

Genetic Improvement of Protein Quality in Edible Beans with Adaptation to Manitoba

2013 Annual Report to MPGA (2nd year)

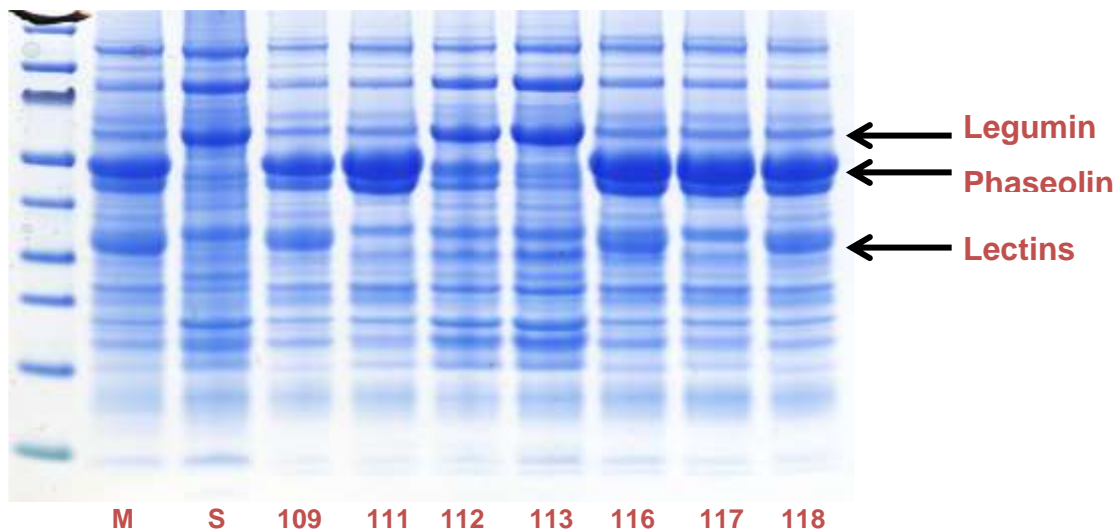
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Edible bean contains a high protein content, however, its protein quality is considered poorer compared with some other crops such as soybean. The key factor limiting the protein quality in edible beans is the sub-optimal content of sulphur-containing amino acids, particularly methionine. Bean germplasm line (SMARC1N-PN1) lacks major seed storage proteins, leading to increased total cysteine and methionine content. To study the feasibility of improving protein quality while not sacrificing other major agronomic traits in edible beans and develop breeding materials with improved protein nutrition in Manitoba, a cross was made between SMARC1N-PN1 and the locally-adapted navy bean cultivar ‘Morden003’. A recombinant inbred line population was developed via single seed descent in the greenhouse at the Morden Research Station. In 2013, a population of 182 lines were grown at Morden for further seed increase. Sufficient seeds have been produced for replicated tests at multiple locations in 2014.

Protein Profiles Preliminary screening with SDS protein electrophoresis revealed significant variation in polypeptide compositions in the lines of the population. Sixty one of the 182 lines analyzed had Morde003 type phaseolin and lectin; 59 lines had Morden003 type phaseolin and SMARC1N-PN1 type lectin; 38 lines had SMARC1N-PN1 type phaseolin and Morden003 type lectin; and 24 lines had SMARC1N-PN1 type phaseolin and lectin. The results were confirmed in two generations of the recombinant inbred lines.



Representative samples and electrophoresis results showing protein profiles of Morden003 (M), SMARC1N-PN1 (S), and selected lines with protein patterns same as Morden003 (Lines 109, 116, 118), and SMARC1N-PN1 (Line 113)

Amino Acid Analysis Total amino acid profiles were analyzed for a subset of lines at the Advanced Protein Technology Centre, Hospital for Sick Children, Toronto, ON. Methionine levels were found to be remarkably higher in Morden003 than in SMARC1N-PN1, while cysteine was higher in SMARC1N-PN1 than in Morden003. Recombinant lines were identified with high total methionine and cysteine content (60 nmol per mg), as compared with 51 nmol per mg for Morden003 and 46 nmol per mg for SMARC1N-PN1. The lines are being examined further for their protein profile, amino acid composition and agronomic characteristics.

Agronomic Performance In the three replications tested at Morden in 2013, no obvious growth abnormalities were observed for agronomic traits. The plant growth habit varied from type I to type II with upright growth. The plant morphology varied from resembling one of the parents to intermediates. Flowering occurred between 40 and 61 days after seeding. Pod height ranged from 50 to 97% of the pods above 5 cm from the ground. Most of the lines (84% of the plots) had a rating of over 80%, and around one-third had more than 90% of the pods off the ground. Days to maturity ranged between 86 and 113 days. Severe common bacterial blight infection occurred in about 6% of the plots. Very little white mould was observed. Many lines were identified with high yield potential, good maturity, good visual seed quality and agronomic traits. Superior lines will be tested at two locations in 2014 and will be compared by amino acid variation and protein profiles. Selections will be used in crossing for various edible bean market classes.

Budget Summary The funding support for this project from MPGA (\$12,000) has been used to hire a summer student at Morden (\$5,000) and purchase experimental supplies for chemical analysis at London (\$7,000), which is greatly appreciated.

Two presentations have been made from this research project

Hou A., Marsolais F., Pajak A. and R.L. Conner. Genetic improvement of protein quality in edible beans with adaptation to Manitoba. Poster presentation. Bean Improvement Cooperatives, October 28-30, 2013, Portland, OR.

Hou, A., Marsolais, F., Pajak, A. and Conner, R.L. Genetic improvement of protein quality in edible beans with adaptation to Manitoba. Poster presentation. 9th Canadian Pulse Research Workshop, November 7-9, 2012, Niagara Falls, ON.