**Quality of the United States Soybean Crop: 2011[[1]](#footnote-1)**

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Summary

The American Soybean Association and the US Soybean Export Council have supported a survey of the quality of the US soybean crop since 1986. This survey is intended to provide new crop quality data to aid international customers with their purchasing decisions.

2011 Acreage, Yields, and Total Production

According to the 9 November, 2011 United States Department of Agriculture, National Agricultural Statistics Service (USDA-NASS) crop report, the total US soybean production area decreased slightly from last year to 29.8 million hectares harvested (Table 1). Average yields decreased as well, to 2.77 MT per ha. With a smaller production area than in 2010 and smaller yields, total US soybean production is estimated to be 83.0 million MT. This makes the 2011 crop 9% smaller than the crop of 2010.

Quality of the 2011 US Soybean Crop

By 30 August, 2011 sample kits were mailed to 10,637 producers that were selected based on total land devoted to soybean production in each state, so that response distribution would closely match soybean production. By 22 Decmeber, 2011, 2047 samples were received. These were analyzed for protein, oil, and amino acid concentration by near-infrared spectroscopy (NIRS) using a Perten DA7200 diode array instrument (Huddinge, Sweden) equipped with calibration equations developed by Perten in cooperation with the University of Minnesota. Regional and national average quality values were determined by computing weighted averages using state and regional soybean production values, so that average values better represent the crop as a whole. Results are in Tables 2 and 3.

Interpretation of Protein and Oil Results

Average protein and oil concentrations for the 2011 US soybean crop dropped slightly from that of the 2010 US crop and were both lower than the long-term US averages. Average US soybean protein concentration was 0.1 percentage points lower in 2011, at 34.9%, and average oil concentration was 0.5 percentage points lower at 18.1% when compared with 2010 (Table 4). As is noted in most years, Western Corn Belt states showed lower protein concentrations than the US crop as a whole. Soybeans grown in the Southeast and East Coast states tended to have higher protein concentrations. Midsouth, Southeastern, and East Coast states produced a soybean crop with higher oil concentration than the main soybean production regions of the Eastern and Western Corn Belt.

Compared with the 2010 crop, protein concentrations from the Western and Eastern Corn Belt regions, decreased slightly. Protein levels increased slightly in the Midsouth, but were significantly higher in the Southeast and East Coast region. Oil concentrations were lower throughout all of the regions, except the MidSouth, where there was a slight increase.

As was the case in 2010, seed from the 2011 crop tended to be dryer than normal at harvest time. The average moisture of samples received in 2011 was 10.8%. The driest soybeans were found in the Western states (Kansas, Nebraska, and South Dakota). The Western Corn Belt region as a whole had average moisture levels of 10.1%. When protein levels are adjusted to an ‘as-is’ basis rather than a 13% moisture basis, the protein level of the average US soybean increased from 34.9 to 35.6%. Similarly, oil values increased from 18.1 to 18.5%, on an ‘as-is’ basis.

Interpretation of Seed Size Results

While seed size may not be important for most commodity soybean purchasers, seed size does provide some insight into the environmental conditions present during the production season. Seed size can also be correlated with changes in protein and oil concentration due to these same environmental conditions. In general, environmental stresses such as drought in the early seed-filling period (late July and early August) tend to reduce the number of seeds on individual plants; if conditions return to normal, these remaining seeds can expand, resulting in larger than average seed size. Alternatively, stresses at the end of the seed-filling period (late August through September) reduce the energy available for each seed and seed size may be smaller than average.

In 2011, seed size was 8% larger than in 2010, with the average seed size increasing from 14.3 grams per 100 seeds in 2010 to 15.1 in 2011 (Table 3). Seed size tended to be largest in the East Coast region, where the soybean crop received abundant late-season rainfall.

Amino Acids

Amino acids are the “building block” organic compounds linked in various combinations to form unique proteins. In human diets, amino acids are supplied by the variety of plant and animal proteins ingested. In animal feed, amino acids come from feed proteins such as soybean meal, or from synthetic amino acid supplements. Soybean meal is the major feed protein source in poultry, swine, and cultured fish diets because of its high nutritional quality including its balanced amino acid profile. Optimal animal performance occurs when the feed protein contains an ideal amount and proportion of all essential amino acids (those amino acids which cannot be formed by animals) – this is an “ideal protein”. Typically, feed diet formulation, seeking to achieve an ideal feed protein, is based on knowing crude protein then adding “insurance” levels of amino acids in order to avoid any amino acid shortage. Often this approach results in an excess of nitrogen compounds because the protein supply does not ideally match the animals’ needs; the excess is excreted and lost, and can pose an environmental contamination risk. Additionally, this approach involves higher production costs.

Preferably, the use of a high quality protein source with an excellent balance of amino acids to meet the most limiting amino acid requirements at a lower protein concentration is a far more efficient option than using a lower quality protein source. In a comparison of soybean meal from US and other origins, US soybean meal had lower protein content than Brazilian soybean meal, but better quality of protein – higher concentrations of essential amino acids (Park and Hurburgh, 2002; Thakur and Hurburgh, 2007; Bootwalla, 2009). Although soybeans from the US are generally lower in crude protein, both US soybeans and soybean meal contained higher concentrations of essential amino acids (Thakur and Hurburgh, 2007), thus making their protein fraction of higher quality.

We have recently investigated the relative abundance of amino acids found in soybean protein within the US by evaluating Soybean Quality Survey samples from 2006-2009. We identified approximately 100 samples each year which collectively represented the US crop. These samples were evaluated with HPLC (High Performance Liquid Chromatography) for total amino acids. In 2009 and 2010, more than 1,500 samples were evaluated for total amino acids using NIRS. Lysine, expressed as percent of the protein, is evaluated since lysine is an often limiting amino acid in vegetarian diets. If the first limiting amino acid is not supplied in adequate amounts in feed diets, the remaining essential amino acids are not efficiently used. For these analyses we considered the ten essential amino acids to include: leucine, histidine, isoleucine, lysine, methionine and cysteine, phenylalanine, threonine, tryptophan, and valine. The eight non-essential amino acids included: alanine, arginine, aspartic acid, glutamic acid, glycine, proline, serine, and tyrosine. While the relative abundance of each of the amino acids varied from sample to sample and average values varied across years, the same general trends noted in previous work that compared US and Brazilian soybean samples was noted within US soybeans.

* Soybean samples with lower crude protein levels tend to have a protein fraction that is enriched in essential amino acids relative to higher protein samples
* The largest and most consistent increase in relative abundance of the essential amino acids appears to be lysine. In other words, lysine appears to be an important factor driving this increase in the sum of the essential amino acids in lower protein samples

2011 Amino Acid summary

The 2011 amino acid results supported results obtained from previous years discussed above. When analyzed as a percent of crude protein, lysine appeared to be slightly more abundant in samples with lower overall protein concentrations, but this was not always the case in 2011. The sum of ten essential amino acids appeared to be a more consistent measure of protein quality. Soybean samples from Minnesota, Iowa, Missouri, and Illinois tended to have slightly higher levels of essential amino acids relative to other major soybean producing states.

Climate Summary

Planting: precipitation for the period covering March, April, and May was 200% of normal from southwestern Missouri through the Ohio Valley. Temperatures were generally below normal in Iowa, Minnesota, and Wisconsin, and above normal farther south. In *May*, the temperature trend was generally cooler in the west and warmer in the east. Persistent wet weather and flooding impacted spring planting progress; at the end of May in Ohio only 7% of soybeans were planted compared to the average 76%. As of May 29, 51% of the intended US soybean acreage was planted, 20% behind normal pace. Iowa and some other Midwestern areas, however, were ahead of the normal pace of planting and the soybean crop there benefited from frequent rains.

Mid-season: *June* precipitation was either 2 to 3x normal rainfall in parts of Iowa, Illinois, and Michigan or <50% of normal in Missouri and along the Michigan-Ohio border. Temperatures were slightly below normal in the northwest and above normal in the south. *July* was much warmer and more humid then normal across the Midwest. Missouri experienced its hottest month in more than 30 years. Flooding continued along the Missouri River in Iowa and Missouri in July. *August* rainfall was very variable across the Midwest, from <25% of normal to almost 200% of normal. Temperatures were mostly normal to above normal. A record drought continued throughout the summer in Texas, Oklahoma, Southern Kansas, and Western Louisiana. Drought conditions continued to intensify through the state of Georgia throughout the late summer. A moderate drought stressed the soybean crop from August through harvest time in Indiana, Illinois, Iowa, and Minnesota. This widespread drought had the largest effect on the US soybean crop of any weather event in 2011.

Harvest: *September* started out hot but ended cooler than average. In regions from Wisconsin and Illinois eastward through Ohio and Kentucky there was excessive rainfall, but in areas west of the Mississippi River rainfall was well below normal (Figure 1). In addition to the dry conditions, the upper Midwest had a freeze on September 15. At the time of the freeze, only a small proportion of the soybeans were fully mature and yield losses were realized. Growers were harvesting across much of the major soybean growing region by September 25. By *October* 30, 87% of the soybean crop had been harvested, 8% behind last year’s pace but 8% ahead of the 5-year average (Figure 2); 56% of the crop was rated in good or excellent condition as of October 9.

Overall the 2011 season was marked by a slower planting pace than normal because of excess moisture and cool temperatures; this led to slower crop development. Later in the season, drought and mid-September freezing temperatures impacted the crop in some major production areas.

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1. Prepared for the American Soybean Association – International Marketing Quality Mission to Asia, 14-18 November, 2011, updated December 22, 2011 [↑](#footnote-ref-1)
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