Gray Leaf Spot - A Serious, Emerging Disease on Perennial Ryegrass

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I have been interested in plant diseases in one form or another since I was young. I grew up on a small farm in northern Minnesota and saw many different diseases on the plants and trees around me. As I got older, and especially during my undergraduate training I became more interested in science and research in general. When I came to graduate school at UW-Madison I knew that I wanted a research project that emphasized both genetics and plant disease. There were several projects of this type in the Plant Pathology department, but the project dealing with perennial ryegrass and gray leaf spot in Dr. Jung's lab seemed like the best one for me. In this article I would like to tell you a little bit about gray leaf spot itself, what superintendents and turf managers are doing about it, and finally a little bit about my research.

The main host for gray leaf spot is perennial ryegrass (*Lolium perenne*), although it also causes problems on tall fescue (*Festuca arundinacea*), and warm-season grasses such as St. Augustinegrass (*Stenotaphrum secundatum*). Perennial ryegrass is a valuable cool-season turf and forage grass, extensively used on golf fairways and roughs, as well as on athletic fields and home lawns. Lately many improved cultivars have become available, causing renewed interest in and more widespread use of this species.

Gray leaf spot has recently emerged as a serious disease on perennial ryegrass. It is caused by *Magnaporthe grisea*, the fungus that causes rice blast disease on rice, as well as other diseases on a very wide host range among the grass family. For example, it causes foliar disease on wheat, barley, and other turf and forage grasses such as forage annual ryegrass (*Lolium multiflorum*).

Although gray leaf spot has been known on annual ryegrass and St. Augustinegrass in the south for many years, it was first reported on perennial ryegrass in Pennsylvania in 1992 after a spell of hot, humid weather. It was subsequently reported in other midwestern, eastern, and southeastern states, now reaching as far north and west as central Illinois and Kansas. Under warm, humid conditions mature ryegrass plants, and the fields or fairways they compose, can be completely destroyed in a matter of several days.

Most perennial ryegrass varieties are susceptible to this disease, although data from the National Turfgrass Evaluation Program (NTEP) shows some difference among varieties in damage from gray leaf spot. The current control methods involve cultural practices such as reduction of leaf wetness (by changing irrigation practices), lowered cutting heights, which act to create a less favorable environment for the fungus, and reduction of nitrogenous fertilizer applications, as too much nitrogen increases the turf's susceptibility to gray leaf spot.

Also very important is fungicide application, as the other practices only contribute to the control of the disease. However, the causal fungus has begun to develop resistance to one of the most effective fungicides, the strobilurins (Heritage). Although only a few strains are resistant and there are other classes available, such as thiophanate-methyl and DMIs, the ability of this fungus to rapidly change genetically suggests that resistance to these other fungicides may also arise. Therefore resistance management strategies, such as not applying strobilurins repeatedly, are very important.

One control tactic that would be very useful against gray leaf spot is host resistance. In fact, in rice, which is the main crop host of *Magnaporthe grisea*, resistance is the most commonly used strategy. If resistant perennial ryegrass cultivars were available, the amount of fungicide applications required would be greatly reduced. And that is the main focus of my research.

Our lab received a group of ryegrass genotypes derived from a cross of annual and perennial ryegrass made at Oregon State University. This group of plants was constructed in such that genetic traits could be studied using molecular DNA markers, which are basically tags or points of reference on the chromosomes. Specifically, two crosses were made, first between a clonally propagated plant of 'Manhattan' perennial ryegrass which was grown from a single seed and a similarly grown plant of 'Floregon' annual ryegrass. Then another cross was made between two other clones of 'Manhattan' and 'Floregon'. These crosses created the annual x perennial hybrid parents, which were designated MFA and MFB. Then, crosses were made between MFA and MFB, to create the mapping population, which is composed of all the progeny from the MFA by MFB cross and will likely display differences in traits such as disease resistance between progeny individuals. This population can then be used to make a genetic map of ryegrass chromosomes using molecular markers, so that the chromosomal location of all the DNA markers (points of reference), and then the chromosomal location of important traits like gray leaf spot resistance, can be determined.

In my work I have inoculated these plants with strains of the gray leaf spot fungus, and have found that the parents, MFA and MFB, are much less susceptible than the standard perennial ryegrass varieties I've tested. The perennial material consists of crosses between clones of varieties 'Linn', 'SR4400', and 'SR4500'. Moreover, the progeny plants from the two parents range widely from more susceptible than perennial types to more resistant than the parents. That is, the susceptible plants lose about half of their leaves to the disease, while the resistant plants only develop very small lesions that simply disappear, and do not permit the disease cycle to be completed.

This result will be useful to us in at least two ways, the first being eventual development of resistant cultivars. These plants have now been inoculated twice in the greenhouse, and some particular plants about half a dozen times, and the resistant ones consistently come up resistant. If they hold up in the field inoculation tests we have planned down in Illinois where gray leaf spot occurs naturally, they will show very high potential for use in breeding for gray leaf spot resistance, which can easily result in new varieties of ryegrass for use on fairways, roughs, playgrounds, and athletic fields. This will be very important for superintendents as perennial ryegrass establishes quickly from seed, so that it can be simply overseeded rather than having to completely renovate a fairway or rough using sod.

In addition, because these plants compose a population designed for genetic mapping, as explained earlier, we will also be able to determine the chromosomal location, number, and the type of action (how much effect on resistance each gene has) of the genes controlling gray leaf spot resistance in the population. We will also be able to develop molecular DNA tags that allow quick, accurate detection of resistant plants at the seedling stage using the marker-assisted selection strategy first developed in crop plants. This method will also allow detection of plants with multiple genes for resistance, rather than just one, which has been shown to increase the strength and longevity of disease resistance.

In closing, this is a very exciting project, and I am very glad to be working on it for my Ph.D. It can be pursued in many different directions, because so much is known about the genetics of the *M. grisea-plant* host system, and more importantly because the causal fungus infects so many important grass species, ranging from cereal crops to forage grasses to some of the most important amenity turfs in the expanding golf industry. And as distant as these grasses may seem, they are all in fact genetically related, so that often genetic information gained from one species can be used to help solve a problem in another. For example, ryegrass's nearest relative in the grain crops is barley, which also is susceptible to *M. grisea*. Finally this project promises many interesting results, both for scientists and end-users in the golf and turf management industries.