

MPSG FINAL EXTENSION REPORT

PROJECT TITLE: Effect of cultivar, growing location and year on dietary fiber contents, trypsin inhibitor activity and oligosaccharides in Manitoba grown dry beans

PROJECT START DATE: 1 April 2016

PROJECT END DATE: 31 March 2018

DATE SUBMITTED: 29 January 2018

PART 1: PRINCIPAL RESEARCHER

PRINCIPAL

NAME:	Dr. Ning Wang
POSITION:	Research Scientist
INSTITUTION:	Canadian Grain Commission
EMAIL:	ning.wang@grainscanada.gc.ca
PHONE:	204-983-2154

PART 2: EXECUTIVE SUMMARY

Outline the project objectives, a summary of the activities and results, and their relevancy to pulse and soybean farmers.

The objectives of the project were (1) to evaluate dietary fiber (soluble, insoluble and total dietary fiber), oligosaccharides and trypsin inhibitor activity in dry beans grown at two locations in Manitoba over two years, and (2) to investigate the effect of cultivar, growing location and year on these quality traits.

Twenty bean cultivars were grown in three replications in a randomized complete block design at two locations in Manitoba (Morden and Portage la Prairie) in 2013 and 2014. The cultivars chosen are commonly grown in Canada and frequently used in crossing in the Morden Dry Bean Breeding Program in Manitoba, Canada. Insoluble (IDF), soluble (SDF) and total dietary fiber (TDF), oligosaccharide contents and trypsin inhibitor activity (TIA) were determined according to the published methods. Statistical analyses were conducted using the SAS (v.9.4, SAS Institute, Cary, NC).

It was found from this study that cultivar, growing location and year significantly affected SDF, sucrose, oligosaccharide content and TIA in beans. Cultivar and growing year had a significant effect on IDF whereas TDF was only affected by cultivar.

Knowledge gained from this research on the cultivar and environmental interaction on quality traits of beans will assist breeders in developing bean cultivars with improved quality and nutritional values, which will in turn help the pulse growers and industry for competitiveness in both the domestic and international markets. Information gathered from this study on the nutritive values of beans will also be useful in supporting and enhancing the marketability of Manitoba grown dry beans.

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.

Twenty bean cultivars were grown in three replications in a randomized complete block design at two locations in Manitoba (Morden and Portage la Prairie) in 2013 and 2014. The cultivars chosen are commonly grown in Canada and frequently used in crossing in the Morden Dry Bean Breeding Program in Manitoba, Canada. Insoluble (IDF), soluble (SDF) and total dietary fiber (TDF), oligosaccharide contents and trypsin inhibitor activity (TIA) were determined according to the standard methods. Statistical analyses were conducted using the SAS (v.9.4, SAS Institute, Cary, NC). The Duncan multiple range test was used to separate means and significance was accepted at $p < 0.05$.

IDF ranged from 144.7 to 215.1 g/kg dry matter (DM) with a mean of 174.1 g/kg DM. Analysis of variance showed that cultivar and growing year had a significant effect on IDF. Cultivar accounted for 16% of the variance whereas growing year for 13% (Fig. 1). Small red bean cultivar AC Earlired had the highest mean IDF content whereas pinto bean cultivar AC Pintoba exhibited the lowest. Beans grown in 2013 had significantly ($P < 0.05$) higher mean IDF content than in 2014. SDF content ranged from 19.3 to 64.3 g/kg DM. Cultivar contributed 14% of the variance in SDF content whereas growing location and year contributed 24% (Fig. 1). Black bean cultivar AC Carman and navy bean cultivar Envoy exhibited the highest SDF content, while great northern bean cultivar Beryl had the lowest. Beans from Morden had higher mean SDF content than Portage la Prairie, whereas beans grown in 2013 had significantly ($P < 0.05$) lower SDF content than in 2014. TDF content varied from 168.4 to 250.3 g/kg DM with an average of 213.9 g/kg DM. Cultivar accounted for 16% of the variability in TDF content whereas interactions of cultivar-by-year and location-by-year for 18% (Fig. 1). Small red bean cultivar AC Earlired had the highest TDF content, whereas pinto bean cultivar AC Pintoba had the lowest.

Sucrose content in beans varied from 25.6 to 48.0 g/kg DM with a mean value of 34.5 g/kg DM. Cultivar contributed the largest component of the variance (63%) in sucrose content whereas growing location and year contributed 9% and 11%, respectively (Fig. 1). Great northern bean cultivar Beryl and pinto bean cultivar PT92-19-1 had the highest sucrose content whereas navy bean cultivar Envoy had the lowest. Beans from Morden had significantly ($P < 0.05$) higher mean sucrose content than from Portage la Prairie. Beans grown in 2013 had significantly ($P < 0.05$) higher mean sucrose content than in 2014. Raffinose content ranged from 1.67 to 10.2 g/kg DM with an average of 4.68 g/kg DM. Cultivar contributed the largest component of the variance in raffinose content (Fig. 1). Great northern bean cultivar GN13-10-1 had the highest raffinose content while light red kidney bean cultivar Clouseau had the lowest. Beans from Morden exhibited significantly ($P < 0.05$) higher raffinose content than from Portage la Prairie. Beans grown in 2013 showed significantly ($P < 0.05$) higher mean raffinose content than in 2014. Stachyose content varied from 26.8 to 44.7 (g/kg DM). Cultivar accounted for 55% of the total variability in stachyose content (Fig. 1). Black bean cultivar AC Jet and light red kidney cultivar Pink Panther had the highest stachyose content whereas pinto bean cultivar Windbreaker exhibited the lowest. Significant ($P < 0.05$) higher mean stachyose value was observed for beans from Portage la Prairie than from Morden. Beans grown in 2013 had significantly ($P < 0.05$) higher mean stachyose content than in 2014. Verbascose content in beans ranged from 0.01 to 3.0 g/kg DM. Cultivar contributed 67% of the total variability in verbascose content (Fig. 1). Light red kidney bean cultivar Clouseau had the highest verbascose content, whereas pinto bean cultivar Windbreaker exhibited the lowest. Beans from Morden had significantly higher mean verbascose content than that from Portage la Prairie. Beans from 2013 exhibited significantly ($P < 0.05$) higher mean verbascose content than from 2014.

Trypsin inhibitor activity (TIA) ranged from 3.7 to 14.4 mg/g DM with a mean of 8.3 mg/g DM. Cultivar accounted for 57% of variance in verbascose content (Fig. 1). Navy bean cultivar Lightning had significantly ($p < 0.05$) higher TIA value than the other cultivars. Beans from Morden had significantly lower mean TIA value than from Portage la Prairie. Beans from 2013 exhibited significantly ($P < 0.05$) lower mean TIA level than from 2014.



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.

Results from this study showed that cultivar had a significant effect on dietary fiber, oligosaccharides content and trypsin inhibitor activity in dry beans. The findings indicated that development of a bean cultivar with high dietary fibre and reduced oligosaccharides and trypsin inhibitor activity is possible. However, results from this study demonstrated that some of the quality traits were also largely affected by environmental factors such as growing location, year and their interactions. Information obtained from the project will benefit bean breeders in effort to improve nutritive values of new bean cultivars through selecting parental lines for crossing and cultivar development in various bean market classes. This will in turn enhance the marketability of Canadian beans.

PART 5: COMMUNICATION

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

1. Wang, N., Hou, A., Santos, J. and Maximiuk, L. (2017). Effects of cultivar, growing location and year on physicochemical and cooking characteristics of dry beans (*Phaseolus vulgaris*). *Cereal Chemistry*, 94:128-134.
2. Wang, N., Hou, A., Maximiuk, L. and Santos, J. (2016). Variation in dietary fibre and oligosaccharide contents of different beans (*Phaseolus vulgaris*) grown in Manitoba. Presented at the 10th Canadian Pulse Research Workshop, October 26-28, 2016, Winnipeg MB.



APPENDIX

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

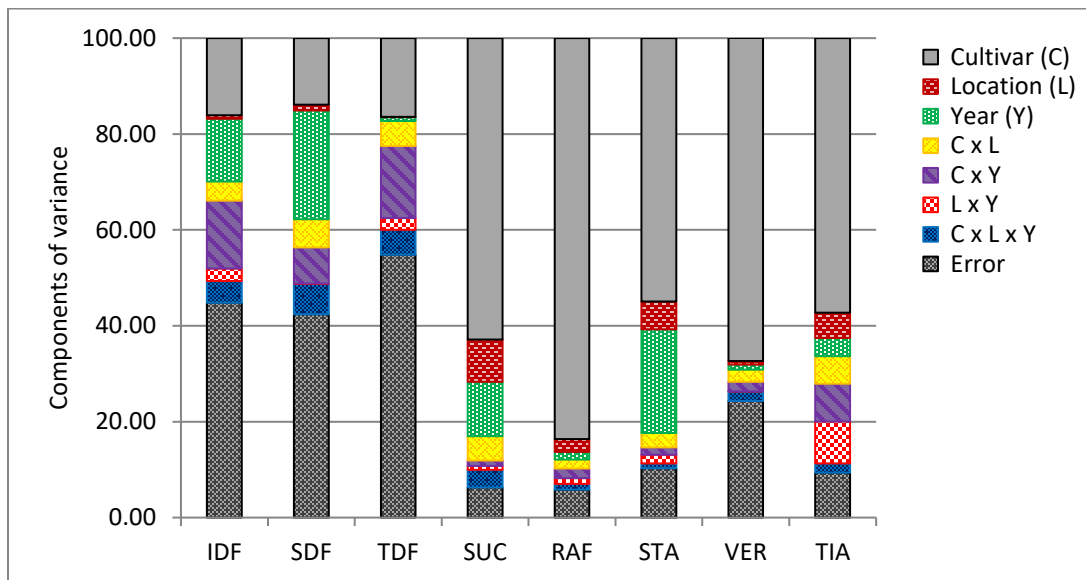


Fig. 1. Contributions to variance of quality traits of beans grown in Manitoba at two locations in 2013 and 2014. IDF=insoluble dietary fiber (g/kg dry matter); SDF=soluble dietary fiber (g/kg dry matter); TDF=total dietary fiber (g/kg dry matter); SUC=sucrose (g/kg dry matter); RAF=raffinose (g/kg dry matter); STA=stachyose (g/kg dry matter); VER=verbascose (g/kg dry matter); TIA=trypsin inhibitor activity (mg/g dry matter).

