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MPSG FINAL EXTENSION REPORT

PROJECT TITLE: **Frequency of soybean in rotations-exploring root and foliar pathogens**

PROJECT START DATE: 1 June 2017 **PROJECT END DATE: 31 May 2019**

DATE SUBMITTED: Click here to enter a date.

PART 1: PRINCIPAL RESEARCHER

PRINCIPAL

NAME:	Dr. Fouad Daayf
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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.

Soybean (Glycine max) continues to maintain its place as the third most cultivated crop in Manitoba after canola and spring wheat, with an acreage that exceeded 2.3 million acres in 2017 (Statistics Canada). This means that soybeans are grown more frequently in crop rotations across Manitoba, which raises questions about potential risks of diseases and pests. For soybeans, there is no or scarce information about proper rotation regimes that would be ideal for Manitoba conditions.

In 2013, a 4-year crop rotation agronomy-based project was established at three locations in Manitoba (Carman, St. Adolphe, Melita). While the project was set to study agronomy-related issues, we took advantage of this setting to investigate the effects of rotations on soybean diseases.

The main disease-related question in this initial project was whether the frequency of soybean in the rotation does increase the incidence/severity of any important diseases, which eventually reduce soybean yield. Therefore, the main objective of the project was to investigate the effect of different crop rotation regimes on soybean diseases at contrasting locations in Manitoba, namely Carman, St. Adolphe and Melita.

PART 3: EXPERIMENT DESCRIPTION & RESULTS

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

Setting: The 4-year crop rotation project established at Carman, St. Adolphe, and Melita was set with the following treatments:
1- Continuous soybeans (soy-soy-soy-soy);
2- Soybeans every second year (corn-soy-corn-soy);
3- Soybeans every second year (canola-soy-canola-soy); and
4- Soybeans every fourth year (wheat-canola-corn-soy).
The experiment was set up with a randomized complete block design with four replicates. Each location had 16 replicates. Cultivar (DKC 24-10 RY) was planted in the three locations.

Scouting and sampling: The fields were visited during the different growing stages (V1-R8). Ten plants were collected from each replicate (160 plants/visit), and transferred to Dr. Daayf's lab, Plant Sci. Dept., Univ. of MB, for further investigation.

Disease assessment: Each plant was examined for diseases on roots, stems and leaves. A disease severity index of the most damaging disease was calculated using the formula: DSI = Σ [(class number)x(number of carrots in each class)]/(total number per sample)(number of classes -1) ×100.

Isolation: Root, stem and foliar pathogens were isolated using conventional methods, i.e., specific nutrient media. Infected plant parts were cut into small pieces (1-cm) and surface-sterilized by rinsing infected areas with 95% ethyl alcohol prior to isolation. These parts were placed on petri plates containing potato dextrose agar (PDA) and/or acidified potato dextrose agar (APDA) and incubated at 25°C under 12-h light and dark intervals for identification purposes.

Pathogenicity assays: The pathogenicity of the isolated pathogens was confirmed in the greenhouse following Koch's postulates. This is a very important step to prove and verify the observed diseases and pathogenicity of the isolated pathogens. Healthy soybean plants were inoculated with pure cultures of the pathogens, and incubated in the greenhouse (Plant Sci. Dept., Univ. of MB). Pathogen re-isolations from all replicated inoculations were conducted using the same techniques described above to complete Koch's postulates.

Results
Root rots caused by *Fusarium* sp. was the most prevailing and damaging disease in the 2017 season in these experimental plots, with disease incidence reaching 100%, 50% and 100% in Carman, St. Adolph and Melita, respectively. The continuous soybean rotation had the highest root rot severity, followed by the "canola/soybean" rotation, while the "corn/soybean" and "wheat/canola/corn/soybean" rotations had the lowest root rot severity, with no significant differences between these two rotations (**Fig. 1**). The highest root rot severity (80%) was observed on soybean plants collected from the "continuous soybean" rotation from the Melita plot. The lowest root rot severity (6.8%) was observed on soybean plants collected from the "wheat/canola/corn/soybean" rotation from the St. Adolph plot (**Fig. 1**). *Fusarium spp* was the most isolated pathogen from soybean roots in the three different locations (**Fig. 2**). *Fusarium oxysporum* was the most isolated species from soybean roots at the three different locations (**Fig. 3**).

Communication: We have reported for the first time that *Fusarium cerealis* can cause root rot of soybean roots (Abdelmagid et al. 2018, Plant Disease 102:2638-2639). We also reported "Norther Stem Canker" as a new disease of soybean in Western Canada (Abdelmagid et al. 2019, Plant Disease 103:372).

PART 4: RELEVANCE TO FARMERS AND FUTURE RESEARCH

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.

This is the first scientific research that investigates and documents the diagnosis and validation of more than one disease within the same study on soybean in Manitoba. It is not only based on visual assessment, but also on isolating the causal pathogens before confirming the existence of any disease on soybean in Manitoba. The study was conducted for one season as part of a larger agronomy-focused study led by Dr. Lawley (Univ. of MB). Among the compared treatments, the continuous soybean rotation had the highest root rot severity. With the increased acreage and frequency of soybeans in crop rotations across Manitoba, information from this study will help soybean farmers to plan their crop rotations and anticipate risks for increasing the frequency of soybeans in rotation and balancing their overall rotations. Collecting more scientific information about the impact of certain rotations at contrasting soil textures and environments on the incidence and severity of important diseases, which can reduce soybeans yield in Manitoba, will be very beneficial to soybeans growers in Manitoba and will help them choose better crop rotations in the future. The results from this initial small-scale study will set the track for further larger studies and for better handling and anticipation of plant disease issues that may arise in this crop in the future.

Further investigation of the effect of crop rotations on soybean diseases will be sustained to provide soybean farmers in MB with verified scientific data in order to help them choose better rotation regimes for their crops. Information on the effect of rotations on soybean diseases in Canada is still very limited. This research will shade some light on positive and negative effects of the crop rotations used in commercial soybean cropping on important crop diseases.

PART 5: COMMUNICATION

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

Past and future publications relevant to the project:

1-Abdelmagid, A., Hafez, M., Lawley, Y., Adam, L.R. and Daayf, F. (2018) First Report of *Fusarium cerealis* causing root rot on soybean. Plant Disease 102:2638-2639.

2-Abdelmagid A, Hafez M, Lawley Y, Adam LR, Daayf F. (2019): First Report of Northern Stem Canker caused by *Diaporthe caulivora* on Soybean in Western Canada. Plant Disease 103 Issue: 2 Pages: 372-372.

3- Specific detection and identification of *Fusarium graminearum sensu stricto* using a PCR-RFLP tool and specific primers targeting the translational elongation factor 1 alpha gene (*submitted to Plant Disease*).

4- First report of *Fusarium sporotrichioides* causing root rot of soybean in Canada and detection of the pathogen in host tissue (*in preparation*).

APPENDIX

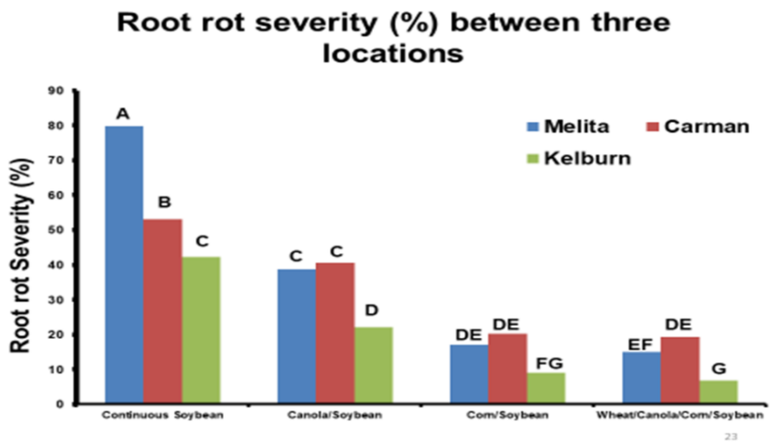

Fig. 1: Root rot severity % between Melita, Carman and St. Adolph, Manitoba

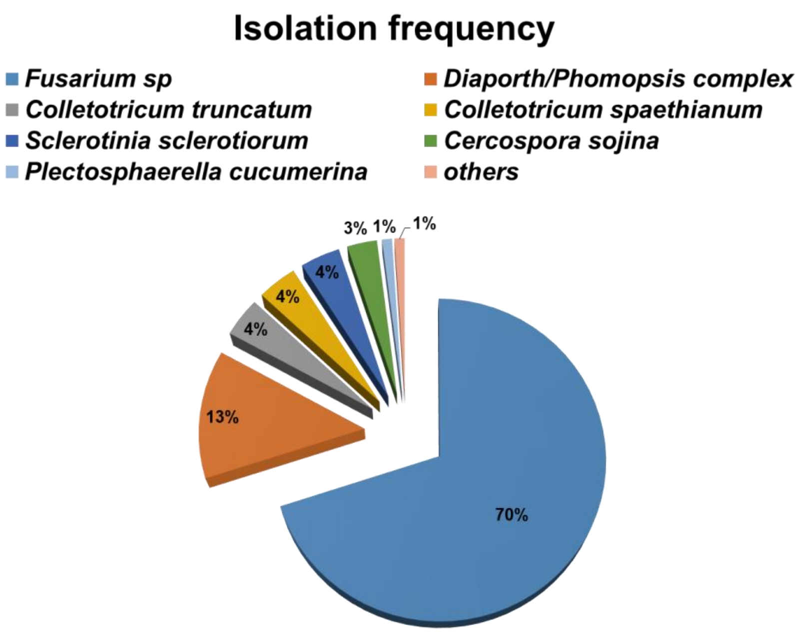

Fig. 2: Isolation frequency of the major fungal pathogens isolated from soybean roots and stems from three different locations.

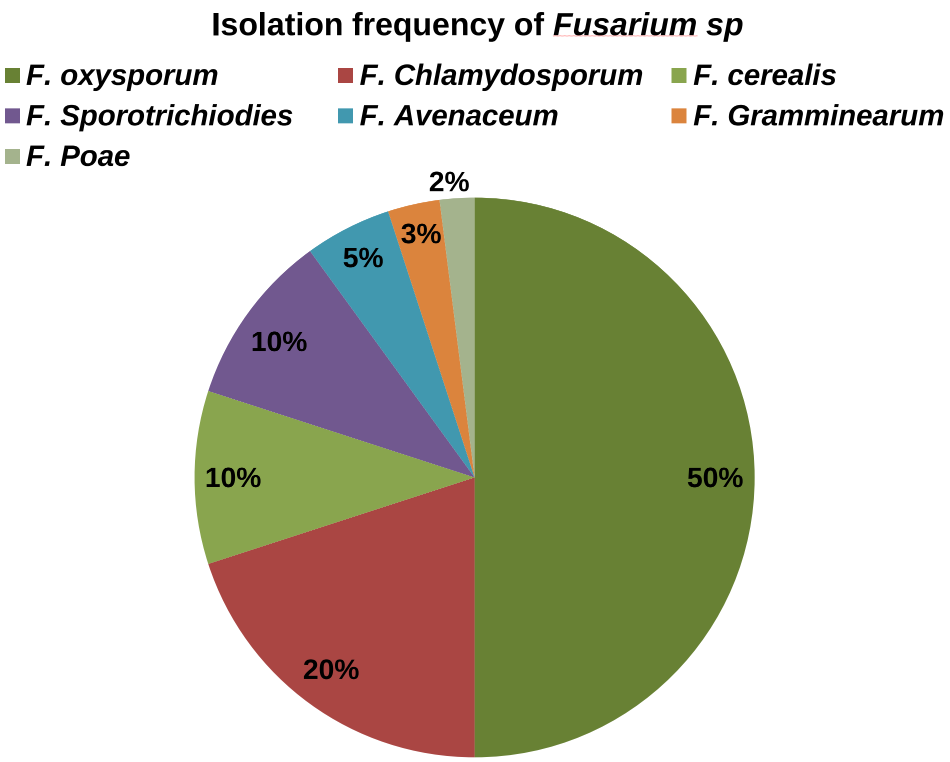

Fig. 3: Isolation frequency of Fusarium Spp. isolated from soybean roots at three different locations in Manitoba.