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Greenhouse assay for the evaluation of sugarbeet resistance to Rhizoctonia root rot.

ABSTRACT

Evaluation of sugarbeet for resistance to Rhizoctonia root rot using field nurseries can be costly and subject to environmental variables that restrict disease development. A rapid method for the detection of resistance to Rhizoctonia root rot in sugarbeet in the greenhouse was developed. Sterile barley grain inoculated with an isolate of *Rhizoctonia solani* AG2-2 (R9 isolate) known to cause root rot in sugarbeet is the basic inoculum. Infested grain is used to inoculate 5 week-old sugarbeet plants in the greenhouse and evaluation of root rot severity is determined at 2-3 weeks post-inoculation. Sugarbeet germplasm from the USDA Fort Collins breeding program and one commercial hybrid were used to validate the method and included highly resistant material (FC709-2 and FC718) and highly susceptible material (FC403, FC607, and Maribo 'Ultramono'). Ranking of the germplasm accessions for percent healthy roots after inoculation in the greenhouse was similar to the ranking of the same germplasm in the Rhizoctonia root rot nursery in Fort Collins over several years of testing. The method can be used for the selection of individuals exhibiting superior root rot resistance from a segregating population. Evaluation of progeny in a segregating population using the assay can improve the accuracy of root rot resistance scoring for use in molecular marker mapping programs. A preliminary characterization of resistance gene candidates (RGCs) amplified by the polymerase chain reaction that differ between plants exhibiting root rot resistance and root rot susceptibility is presented.

Objectives

The objective of this project was the development of an inoculation technique capable of distinguishing sugarbeet that is resistant to root rot caused by *Rhizoctonia solani* AG2-2 from that which is susceptible to the pathogen. Such a technique could accelerate breeding programs seeking to incorporate root rot resistance into germplasm or hybrids and could reduce variability in the scoring of progeny for programs directed toward tagging of resistance genes.

Procedures

Germplasm accessions possessing a range of susceptibility to *R. solani* AG2-2 provided the foundation for the study. Accessions characterized by high root rot resistance were produced through years of selection from the root rot nursery at Fort Collins, CO followed by seed increase. Previous work has shown that heritability of resistance to *R. solani* is moderate to high and should be readily detected in a greenhouse environment.

Seed of accessions FC709-2, FC718, FC907, FC607, FC403 and the hybrid Maribo 'Ultramono' was planted in 8" pots containing Sunshine Mix #3 supplemented with Osmocote slow-release fertilizer. Each pot was rogued to 1 or two well-spaced plant per pot. At 3 weeks post-planting, sterile barley grain was swelled in potato dextrose broth (PDB) and re-autoclaved. The residual PDB was decanted off of the grain and the kernals were transferred to Petri dishes containing one

week-old cultures of *R. solani* AG2-2 (R9 isolate). At 5 weeks post-planting, most of the sugarbeet roots are between 1.5 and 2 cm in diameter. Two barley grains infested with *R. solani* were placed at a single point next to the plant root at ~2 cm below the soil surface. The grain was covered with soil, the plants were watered immediately after the inoculation, and the plants were maintained in the greenhouse with a 16 hr photoperiod at an average temperature of 22° C. Plants of susceptible accession were monitored every three days for disease symptoms (blackening of root and wilting of foliage). At two weeks post-inoculation, planted were topped, the roots were pulled, and the soil was removed form the root surface. Roots were evaluated for disease severity using a 0-4 scale where 0 = no visible disease and 4 = 90-100% of the root is rotted or the root is dead.

In three trials of the technique in the greenhouse at the USDA-ARS Northern Crop Science Lab in Fargo. N.D., ranking of germplasm for resistance to *R. solani* was similar to the ranking of these accessions in the Rhizoctonia field nursery at Fort Collins, CO. Accession FC709-2 consistently ranked as most resistant to root rot, whereas FC403 and the hybrid Maribo 'Ultramono' were highly susceptible. Accessions with intermediate resistance (FC907 and FC718) exhibited greater between-trial variation in the mean disease reaction. Nevertheless, these accessions also ranked in the greenhouse assay as they have in the root rot nursery.

Conclusions

A root rot assay was developed capable of detecting resistance in greenhouse-grown sugarbeet to *Rhizoctonia solani* AG2-2. High susceptibility and high resistance to root rot disease was most easily determined using the assay, whereas germplasm accessions exhibiting intermediate resistance varied in disease severity to a greater extent between trials. It is concluded that the method would be useful in the identification of candidate parent material for incorporating root rot resistance into commercial varieties.