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MPSG ANNUAL EXTENSION REPORT

PROJECT TITLE: Predicting Soybean Phenology in Manitoba

PROJECT START DATE: 1 April 2018 **PROJECT END DATE: 31 March 2019**

DATE SUBMITTED: 16 May 2019

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.

Soybean requires short days (<14 hours) to stimulate flowering. Maturity group classifications (often not established in Manitoba) are usually based on time (days) or Crop Heat Units (CHUs) to maturity and do not always accurately predict critical crop growth stages (such as the beginning of flowering or maturity) in Manitoba. In Manitoba, MG 000 to MG I can be grown depending on the amount of CHUs received. Each MG classification is further sub-divided into decimal units. The objective of this project will be to confirm differences in soybean phenologial development in Manitoba and then use this information to develop a more accurate model to predicting critical growth stages for farmers and agronomists. This model will be based crop heat units, photoperiod (latitude), and soybean maturity groups. The model will be used by farmers and agronomists to accurately predict critical growth stages of soybean in Manitoba.

The field trials in Carman and Ottawa were completed in 2018. Phenology notes were also collected in 2018 from two MPSG soybean variety trials to have additional data to validate the soybean phenology model being developed for Manitoba. The MSc graduate student working on this project initated a controlled environment experiment to determine photoperiod coefficients for the model being developed. Analysis of the complete data set from 2008-2011 and 2017-18 to compare phenological development for soybean cultivars grown in Manitoba and Ontario has been completed and presented at a scientific conference, local agronomy conferences, and field days in Manitoba.

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.

Field Experiment: At Ottawa and Carman 12 short season cultivars with maturities from MG 000-MG I were planted in an RCBD with four replications. Seeding was coordinated between the two locations to synchronize the time of year and the rate of daylength change between locations. Agronomy and weed control were kept as similar as possible. At Ottawa, plots were 5 m in length with 4 rows spaced 40 cm apart. Plots were seeded at a density of 55 seeds m-2. The Carman location was seeded similarly other than plot lengths were 8 m. Crop protection products were applied as needed. Detailed phenological notes were taken every three days at each location based on the Fehr and Caviness (1977) scale. Weather was recorded at each location and the daylength calculated based on latitude.
Plots were harvested at maturity and seeds centrally processed in Ottawa for quality parameters (protein, oil, and sugar) using the FOSS infratec (FOSS, Hilleroed, Denmark). Yield and seed quality parameters were analyzed in SAS (SAS Institute Inc., Carry, NC) using PROC GLM.

Table 1. Short season soybean cultivars included in the trial. Maturity group is included.

Code	Cultivar	Maturity Group
1	90A01	00.0
2	Dundas	0.8
3	Maple Presto	000.9
4	Rodeo	0.3
5	Montcalm	00.7
6	Alta	00.4
7	Roland	0.0
8	9063	0.5
9	OT02-11	1.3
10	Maple Ridge	00.3
11	22-60 RY	000.9
12	23-11 RY	000.9

Validation Data Set Collection: In 2018, notes on commercial soybean cultivars in the MPSG soybean variety trial were collected by the graduate student working on this project to have additional data to test and validate the model being developed. Similar to the field trials at Carmand and Ottawa, detailed phenological notes were taken every three days at field trials located near Carman and Portage based on the Fehr and Caviness (1977) scale. Weather were recorded at each location and the daylength calculated based on latitude.

Controlled Environment Experiment: Early in 2019, a controlled environment experiment designed to isolate photoperiod effects on time to first flower (R1) was initiated. Soybean has four major photosensitive genes that control time to first flower. These genes have been identified in cultivars from the field experiment. The cultivars from the field experiment plus three additional cultivars were added to cover all combinations of these genes (Table 2). The experiment has a Latin square design with photoperiod treatments of 14, 15, 16 and 17 h. Results will be analyzed using non-linear regression to determine the effects of total number of dominant alleles, magnitude of each allele and allele combination effects on time to first flower in soybean. This experiment is ongoing and is expected to finish by July 2019.

APPENDIX

Table 1: Seed yield and quality in 2017 and 2018 for Carman, Manitoba. Cultivars were compared using LSD (P=0.05) within each year. The mean for each cultivar within year and the overall means for all cultivars are presented for each year.

Cultivar	Maturity Group	Yield (kg ha^{-1})	TKW	Protein (%)	Oil (%)	Sugars (%)
			2017			
90A01	00.0	2103.3	123.2	39.8	21.9	12.5
Dundas	0.8	3006.0	131.7	39.1	21.5	12.7
Maple Presto	000.9	2341.3	126.9	38.3	20.5	13.9
Rodeo	00.3	2702.5	123.6	39.2	22.6	11.9
Montcalm	00.7	2509.3	128.0	38.9	21.9	12.6
Alta	00.4	2312.5	145.5	36.1	22.4	13.7
Roland	0.0	2737.8	133.9	37.3	22.1	13.0
9063	0.5	2985.1	136.8	36.7	21.5	13.5
OT02-11	1.3	2702.2	121.0	37.0	22.2	13.4
Maple Ridge	00.3	2374.4	126.2	39.2	20.6	13.5
22-60 RY	000.9	3176.3	128.1	37.9	21.7	13.2
23-11 RY	000.9	3023.4	129.4	36.7	22.1	13.3
Mean		2664.5	129.5	38.0	21.7	13.1
LSD within year		540.9	6.7	1.4	0.5	0.4
			2018			
90A01	00.0	2146.9	0.0	40.2	21.4	11.7
Dundas	0.8	2404.6	0.0	40.0	21.4	12.5
Maple Presto	000.9	1973.8	0.0	39.9	20.1	12.5
Rodeo	00.3	2127.2	0.0	39.2	22.7	11.9
Montcalm	00.7	1978.2	0.0	38.4	22.6	12.3
Alta	00.4	1998.4	0.0	36.5	22.8	12.6
Roland	0.0	1790.7	0.0	38.9	20.8	12.7
9063	0.5	2840.4	0.0	37.8	22.3	12.7
OT02-11	1.3	2379.0	0.0	35.6	22.9	13.1
Maple Ridge	00.3	2167.3	0.0	39.2	20.7	13.0
22-60 RY	000.9	2083.5	0.0	38.0	22.5	12.1
23-11 RY	000.9	1284.4	0.0	38.5	21.7	12.3
Mean		2097.9	0	38.6	21.9	12.5
LSD within year		653	0	1.5	1.1	0.3

Table 2: Seed yield and quality in 2017 and 2018 for Ottawa, Ontario. Cultivars were compared using with PROC GLM in SAS, means by year and LSD (P=0.05) are included as well as the overall means for both years and the corresponding LSD (P=0.05) to separate the year mean

Cultivar	Maturity Group	Yield (kg ha^{-1})	TKW	Protein (%)	Oil (%)	Sugars (%)
			2017			
90A01	00.0	2324	169.98	41.90	20.18	11.73
Dundas	0.8	3397	191.50	41.10	20.85	12.05
Maple Presto	000.9	1847	176.50	41.13	19.23	13.13
Rodeo	00.3	3177	193.92	41.63	21.55	11.28
Montcalm	00.7	2222	180.47	41.88	20.10	12.15
Alta	00.4	2162	225.42	40.15	20.55	12.55
Roland	0.0	3075	190.97	40.18	20.85	12.40
9063	0.5	2573	197.71	41.00	20.13	12.38
OT02-11	1.3	2903	168.65	39.98	20.45	13.03
Maple Ridge	00.3	1940	183.76	41.45	19.53	12.70
22-60 RY	000.9	2465	188.55	40.38	19.78	12.85
23-11 RY	000.9	2659	179.72	40.15	19.80	12.70
Mean for 2017		2562	187.26	40.91	20.25	12.41
LSD within year		418	6.74	0.62	0.44	0.28
			2018			
90A01	00.0	3134	179.16	43.33	20.63	11.85
Dundas	0.8	4848	199.20	41.88	22.15	11.53
Maple Presto	000.9	3403	194.32	41.63	20.43	12.95
Rodeo	00.3	4548	194.53	42.00	22.75	10.90
Montcalm	00.7	3577	193.57	43.58	21.20	11.58
Alta	00.4	3908	239.33	41.00	21.85	12.40
Roland	0.0	4436	196.11	41.10	22.23	11.78
9063	0.5	4770	217.16	41.13	21.80	12.00
OT02-11	1.3	4737	196.89	39.70	22.33	12.85
Maple Ridge	00.3	2960	182.18	42.43	20.48	12.68
22-60 RY	000.9	3329	204.55	42.03	21.48	11.98
23-11 RY	000.9	3525	187.79	40.65	21.88	12.35
Mean for 2018		3931	198.73	41.70	21.60	12.07
LSD within year		318	15.56	0.43	0.22	0.39