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MPSG ANNUAL EXTENSION REPORT

PROJECT TITLE: Enhancing Manitoba Soybean Yield and Quality Under Sub-Optimal Conditions

PROJECT START DATE: 1 April 2014 **PROJECT END DATE: 31 March 2018**

DATE SUBMITTED: 24 February 2017

PART 1: PRINCIPAL RESEARCHER

PRINCIPAL

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PART 2: EXECUTIVE SUMMARY

Outline the project objectives, their relevancy to pulse and soybean farmers, and a summary of the project to date, including methods and preliminary results.

Research in the United States suggests that soybean cultivars may vary in their response to soil moisture extremes; however, this information is not currently available for Manitoba. If differences in the tolerance of cultivars to soil moisture extremes are identified, potential may exist to grow the most resilient cultivars in fields or parts of fields affected by deficit or excess moisture, and thereby increase yield potential under these sub-optimal growing conditions. If successful, this approach may provide a low cost tool for reducing production risk and increasing economic returns for producers.

Small plot studies were conducted at Carberry (2015-16) and Portage la Prairie (2014-16) to assess the effect of three moisture regimes (reduced, rainfed, excess) on nine soybean cultivars differing in root rot susceptibility. Hail damage resulted in the loss of yield data at Portage in 2016. Findings to date suggest increased root rot severity in some cultivars when exposed to moisture extremes. A trend of highest mean root rot ratings in the deficit treatment often occurred. Wet and cool spring conditions in 2014 and 2015 may have contributed to root rot development, such that the roots of diseased plants were less able to access water once moisture deficit treatments were imposed. Preliminary results suggest differences in the yield response of cultivars to excess and reduced moisture in some cases. While soybean appeared more tolerant of excess than reduced moisture in 2015, average yields did not vary among moisture regimes at Carberry in 2016. Additional field studies are planned at Carberry and Portage in 2017 to confirm these findings.

PART 3: PROJECT ACTIVITIES AND PRELIMINARY RESULTS

Outline project activities, preliminary results, any deviations from the original project and communication activities. You may include graphs/tables/pictures in the Appendix.

Project activities: In 2016, field experiments were conducted at the Agriculture and Agri-Food Canada site at Portage and at the Canada-Manitoba Crop Diversification Centre at Carberry. A factorial combination of three moisture regimes (reduced, rainfed, excess) and nine soybean cultivars was arranged in a split-plot design with four replicates. The same cultivars were grown at each site. Cultivars were selected based on root rot data from ongoing studies so that cultivars grown varied in their susceptibility to root rot (McLaren et al., pers. comm.).

To produce three moisture regimes, main plots were either covered with rainout shelters (reduced moisture), irrigated such that soybean plants began to show chlorosis (excess moisture), or left uncovered and unirrigated (rainfed) (Table 1). Seeding rates were adjusted based on seed weight and germination of each cultivar. Generally-accepted agronomic management was employed with respect to crop establishment, fertility, weed control and harvest. At Carberry, soybean was planted on May 18 and harvested on October 14. At Portage, soybean was planted on June 7 but a severe hailstorm in August resulted in crop damage, although in-crop data had been collected until that point. Data collection in 2016 included plant counts, chlorophyll meter readings, yield, grain quality, and soil temperature and moisture. Also, 40 plants/cultivar were pulled, washed and rated for root rot on a scale of 0 (healthy) to 9 (death of plant).

Preliminary results: Plant stands averaged 29 and 19 plants/m2 at Carberry and Portage, respectively, although plant stands varied somewhat among cultivars.

Root rot was observed in all plots in 2016, and severity (scale of 0-9) ranged from 2.8-4.6 at Carberry and 3.1-4.3 at Portage, with a mean of 3.7 at both sites. Root rot severity varied among cultivars and moisture regimes. At both Portage and Carberry, root rot means were highest under deficient moisture conditions, with lower means often observed under rainfed and excess moisture regimes. The 2014 and 2015 data suggested a trend of increased root rot severity with some cultivars under deficient and excess moisture regimes compared with the rainfed regime. The reduced and excess moisture regimes are indicative of plant stress situations which can often increase root rot. At Portage, differences in the mm of water received between the rainfed and excess moisture regimes were smaller in 2016 than 2015, and this may have contributed to the similar root rot levels observed for these moisture treatments for some cultivars. At Carberry, the mm of water applied was much higher in the excess than rainfed treatments but this didn't often translate into higher root rot ratings for cultivars within the excess moisture compared to rainfed regime as in 2015.

At Carberry in 2016, a statistically significant cultivar x moisture interaction suggested that cultivars varied in their yield response to different moisture regimes (Fig. 1). Contrast analysis showed that excess moisture produced a higher yield than rainfed conditions for Cultivar 5 (114% of rainfed) and Cultivar 6 (125% of rainfed), but not for the remaining cultivars (92-110% of rainfed). No overall yield differences were evident between rainfed and reduced moisture treatments (69% precipitation of rainfed), with yields ranging from 90 to 106% of rainfed depending upon the cultivar.

Based on study results in 2015, soybean appeared to be more tolerant of the excess than reduced moisture treatment. At Carberry and Portage, mean seed yield under rainfed conditions was similar to that under excess moisture (Fig. 1), while soybean grown under reduced moisture (~25% of rainfed) yielded about 70% that in the rainfed and excess moisture treatments overall. No yield differences were evident among cultivars. While the cultivar x moisture interaction was not significant in 2015, suggesting that cultivars responded similarly to different moisture regimes, contrast analysis showed that for Cultivar1 at Carberry and Cultivar5 at Portage, excess moisture produced a statistically higher yield than rainfed conditions. No yield differences were noted for the other cultivars. In 2014 at Portage, yields in the reduced moisture treatment ranged from 82 to 106% that in the rainfed treatment depending on the cultivar, while seed yields in the excess moisture treatment ranged from 95 to 119% that in the rainfed treatment depending on the cultivar (Fig. 1).

APPENDIX

Table 1. Rainfall and irrigation received in 2016 soil moisture treatments, from soybean planting to harvest.

Moisture	Rainfall (mm)						Irrigation (mm)	Total (rainfall+irrigation)**	
treatment	May*	June*	July	August	September	October*	In-season	Seeding to Harvest	
Carberry								mm	inches
rainfed	66.4	92.7	56.9	39.7	43.3	56	0	355	14
deficient	66.4	92.7	28.6	0	0	56	0	244	9.6
excess	66.4	92.7	56.9	39.7	43.3	56	635	990	39
Portage* **									
rainfed		119	85	123	54	13.4	0	394	15.5
deficient	---	119	50	0	0	12.4	0	180	7.1
excess	---	119	109	159	102	13.4	108	502	20.1

*Rainfall reported for May/June and October includes only those days between seeding and harvest dates. At Carberry, seeding date, harvest date, and installation of rain shelters were: May 18th, October 14th, and July 15th, respectively. Irrigation was applied from July 20th to August 31st. At Portage, seeding date, harvest date, and installation of rain shelters were: June 7, October 15th, and July 15th, respectively. Irrigation was applied from July 27 to September 15th.

**In 2016, reduced and excess moisture treatments received approximately 69% and 279% the amount of precipitation received by the rainfed treatment at Carberry, and 46% and 130% the amount of precipitation received by the rainfed treatment at Portage. In comparison, in 2015, reduced and excess moisture treatments received approximately 24% and 182% the amount of precipitation received by the rainfed treatment at Carberry, and 27% and 139% the amount of precipitation received by the rainfed treatment at Portage.

***Significant hail damage occurred at the Portage site on August 15th.

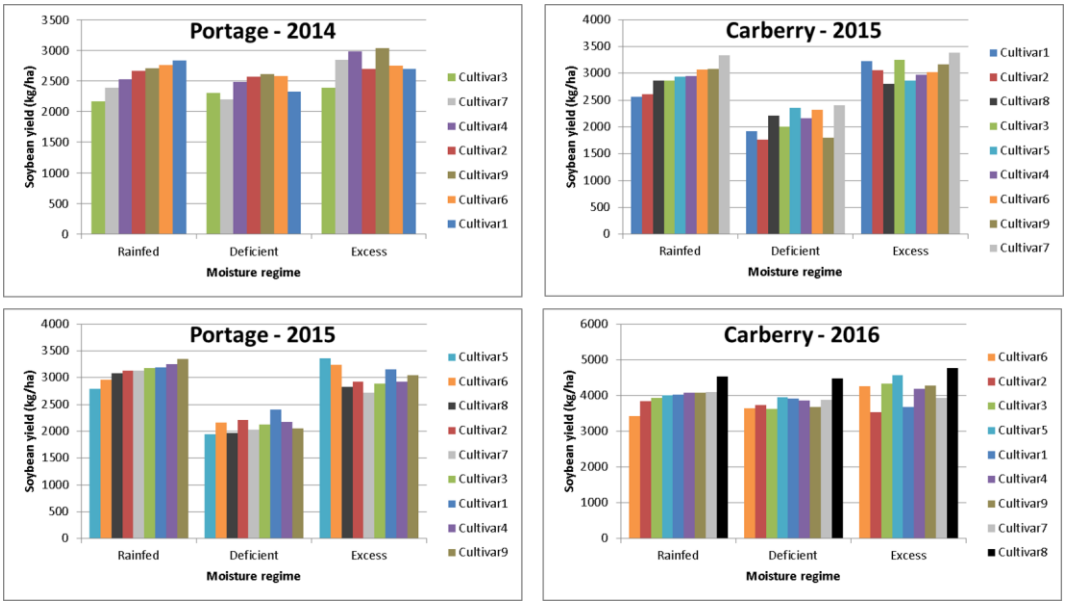

Figure 1. Yield of soybean cultivars under rainfed, reduced and excess moisture conditions at Portage in 2014 and 2015, and Carberry in 2015 and 2016. (For each site-year, cultivars are reported in the order of increasing yield under rainfed conditions. The same cultivars were used in all site-years.)

Summary of grain quality results for 2016:

At Carberry, cultivar influenced oil and protein concentration of the seed as well as test weight. Overall, excess moisture conditions increased protein concentration in seed compared to rainfed and reduced moisture conditions which produced similar protein concentrations. Conversely, oil concentration declined with increasing moisture availability. Average test weight was higher under rainfed than excess moisture conditions, with reduced moisture conditions resulting in intermediate test weights.

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