

Development of Gray Leaf Spot Resistant Perennial Ryegrass Through Breeding and Biotechnological Approaches

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Objectives:

1. To evaluate Pi-CO39, a resistance gene from rice, for effectiveness against gray leaf spot.
2. Introduce gray leaf spot resistance into perennial ryegrass.

Start Date: 2000

Project Duration: 3 years

Total Funding: \$75,000

Gray leaf spot is an emerging and devastating disease of perennial ryegrass. The disease is caused by the fungus *Pyricularia grisea* which has an extremely broad host range among the gramineae. *P. grisea* infects over 50 species of grass, including crops such as rice, wheat, barley, oats, rye and millet. However, the fungus displays considerable host specificity and any given strain is usually only capable of infecting one or two host species.

Unfortunately, there appears to be little or no natural resistance to gray leaf spot in perennial ryegrass as most cultivars are susceptible to the disease. For traditional breeding approaches, it is necessary to seek resistance in grasses that are closely related to perennial ryegrass.

However, there are now methods for genetic transformation of perennial ryegrass. This, along with the burgeoning availability of cloned plant disease resistance genes, opens up the possibility of finding resistance in more "exotic" sources which may be used for genetic engineering of disease-resistant perennial ryegrass.



Gray leaf spot destroys perennial ryegrass fairways and rough by infecting stem and crown tissues.

Rice represents the cornerstone crop of the cereal genome efforts. Due to its small genome size, it is likely to be the first crop to have its whole genome sequenced. Many disease resistance genes have already been mapped on the rice chromosomes and completion of the rice genome sequence will enable these resistance genes to be cloned and transferred into diverse crops. The *P. grisea* strains which are responsible for gray leaf spot in perennial ryegrass and tall fescue are unable to infect rice. These findings indicate that rice will be a useful source of resistance to gray leaf spot in perennial ryegrass.

We are using two approaches to try and obtain perennial ryegrass plants that are resistant to infection by the gray leaf spot pathogen, *Pyricularia grisea*. The first approach is based on the observation that strains of the fungus causing gray leaf spot of perennial ryegrass are unable to cause disease on rice. This suggests that rice may have disease resistance genes that recognize gray leaf spot strains, enabling rice to resist infection.

Introduction of such genes into perennial ryegrass may enable the grass to mount a defense to gray leaf spot pathogens. Work performed in the first eight months of the USGA-funded project has shown that one variety of rice (C039) is resistant to gray leaf spot because the fungus possesses a gene whose presence elicits a defense response in this host.

Moreover, this defense response is controlled by a resistance gene that has been well characterized. We hope to introduce this resistance gene into perennial ryegrass within the duration of the project to determine if it will function to provide gray leaf spot resistance to this species. The other approach we are taking is



At University of Kentucky, Dr. Mark Farman is using conventional and molecular genetics to help identify resistance to gray leaf spot that infects perennial ryegrass.

traditional breeding. Prior to starting this project, we had identified an annual ryegrass x tall fescue hybrid with high levels of resistance to gray leaf spot. This hybrid was crossed with both perennial ryegrass and tall fescue and a small amount of seed was obtained from each cross. During the past eight months, we have used inoculation tests to examine gray leaf spot resistance in the progeny from these crosses. We have found that resistance was not transmitted to any of the progeny of a cross between the hybrid and perennial ryegrass.

However, resistant progeny were identified when the hybrid was crossed with tall fescue. In the spring of 2001, we will attempt to introduce the hybrid's resistance into perennial ryegrass by performing additional crosses and by screening much larger numbers of progeny. We will also explore the possibility of introducing the resistance into perennial ryegrass by using tall fescue as an intermediary.

Summary Points

- The gray leaf spot resistance mechanism in rice is being elucidated.
- Transformation of perennial ryegrass has not started.
- Hybrid annual ryegrass x tall fescue crossed to perennial ryegrass has not produced resistant progeny.