Soybean Protein and the Impact of Genotype and Environment on Quality

Crude protein levels were comparatively lower (40.4%, dry matter basis; 35.2%, 13% moisture basis) from soybeans grown in northern environments, but these soybeans contained greater concentrations of critical amino acids indicating that crude protein alone may undervalue the nutritional value of Manitoba-grown soybeans.

SOYBEANS GROWN IN western Canada have lower crude protein values than those grown in eastern Canada and the southern U.S., limiting opportunities for future development of the soy processing sector. Protein plays an important role in determining the value of the crop as it relates to the feed value of meal for livestock. However, feed formulation strategies have evolved away from a primary focus on crude protein content to a focus on digestible amino acid content.

Essential amino acids (EAA) must be provided in the diet. Diets with high crude protein that are limited or deficient in one or more EAA cannot support livestock growth and production targets. Thus, a more accurate reflection of soybean nutritional quality is the concentration of EAA that are primarily limited in livestock feeds — specifically, lysine, cysteine, threonine, methionine and tryptophan. The sum of these EAA is the critical amino acid value (CAAV). The higher the CAAV, the better the feeding value.

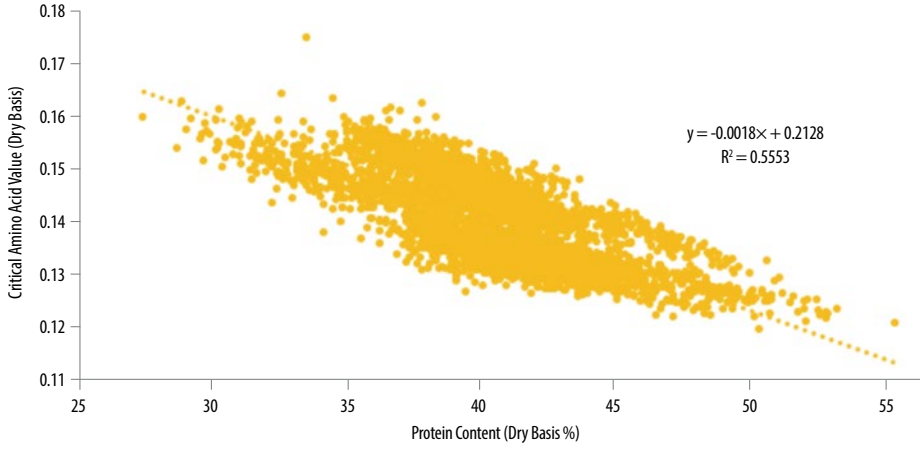
Protein and amino acid profiles are influenced by variety (genotype), environment and the interaction between the two. This research evaluated these effects on soybean protein and amino acid concentrations. Approximately 4,700 whole soybean samples were supplied from 13 different variety trial locations across Manitoba in 2018 and 2019. Near-infrared (NIR) spectroscopy was used as a non-destructive, simple and fast method of assessing protein and amino acid contents.

On average, crude protein levels (% dry matter basis) were 39.1% (range: 27.3–50.5%) and 42.2% (range: 34.1–55.3%) in 2018 and 2019, respectively. There were significant effects of genotype, environment and genotype × environment interactions on soybean crude protein and amino acid content. Among those factors, genotype was responsible for most of the variation for all traits. Protein and amino acids responded differently to various environments, but what made environments favourable for soybean protein and amino acid accumulation was unclear. Statistical analysis identified varieties where protein and amino acid contents persisted across growing environments and cropping years.

There was a negative correlation between crude protein and the CAAV (Figure 1), providing evidence that the nutritional value of soybeans may not be best represented by crude protein levels. Thus, in soybeans with high crude protein content, less of the protein consists of critical amino acids, suggesting that after a certain stage, the increased protein in soybean grain is mainly composed of other amino acids. These results are consistent with data from the northern plains of the U.S. and provide evidence that crude protein alone may not be the best predictor of the overall nutritional value of soybean meal derived from crops produced in northern latitudes.

The next step of this research is underway, characterizing the nutritional profile and feeding value of Manitoba-grown soybean meal and oil for use in diets of layer, pullet and broiler chickens, and swine.

Figure 1. Relationship between critical amino acid values (the sum of lysine, cysteine, threonine, methionine and tryptophan amino acid content divided by crude protein %) and crude protein (dry basis %) in soybeans in Manitoba in 2018 and 2019, combined.



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