Soybean Root Rot
Identification of the pathogens associated with root rot of soybean

2013 Annual Report to MPGA (2nd year)

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Project Duration: April 1, 2012 – March 31, 2015
Budget: $8,000/year

Executive Summary: Funding for Project was approved in 2012 by the MPGA for three years. In 2013, 40 soybean crops were surveyed in Manitoba for root diseases during late July when most plants were at the early flowering stage. Root rot was severe in low-lying areas of some fields indicating that yield and quality may have been affected. Root rot was observed in all soybean crops surveyed in 2013. Two diseases, Fusarium root rot and Rhizoctonia root rot were identified. The microorganisms most frequently isolated from roots of infected plants were Fusarium spp., followed by Rhizoctonia solani. The highest disease severities were observed in fields where Fusarium spp. were isolated from infected roots. The lower recovery rate of R. solani when both Fusarium spp. and R. solani were isolated suggests that R. solani may not be as important a root rot pathogen in soybean as are Fusarium spp. in Manitoba, compared with other regions in western Canada (Chang et al. 2013). Fusarium spp. isolated from symptomatic tissue and identified morphologically included F. avenaceum, F. acuminatum, F. oxysporum, F. solani, F. redolens, F. tabasinum as well as additional Fusarium spp. and Rhizoctonia solani. Through pathogenicity testing, twelve Fusarium isolates were reisolated from roots of symptomatic plants including the species F. oxysporum, F. graminearum, F. avenaceum, F. redolens and F. equiseti. A repetition of the pathogenicity test is ongoing, where root and shoot weight will also be analyzed.

Background Information:
Fusarium root rot is a major disease of soybean in Canada and the United States (Wrather et al. 2001) and can cause significant yield reductions due to reduced plant stands, stunted seedlings and weakened root systems. Control of Fusarium root rot is difficult and cultivars with high levels of resistance are not yet available. According to previous studies, Fusarium solani and F. oxysporum have been reported as major pathogens causing soybean root rot in North America (Nelson, 1999). Four Fusarium species (F. oxysporum, F. graminearum, F. avenaceum and F. tricinctum) have been frequently isolated from soybean roots in eastern Ontario (Zhang et al. 2010). Of these four species, F. avenaceum was the most pathogenic, followed by F. graminearum. In a preliminary examination of soybean roots collected from one Manitoba field and four Alberta fields in 2011, Fusarium species were predominately isolated from infected roots. This disease is more common and severe when soybeans are seeded into cold soils. For this reason, Fusarium root rot may be more prevalent on the prairies than it is in Ontario. The long-term and most economical approach for managing Fusarium root rot is the use of resistant cultivars, but soybean cultivars with high levels of resistance are not yet available. In Ontario, F.
oxysporum, F. graminearum, F. avenaceum and F. tricinctum have been the most prevalent causal agents for fusarium root rot in soybean, but little information is available on the root rot pathogens associated with this crop in western Canada. More information on Fusarium root rot pathogens is needed in order to develop best management practices for this root rot complex.

Soybean production continues to increase with 354,000 ha (875,000 acres) and over 400,000 ha (one million acres) seeded in Manitoba in 2012 and 2013, respectively. This represents the sixth consecutive annual increase in soybean area in Manitoba. Limited information is available from Manitoba on possible disease risks to this crop, but root rot is a constraint in other areas of Canada where soybean production is established (Chang et al. 2013; OMAFRA, 2011).

To acquire new information on root rot pathogens in Manitoba, commercial soybean fields will be surveyed for the incidence and severity of root rot. Root rot pathogens will be identified and pathogenicity tests will be conducted using a susceptible soybean cultivar. This research will provide new information on Fusarium root rot pathogens in order to screen for host resistance and design effective control measures.

Project Objectives:
(1) evaluate commercial crops of soybeans in Manitoba for root rot;
(2) isolate and identify fungal colonies from root rot lesions;
(3) conduct pathogenicity tests for Fusarium isolates from infected soybean root tissue.
(4) Provide an annual report.

Project Progress:

Survey of commercial crops of soybean
In 2013, 40 soybean crops were surveyed in Manitoba for root diseases, with crops randomly chosen from regions in south-central and southwest Manitoba, where soybean is commonly grown. The surveys for root diseases were conducted during late July when most plants were at the early flowering stage. At least ten plants were sampled at each of three random sites in each crop surveyed. Root diseases were rated on a scale of 0 (no disease) to 9 (death of plant). Root rot was severe in low-lying areas of some fields indicating that yield and quality may have been affected.

In 2013 the cropping season in Manitoba started with excessive spring moisture in some areas and cool conditions. Spring seeding was later than average for most crops. Some planned soybean acres were sown as canola in order to meet crop insurance deadlines (MAFRI Crop Report, 2013). Crop growth continued to be suppressed by lower temperatures and frequent rainfall in areas of the province, which favoured the prevalence and severity of some diseases. Later in the summer, warmer weather with frequent rainfall prevailed. However in some soybean crops, maturity was a concern and harvest did not start until October, emphasizing the importance of variety selection in 2014.

Root rot was observed in all soybean crops surveyed in 2013. Two diseases, Fusarium root rot and Rhizoctonia root rot were identified. The microorganisms most frequently isolated from
roots of infected plants were *Fusarium* spp., followed by *Rhizoctonia solani*. Root rot ratings for crops in which *Fusarium* spp. were isolated ranged from 0.3 to 4.9 with a mean severity of 2.2. *Rhizoctonia* root rot (*Rhizoctonia solani*) was detected in two crops surveyed in 2013, with a severity range of 1.2 to 2.6 and a mean of 1.9.

The highest disease severities were observed in fields where *Fusarium* spp. were isolated from infected roots. The lower recovery rate of *R. solani* when both *Fusarium* spp. and *R. solani* were isolated suggests that *R. solani* may not be as important a root rot pathogen in soybean as are *Fusarium* spp. in Manitoba, compared with other regions in western Canada (Chang et al. 2013).

**Identification of *Fusarium* spp. from root rot lesions**

To confirm the visual disease identification, 15 symptomatic roots were selected from a subsample of 10 fields (2013) for immediate fungal isolation and identification. An additional fifteen roots from each of these fields were frozen for future PCR analysis of root rot pathogens. From the fresh samples, the identification of *Fusarium* species involved visual assessment, microscopic examination and morphological characterization using the criteria of Leslie and Summerell (2006). *Fusarium* spp. identified through this process included *F. avenaceum*, *F. acuminatum*, *F. oxysporum*, *F. solani*, *F. redolens*, *F. tabasinum* as well as additional *Fusarium* spp. and *Rhizoctonia solani*.

**Pathogenicity testing of *Fusarium* isolates from root rot lesions**

In 2012, three soybean fields were selected for an in-depth study where 40 plants were sampled per field with 20 roots frozen for future PCR analysis and 20 roots plated out immediately. *Fusarium* spp. identified through morphological characterization were *F. oxysporum*, *F. avenaceum*, *F. acuminatum*, *F. tabasinum*, *F. culmorum*, *F. equiseti*, *F. graminearum*, *F. redolens* and *F. tricinctum*. To determine whether the isolated *Fusarium* spp. were pathogenic, a pathogenicity test was established in the greenhouse with three replicates and included the *Fusarium* spp. and isolates from the in-depth study as well as the 2013 field survey. The soybean cultivar TH320004R2Y was used for these tests. Disease assessment was conducted 29 days after inoculation. Twelve *Fusarium* isolates were reisolated from roots of symptomatic plants including the species *F. oxysporum*, *F. graminearum*, *F. avenaceum*, *F. redolens* and *F. equiseti*. A repetition of the pathogenicity test is ongoing, where root and shoot weight will also be analyzed.

**Discussion:**

The need to identify the major *Fusarium* species causing soybean root rot in Manitoba is important in order to provide more effective disease management strategies and systems to producers. This research will assist in the development of soybean germplasm and resistance to *Fusarium* root rot. Improved disease control will ultimately result in increased competitiveness and profits by increasing yields, reducing risk and enhancing opportunities for using pulse crops such as soybean.

**References:**


**Publications:**


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