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MPSG ANNUAL EXTENSION REPORT

PROJECT TITLE: Overcoming the discount for low protein in Manitoba soybean: Determination of the impact of genotype, environment and year on soy protein quality

PROJECT START DATE: 1 January 2019 **PROJECT END DATE: 31 December 2019**

DATE SUBMITTED: 31 January 2020

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.

In 2017, Manitoba soybean production accounted for 29% of Canadian production (1). However, soybeans grown in Manitoba have demonstrated lower crude protein values when compared to those grown in Eastern Canada or in the Southern U.S. Low crude protein (less than 33% on a 13% moisture basis) levels have led to discounted prices received by producers. In order to address this "Manitoba Protein Deficit", research is required to understand the factors (genetic; environment) that influence protein content, and whether focusing on the amino acid content of soy yields a better reflection of the feeding value of the resultant soybean meal. Therefore, the overall objectives of the current project include: 1) Determining the effect of genotype and environment on the moisture, fat, protein and amino acid composition of Manitoba soybeans; and 2) Developing rapid, Near Infrared Reflectance (NIR)-based methods to determine the amino acid composition of soybeans, to determine the Critical Amino Acid Value (CAAV; sum of key essential amino acids). Samples (n=2700) of soybeans from the 2018 MPSGA field trials were secured, scanned on the NIR system, and crude protein and moisture content determined using existing calibration equations. A statistical sub-sample (n=140) was subjected to full reference chemistry analysis (moisture, crude protein, amino acids), and the calibration equations were refined. Preliminary data provided evidence that the CAAV was inversely proportional to crude protein levels. This data shows that the feeding value of Manitoba soybeans may be underestimated if focus remains on crude protein values alone. Attention should continue to find varieties that have a higher quality of protein, as represented by the CAAV, under Manitoba conditions.

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. Since the start of the project, the following project activities have been conducted:

1. Recruited a Graduate Student (Da Shi) and an Undergraduate Student (Jennifer Nguyen) to work on the project
2. Secured 2700 soybean samples (approx. 500 g each) from Manitoba Pulse and Soybean Growers Association from the 2018 cropping year. The samples represented plots from the MPSGA field trials, and represented both conventional and GM soybean varietals grown in different locations in Manitoba.
3. All intake soybean samples were scanned on a DA7250 NIR system for the determination of moisture, crude protein, amino acid content using established NIR calibration equations
4. A statistical sub-sample (n=140) of the soybean varietals were drawn from each quartile of crude protein content and analyzed via wet chemistry reference methods for dry matter, crude protein and amino acid content using established and approved reference methods
5. New calibration equations were developed for both the DA7250 NIR system and the FT9700 Fourier Transformed NIR system (Perten Instruments) for the determination of amino acid content and the Critical Amino Acid Value (CAAV), taken as the sum of lysine, threonine, tryptophan, and the sulphur amino acids (the key limiting amino acids in cereal grains and pulses used in the livestock feeding sector).

Preliminary Results. To date, we have generated the following results (see representative data in attached Appendix):

1. Protein, Dry Matter, and Amino Acid Content of intact soybean seeds, as determined by NIR (n=2700)
2. Determination of the Protein, Dry Matter and Amino Acid Content of soybean seeds (n=140) as determined by reference wet chemistry values
3. Development of new NIR calibration equations for Manitoba soybean protein and amino acid values
4. Determination of the CAAV of Manitoba Soybeans, including the demonstration that CAAV is inversely related to protein. As such, low protein soybeans maintain their feeding value in relation to their content of key limiting amino acids for monogastric diets (pigs, poultry).

Deviations. None

Communication Activities. The following communication activities are planned:

1. Information on the project and research goals were communicated to pulse and soybean growers in the Fall/Winter 2018 issue of Pulse Beat
2. Data will be shared with MPSG for upcoming Pulse Beat articles
3. Data from the project will inform discussions with Soy Canada re: research priorities
4. Research findings will be presented at upcoming meeting of AOCS in Montreal, QC, via a poster presentation by Da Shi (late breaking abstracts), and future conferences
5. A manuscript outlining the major research findings will be published in an appropriate journal.

APPENDIX

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

Table 1. Crude Protein, Amino Acid and Critical Amino Acid Value contents of Manitoba Soybeans (n=2700)

Component (All based on wet basis)	Average %	Max %	Min %	Median %	Stdev	CV %
Crude Protein (N% * 6.25)	35.60	46.75	25.37	35.79	2.769	7.78
Protein (sum of each AA%)	34.94	43.54	25.68	35.22	2.468	7.06
ALA	1.46	1.80	1.18	1.48	0.082	5.59
ARG	2.50	3.42	1.64	2.52	0.226	9.04
ASP	4.05	5.13	2.96	4.09	0.298	7.36
CYS	0.56	0.66	0.42	0.56	0.034	6.14
GLU	6.31	8.17	4.35	6.38	0.531	8.41
GLY	1.53	1.82	1.15	1.54	0.105	6.86
HIS	0.81	1.03	0.55	0.82	0.068	8.33
ILE	1.59	1.99	1.16	1.60	0.111	6.98
LEU	2.73	3.31	2.09	2.74	0.180	6.60
LYS	2.27	2.70	1.75	2.28	0.131	5.80
MET	0.52	0.62	0.41	0.52	0.029	5.56
PHE	1.80	2.25	1.31	1.81	0.134	7.46
PRO	1.81	2.25	1.34	1.83	0.135	7.45
SER	1.88	2.29	1.40	1.89	0.130	6.94
THR	1.43	1.74	1.12	1.44	0.081	5.70
TRP	0.49	0.57	0.38	0.49	0.029	5.89
TYR	1.28	1.59	0.95	1.29	0.085	6.59
VAL	1.59	1.97	1.20	1.60	0.098	6.15
CAAV (CAA/Crude protein %)	14.79	18.36	13.24	14.76	0.474	3.21
CAAV (CAA/protein% based of sum of AA)	15.06	16.31	14.09	15.03	0.295	1.96

Figure 1. Relationship between Critical Amino Acid Values (CAAV) and Crude Protein content of Manitoba Soybeans (n=2700)