. We will only use boscalid (BASF's Emerald) and a tank mix of iprodione and chlorothalonil. The goals of this study are to determine if these particular fungicide timings can reduce dollar spot levels to below 5 to 10% disease severity and if acceptable dollar spot control is achieved-how much can a turfgrass manager save when compared to a traditional program.

Of course I would like to hear your input and thoughts on these ideas, so please feel free to contact me, my email address is jpk@plantpath.wisc.edu. Also if anyone has room for a dollar spot plot for this spring or summer, we would love to bring a weather station to your course to conduct our forecasting study. However, please keep in mind that the plot is likely to look pretty bad. I am very excited about starting this work and I hope you don't think like Ty Webb-"Don't sell yourself short Jim, you're a tremendous slouch!