Quantitative Trait Loci (QTL) Mapping of Resistance to Gray Leaf Spot in Lolium

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Objectives:

1. To field-evaluate quantitative resistance genes for gray leaf spot in two mapping populations, MFA x MFB and MF-8 x L4B-5.
2. To evaluate interaction between pathogen variability and host resistance in perennial ryegrass.

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Project Duration: three years
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Perennial ryegrass (*Lolium perenne*) is a valuable cool-season turfgrass. Gray leaf spot caused by *Magnaporthe grisea* has become a serious problem on perennial ryegrass. Under favorable environmental conditions, gray leaf spot can completely destroy ryegrass stands in a short period of time.

The use of host resistance is an environmentally sound method to control gray leaf spot. With the introduction of new cultivars with increased resistance to gray leaf spot ('Paragon GLR', 'Palmer GLS', 'Panther GLS', 'SR 4600', and 'Protégé'), there is concern that those resistant cultivars might break down. Research on interaction between pathogen variability and host resistance in perennial ryegrass needs immediate attention.

Our lab has conducted a genetic study about host resistance of ryegrass to gray leaf spot. A high-density linkage map of a three-generation annual x perennial ryegrass mapping population (MFA x MFB) was constructed and used to identify quantitative resistance genes for gray leaf spot. Under the greenhouse inoculations, four potential resistance QTLs were detected on linkage groups (LGs) 2 and 3 of the MFA map and on LGs 4 and 6 of the MFB map.

Some of those QTLs were confirmed in the next generation and in a different genetic background of a new mapping population. The population was derived from a cross between a resistant plant (MF-8) and susceptible plant (L4B-5). Clone L4B-5 is a perennial ryegrass genotype resulting from a cross between a clonal genotype of the forage-type perennial ryegrass cultivar named 'Linn' and the turf-type perennial ryegrass cultivar 'SR4400'. Clone MF-8 is one of the 156 progeny individuals from the MFA x MFB mapping population.

Field plots of the both mapping populations were established at the O.J. Noer Turf Research and Education Facility in Verona, Wisconsin in 2006.

Field tests of the both ryegrass populations (MFA x MFB and MF-8 x L4B-5) were conducted at Southern Illinois University and University of Kentucky. Natural disease pressure and plant growth were not optimal enough to evaluate disease-resistant phenotypes of ryegrass. Field plots of the both mapping populations were established at the O.J. Noer Turf Research and Education Facility in Madison, Wisconsin in 2006.

Both mapping populations were artificially inoculated with a GG9 perennial ryegrass isolate. Increased disease pressure in the field with artificial inoculation successively promoted uniform infection of gray leaf spot throughout the field plots. Preliminary results showed that the QTL on LG 2 of MFA population was present in the field trial, as well as the previous greenhouse trial with the MFA x MFB population.

To evaluate interaction between pathogen variability and host resistance in gray leaf spot disease, four ryegrass clones (MFA, MFB, Manh-1, and Manh-3) and one commercial resistant cultivar, 'Paragon GLR' were inoculated using three perennial ryegrass isolates. The perennial ryegrass isolates were: GG9, BL00, and LP97. The ryegrass plants were inoculated with the perennial ryegrass isolates under growth chamber conditions. As previously evaluated, MFA and MFB were resistant to all three isolates, but Manh-1 and -3 were very susceptible to the isolates. Twelve individual plants were randomly selected from turf plugs that were previously established from seeds of 'Paragon GLR' and were then inoculated with gray leaf spot.

The preliminary results indicated that a range of susceptibility among the 'Paragon GLR' plants was detected. The results suggested that resistance in 'Paragon GLR' is controlled by a small number of genes. If pathogen variability does have an interaction with host resistance, different sources of resistance genes will be combined by crosses in order to broaden the genetic basis of gray leaf spot resistance in perennial ryegrass. In addition, the gray leaf spot resistance QTLs will be reconfirmed in field trials in 2008, and will be used in future marker-assisted breeding efforts.

Summary Points

- Inconsistent disease pressure despite *M. grisea* inoculum introduced to field plots for gray leaf spot on ryegrass mapping populations in South Deerfield, Massachusetts.
- Significant difference in pathogenicity among three gray leaf spot isolates (GG9, BL 00, and LP97) tested under the controlled greenhouse conditions.
- Twelve individual plants were selected of the perennial ryegrass resistant cultivar, 'Paragon GLR.' The plants showed a wide level of resistance which might be controlled a small number of genes.
- Preliminary results indicated no evidence for significant interactions between gray leaf spot isolates and ryegrass germplasms under controlled greenhouse conditions. However, more extensive experiments using a large number of isolates and different sources of resistance are needed to confirm the finding.