**MPSG FINAL EXTENSION REPORT**

**EVALUATION OF ROOT ROT RESISTANCE IN DRY BEAN CULTIVARS**

**PROJECT TITLE:**

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| **PROJECT START DATE: 1 April 2013** | **PROJECT END DATE: 31 March 2018** |

**DATE SUBMITTED:** Click here to enter a date.

***PART 1: PRINCIPAL RESEARCHER***

**PRINCIPAL**

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PART 2: EXECUTIVE SUMMARY

*Outline the project objectives, a summary of the activities and results, and their relevancy to pulse and soybean farmers.*

Bean root rot has been shown to cause serious reductions in plant stand and yield. A number of recent field surveys have shown that bean root rot is caused by a complex of pathogens that includes as many as seven fungal species. Resistance is not a common trait in most of the bean cultivars grown in Manitoba, but a few dry bean cultivars have been shown to have partial resistance to the root pathogens Rhizoctonia solani, Fusarium redolens, F. acuminatum and F. solani. In this research study bean cultivars were separately evaluated for their reactions against isolates of the newly discovered bean root rot pathogen F. cuneirostrum as well as Fusarium avenaceum, F. oxysporum, F. redolens, F. solani and R. solani. New cultivars from all the dry bean classes grown in Manitoba were assessed for their reactions to all of the six root pathogens in separate, replicated field trials. Information from this study will enable bean breeders to choose root rot resistant parents for their crossing programs and will aid bean producers in making informed decisions on the selection of dry bean cultivars for their field operations.

***PART 3: EXPERIMENT DESCRIPTION & RESULTS***

Materials and Methods. Field trials were conducted at Morden and Brandon (Dr. Debbie McLaren) to evaluate the root rot resistance of approximately 68 Manitoba dry bean cultivars each year beginning in 2013 (i.e., 34 different cultivars at each field site). Inoculated field experiments will be carried out to separately assess the root rot reactions of the dry bean cultivars to Rhizoctonia solani, Fusarium solani, F. redolens, F. avenaceum, F. cuneirostrum and F. oxysporum. Inoculum of each root pathogen was increased under controlled environmental conditions in bags of autoclaved wheat. The inoculum of a specific root rot pathogen was added to the seed of each dry bean cultivar just prior to planting. Field experiments consisting of 29 dry bean cultivars and three resistant or partially resistant and two susceptible check cultivars were carried out to separately evaluate their reactions to each root rot pathogen. The experiments were arranged in a randomized complete block design with four replications. All the plots were evaluated for seedling emergence, root rot severity and nodulation.

Results. All of the field trials to evaluate root rot resistance in dry beans went according to plan except for 2014 when all the plots at the Brandon site were lost due to flooding. A total of 68 dry bean cultivars were evaluated for their reactions to seedling blight and root rot caused by Fusarium avenaceum, F. cuneirostrum, F. oxysporum, F. redolens, F. solani and R. solani at field sites near Morden and Brandon. All of the dry bean cultivars were evaluated for seedling emergence, root rot severity (scale of 0-9) and root nodulation (scale of 0-4). At Morden and Brandon, inoculation with R. solani resulted in the lowest average seedling emergence rate with a five-year average of 44% at Morden and 39% at Brandon amongst all the pathogens. The range in the five-year average for seedling emergence among the dry bean cultivars for the root pathogens was 44 to 46% at Morden and 42 to 43% at Brandon.

 At Morden, three dry bean cultivars displayed relatively high rates of seedling emergence over the five years of testing following inoculation with five of the root rot pathogens, which indicates that they were partially resistant to seedling bight. A fourth cultivar had high rates of seedling emergence following inoculation with four of the root pathogens. At Brandon, three dry bean cultivars had relatively high rates of emergence following inoculation with five of the root pathogens. Two other dry bean cultivars consistently had relatively high rates of emergence following inoculation with three of the root pathogens.

 The five-year mean root rot severity was highest in plots inoculated with F. avenaceum at Morden (5.5) and with R. solani at Brandon (3.8). The range of the five-year average for root rot severity among the dry bean cultivars was 5.2 to 5.4 at Morden and 3.4 to 3.7 at Brandon. At both sites, most of the cultivars consistently had high root rot ratings for all the root pathogens throughout the study indicating their susceptibility to the diseases caused by these root pathogens. However, the partially resistant check Etna showed resistance to all six root pathogens at both field sites. One dry bean cultivar tested at Morden had low root rot ratings after inoculation with five root pathogens and two other cultivars were resistant to three of the root pathogens. At Brandon, two dry bean cultivars consistently had low root rot ratings following inoculation with three of the root pathogens. These results indicate that a few of the cultivars in this study carry partial resistance to several root rot pathogens.

 Inoculation with the root pathogens at Morden and Brandon severely reduced nodulation with mean ratings ranging from 0.6 to 0.8 for all the cultivars. Only one cultivar at Morden and one cultivar at Brandon consistently had relatively high nodulation ratings for all the pathogens. An additional cultivar at each site had high nodulation values following inoculation with five root pathogens.

 No cultivar tested at either Morden or Brandon combined resistance to seedling blight and root rot. Only one cultivar at Brandon appeared to combine seedling blight resistance with high root nodulation ratings. It was expected that root rot resistance would have promoted good root nodulation, but this did not occur in this study.

*Concisely describe the experimental methods and results to date. You may include up to 3 graphs/tables/pictures in the Appendix.*

***PART 4: RELEVANCE TO FARMERS AND FUTURE RESEARCH***

The identification of dry bean cultivars with partial resistance to the common causal agents of root rot will reduce economic losses in dry beans caused by this disease. The use of dry bean cultivars that are partially resistant to root rot in combination with other control measures, such as crop rotation and fungicide seed treatment, should enable long-term sustainable dry bean production in Manitoba. Information from this field study will assist in the development of new dry bean cultivars with superior root rot resistance. The results of this study will allow local bean growers to make more informed decisions in choosing dry bean cultivars.

Dr. Conner made presentations on recent research on the control of diseases of dry beans at the 2015 Edible Bean Meetings, which were held in Portage La Prairie and Altona, Manitoba

Together with Dr. Anfu Hou, Drs. Conner and McLaren have submitted a research proposal to the Pulse Cluster of CAP to continue research on the genetics of root rot resistance research using Recombinant Inbred Lines generated from crosses involving the most resistant dry bean cultivars in this study. It appears that this research proposal has been approved, but the level of financial support still remains to be determined.

*Describe how the project results can be captured to benefit pulse and soybean farmers (production recommendations, innovation items, marketing plans, commercialization of technology etc). Identify any future research opportunities.*

***PART 5: COMMUNICATION***

Field days sponsored by the Manitoba Pulse and Soybean Growers were held at AAFC-Morden in 2013, 2014 and 2016 to highlight research on pulses and soybeans. Similarly field tours at AAFC-Morden during its Centennial celebrations in 2015 highlighted research on root diseases of dry bean. I made presentations on recent research on the control of disease of dry beans at the 2015 Edible Bean Meetings, which were held in Portage La Prairie and Altona, Manitoba. In 2017, researchers attending the joint meeting of the Canadian Phytopathology Society and the Canadian Society of Agronomy in Winnipeg toured pulse disease research plots at AAFC-Morden.

This research generated two scientific manuscripts and two conference proceedings. A manuscript on the reactions of commercial dry bean cultivars to seedling blight root rot caused by the six root pathogen will be prepared. In addition, a summary on the results of this study will be prepared for publication in Pulse Beat.

*List extension meetings, papers produced, conference presentations made, project materials developed.*

***APPENDIX***

Include up to 1 page of tables, graphs, pictures.

**Scientific Publications and conference proceedings:**

**Scientific Publications:**

Conner, R.L., Hou, A., Balasubramanian, P., McLaren, D., and McRae, K.B. 2014. Reaction of dry bean cultivars grown in western Canada to root rot inoculation. Can. J. Plant Sci. 94: 1219-1230.

Gossen, B.D., Conner, R.L., Chang, K.F., Pasche, J.S., McLaren, D.L., Henriquez, M.A., Chatterton, S. and Hwang, S.F. 2016. Identifying and managing root rot of pulses on the northern Great Plains. Plant Dis. 100: 1965-1978.

**Conference Proceedings:**

Conner, R.L., Hou, A., Balasubramanian, P., McLaren, D.L., Henriquez, M.A., Chang, K.F. and McRae, K.B. 2014. Reactions of dry bean cultivars from western Canada to root rot. Proceedings of the 6th International Food Legume Research Conference, Saskatoon, SK, No. 165.

Gossen, B.D., Chatterton, S., Conner, R.L., Chang, K.F., Pasche, J.S., McLaren, D.L. and Hwang, S.F. 2016. Root rot: An Ongoing challenge to pulse production on the prairies. (Keynote address) Proceedings of the 10th Canadian Pulse Research Workshop, Winnipeg, MB (in press).