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 the existing MFA x MFB population and in a new mapping population generated by crossing a resistant clone (MF-8), one of the 156 progeny individuals from the MFA x MFB population and a susceptible clone (L4B-5) and a perennial ryegrass genotype resulting from a cross between perennial ryegrass cultivars, 'Linn' and 'SR4400'.

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Project Duration: three years
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Perennial ryegrass (*Lolium perenne*) is a valuable cool-season turfgrass because of fast germination promoting fast establishment and good aesthetic quality including dark green color. Gray leaf spot caused by *Magnaporthe grisea* has become a serious problem on perennial ryegrass since it was first reported on golf course fairways in Pennsylvania in 1992. Under favorable environmental conditions, gray leaf spot can completely destroy ryegrass in a short period of time.

The use of host resistance is an environmentally-sound method to control gray leaf spot which has been well studied and tested in other hosts of *M. grisea*, mostly in rice. However, few resistant ryegrass cultivars are commercially available until recently. Then genetic bases of resistance to gray leaf spot remain largely unknown.

Our lab has conducted a study about host resistance of ryegrass to gray leaf spot using quantitative trait loci (QTL) analysis. Previously, 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. When plants were inoculated with *M. grisea* conidia in the greenhouse, four potential resistance QTLs were detected on linkage groups 2 and 3 of the MFA map and on linkage groups 4 and 6 of the MFB map.

To confirm that those QTLs are still detectable in the next generation and can function in a different genetic background, a new mapping 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 '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.

Three perennial ryegrass genotypes highly susceptible to gray leat spot.

Similar greenhouse inoculation assays were conducted using this second ryegrass population and confirmed that disease resistance genes were segregating in the progeny. The resistance QTL on linkage group 3 of the MFA previously detected in the original MFA x MFB population was also detected in the new population. This result indicated that the marker linked with the resistance QTL on linkage group 3 is likely to be easily transferred to different ryegrass populations.

The resistance loci previously detected in our greenhouse studies will be even more important for marker-assisted breeding if confirmed in the field. Not all QTLs identified in the controlled environment are likely to be efficient in the field, as well. Previously, 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, but natural disease pressure and plant growth were not optimal enough to evaluate disease resistance phenotypes of ryegrass.

Alternatively, we established field plots of the both mapping populations at the O.J. Noer Turfgrass Research and Education Facility in Verona, WI in 2006, and the plots were artificially inoculated with a GG9 perennial ryegrass isolate. Because natural infection of gray leaf spot is not prevalent in this region, millet seed inoculum colonized by *M. grisea* was prepared in the lab and was applied in the field in late July.

Increase of disease pressure in the field with artificial inoculation successively promoted uniform infection of gray leaf spot throughout the field plots. Resistance QTLs for gray leaf spot could be evaluated. As expected, not all QTLs detected under controlled greenhouse conditions were detected in the field, but some QTLs were still strongly contributing the resistance. Preliminary results showed that the QTL on linkage group 2 of MFA detected previously in the MFA x MFB population in the greenhouse was also detected in the field trial. The gray leaf spot resistance QTLs confirmed in both greenhouse and field evaluation will be reconfirmed in field trials and will be used for future marker-assisted breeding efforts.

Summary Points

- *M. grisea* inoculum introduced to field plots promoted gray leaf spot on ryegrass mapping populations in Verona, Wisconsin.
- Some resistance QTLs for gray leaf spot detected under the controlled greenhouse conditions were consistently detected under the field conditions.
- More detailed QTL analysis in a second generation population derived from the original annual x perennial (MFA x MFB) population is currently underway to confirm the potential resistance QTLs previously detected in field and greenhouse conditions in the MFA x MFB population.