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

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Objectives:

1. To generate populations by crosses of resistant clones (from the MFA x MFB and L4B-5 x MF-8 populations) with resistant plants to be selected from commercial perennial ryegrass cultivars and breeding lines including 'Paragon GLR', 'Gray Star', 'Gray Fox', 'Grey Goose', 'Manhattan-5', 2COL-07, and 2NKM-1.
2. To develop perennial ryegrass plants having a broad spectrum of GLS resistance by pyramiding multiple-resistance genes originated from various sources of *Lolium* species and cultivars.

Start Date: 2003
Project Duration: three years
Total Funding: $87,883

Perennial ryegrass (*Lolium perenne*) is a valuable cool-season turfgrass that can be infected with gray leaf spot caused by *Magnaporthe grisea*. Gray leaf spot has become a serious problem on perennial ryegrass in golf course fairways and on home lawns in the US. Gray leaf spot (GLS) can completely destroy ryegrass stands within a few days. Breeding ryegrass for resistance to *M. grisea* is an environmentally sound method of controlling gray leaf spot and has been well studied and utilized in other hosts such as rice.

With the use of recently improved perennial ryegrass cultivars ('Paragon GLR', 'Palmer GLS', 'Panther GLS', 'SR 4600', 'Protégé', 'Gray Star', 'Gray Fox', 'Gray Goose', and 'Manhattan 5') with GLS resistance, there has been some concern that those improved cultivars might break down due to selection of pathogen strains or "races" that can overcome the resistance genes. Research on the interactions between pathogen variability and host resistance in perennial ryegrass needs immediate attention.

Gray leaf spot resistant clonal plants (MAF, MFB, Paragon GLR-1R and -2R) transplanted to the field, University of Massachusetts, Amherst.

Previously detected GLS-resistant QTLs in two ryegrass mapping parent clones (MFA and MFB) indicated partial resistance, meaning several genes were involved in the resistance development. Our objective is to test whether there is a significant interaction between GLS pathogen variability and perennial ryegrass resistance.

The two ryegrass parent clones (MFA, MFB) and five commercial resistant cultivars ('Gray Star', 'Gray Fox', 'Grey Goose', 'Manhattan-5', 'Paragon GLR') were included in the study. Two GLS resistant plants, Paragon GLR-1R, Paragon GLR-2R and two susceptible plants, Paragon-3S and Paragon-4S were selected from individual plants of 'Paragon GLR' based on a previous inoculation experiment.

Ryegrass plants germinated from seeds of the commercial cultivars and lines and the selected clonal plants were grown in French Hall greenhouse at the University of Massachusetts, Amherst. The plants were inoculated with GLS isolates under growth chamber conditions. Based on two inoculations, MFA, MFB, Paragon-1R, and Paragon-2R were resistant to all GLS isolates and Paragon-3S and Paragon-4S were very susceptible as expected. All commercial cultivars and experimental lines were moderately resistant to GLS isolates, but 2NKM-1 and 'Gray Star' were susceptible.

Additional inoculation experiments are needed for further confirmation. In addition, individual plants (5-10 per cultivar or line) will be randomly selected from each population of the resistant cultivars and experimental lines in order to further test pathogen and host interactions on an individual plant basis.

Due to the outcrossing nature of ryegrass, all ryegrass cultivars are synthetic variety indicating a group of genotypically different seeds. Further inoculations using clonally replicated ryegrass plants and 13 geographically diverse GLS isolates will be performed to check whether the resistance in commercial cultivars differ from MFA and MFB. DNA markers significantly associated with QTLs for GLS resistance in the various sources will be developed for marker-assisted selection. Multiple disease resistance genes including gray leaf spot, crown rust, and leaf spot can be incorporated into an elite perennial ryegrass cultivar to strengthen host resistance as part of an integrated pest management strategy for turfgrass.

Summary Points

- Significant differences in pathogenicity among 13 gray leaf spot (GG9, GG11, GG12, BL00, LP97, Lin00, 05T-04, 02V-23.1, 04S-01, 06T-02, 11W-03, and 11W-07) and one rice (6082) isolates under growth chamber conditions.
- Seven recently improved perennial ryegrass cultivars and experimental lines with GLS resistance showed only moderate resistance to the 13 geographically diverse isolates. This result may indicate non-race specific resistance in perennial ryegrass.
- Preliminary results indicated a marginally significant interaction between gray leaf spot isolates and ryegrass germplasm under growth chamber conditions. However, more inoculation experiments with individual plants rather than a whole cultivar of mixed genotypes are needed to confirm the finding.
- GLS-resistant plants from the MFA x MFB mapping population will be crossed with Paragon GLR-1R and -2R plants. Those parent plants were transplanted to the field.