Worldwide consumption of soybean (*Glycine max*) continues to grow and is spurred by demand for the protein and oil harvested from soybean seed (USDA, NASS 2014). Soybean seed produced in the northern and western Corn Belt has a lower seed percentage of protein, with sucrose occupying a larger part of the residual seed content (Breene et al 1998, Miller-Garvin et al, 2014). Additionally, these areas are farthest from the market and thus experience both transportation and quality costs as a basis below the Chicago Board of Trade price. Studies on the physiological basis of soybean seed composition are needed to better understand these regional patterns and identify remedial actions.

Accurately evaluating soybean value requires more than crude protein analysis, the composition of the protein fraction must also be taken into account. Protein quality is the relative abundance of essential amino acids to total protein. Deficits of these essential amino acids correspond to lower nutritional value of the soybean meal resulting in increased feed per unit gain and higher livestock production costs (Fernandez et al, 1994). Results of Thakur and Hurburgh (2007) correlated a decrease in protein quality (percent of essential amino acids) as total protein increases. The increase in protein quality then may offset lower quantity of protein to stabilize soybean value.

A study was initiated in 2013 to examine the relationship between protein quantity and protein quality. Soybean plants were manipulated at the beginning of the rapid seed-filling period (R5) to change the ratio of the accumulating parent plant to the assimilating seed (Proulx and Naeve, 2009). Source-limiting treatments included shade and defoliation; while sink-limiting treatments included depodding and decreased plant competition. Previous research has found that protein and oil accumulation in the seed is highly responsive to source-sink ratio changes during seed fill (Egli et al, 1983; Yamagata et al, 1987). Preliminary results indicate that protein quality is negatively correlated with protein quantity across treatments and there may be physiological limitation to increasing both measures simultaneously. However, decreased plant competition allowed for an increase in the protein plus oil fraction which suggests possible photosynthetic source limitation.

As mentioned, the residual fraction of the soybean seed contains two to three percentage points more sucrose in the northern and western Corn Belt (Miller-Garvin et al, 2014). A study was initiated in 2013 to determine the correlation between environmental conditions during seed filling and after harvest on seed soluble carbohydrate levels. Three varieties of different relative maturities (RM 1.4, RM 1.8, RM 2.3) were planted in early May, early June, and early July to give a range of growing conditions and maturation conditions during seed fill. In addition, post-harvest treatments were conducted to simulate
varied post-harvest conditions (temperature and humidity) to allow or arrest metabolic activity in the seed.

The study results will further elucidate the physiological basis behind seed nutrient partitioning. Once this is better understood, breeders can target physiological changes which correspond to changes in seed composition. Ultimately, the farmer will have access to varieties which have both high quantity and high quality of valued seed components.

References


USDA, NASS. 2014. Oilseed Crop Database.