



Quality of the United States Food Soybean Crop: 2008¹

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Summary

The American Soybean Association has supported a survey of the quality of the US commodity soybean crop since 1986. That survey is intended to provide new crop quality data to aid international customers with their purchasing decisions for the upcoming year. The food soybean survey was conducted for the first time in 2007, and is intended to assist international buyers, as well as to provide producers valuable information about the quality of these specialty soybeans. Due to both the wide range of food bean types (tofu, natto, edamame, etc.) and the range of varieties grown for each type in different geographic regions of the US, it is difficult to provide generalized conclusions regarding the 2008 United States food soybean crop as a whole. This report provides state by state food soybean quality information (protein and oil), regional quality averages by seed size (protein, oil, and carbohydrates), and quality trends for the entire US commodity soybean crop. The commodity soybean crop information is provided as a guide for better understanding the regional environmental influences affecting both commodity and food soybean crops.

2008 Acreage, Yields, and Total Production

According to the October 10, 2008 United States Department of Agriculture, National Agricultural Statistics Service (USDA-NASS) crop report, the total US soybean production area is expected to increase 16% from last year to 30.1 million hectares harvested (Table 1). This increase in US soybean production area essentially reverses the shift toward corn from soybean noted in 2007. With average soybean yields expected to be lower than in 2007, total US soybean production is expected to be 80.0 million MT. If realized, this will be a 10% increase over the historically small crop of 2007, but smaller than crops of 2004, 2005, and 2006.

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Participating companies provided a total of 216 samples as of October 29, 2008. These samples were analyzed (whole) for protein and oil concentration by near infrared spectroscopy (NIRS) using a Perten DA7200 diode array instrument (Huddinge, Sweden) equipped with calibration equations developed at the University of Minnesota. In addition, we analyzed the samples for carbohydrates by grinding and rescanning them on the NIR machine. Lastly, we determined average seed size (grams per 100 seeds) for each sample. Results can be found in Tables 2, 3, and 4.

Interpretation of Protein and Oil Results

Average protein values for the food bean samples by region (Table 2) indicate that samples received from the Northern growing region (Michigan, Minnesota, North Dakota, and Wisconsin) had slightly higher protein concentrations than samples from the Central (Iowa, Illinois, Indiana, Nebraska, and Ohio) and Southern (Arkansas and Missouri) regions. In general, protein concentrations from northerly regions in the US tend to be lower than those from more southerly regions, but those environmental/regional differences were not apparent in 2008. Upon closer examination of the protein concentrations by seed size in the three regions (Table 3), we see that the north-south protein differences across seed size categories are smaller than in 2007 and favor the north, not the 'normal' trend. As in 2007, the small-seeded samples (some identified as intended for natto) show an average protein level that is lower than that of the average- and large-seeded samples. However, the small-seeded samples from the Northern region were as high in protein as the average- and large-seeded samples from the Central and Southern regions, again counter to conventional wisdom. Oil concentrations in the Northern region were lower than those in the Central and Southern regions, again reflecting an unusual reversal in 2008 quality trends relative to 2007. We received a single sample from New York, but because New York does not fit in with the predominant food soybean growing regions, we did not include the sample's data in the report tables. The New York sample had the following quality profile: protein 39.1%, oil 16.6%, fiber 5.5%, sucrose 3.9%, raffinose 0.7%, and stachyose 2.9% (protein and oil on a 13% moisture basis and the others on a dry matter basis).

Carbohydrates

Some international customers have expressed interest in carbohydrate values within the US soybean crop. We received very few food bean samples by the critical deadline for sample analysis of carbohydrates using wet chemistry analysis at the University of Missouri Analytical Laboratories; therefore, we are presenting NIR-predicted carbohydrate data instead (Table 4). The NIR-predicted data indicate that, on average, the sucrose levels were higher in the Northern region than in the Central and Southern regions, the raffinose levels were similar across regions though slightly higher in the Southern region, and the stachyose levels were highest in the Southern region, followed by the Northern region, and lowest in the Central region. These trends follow those

found in the 2007 food bean quality survey. Fiber levels were similar in the Northern and Central regions, and slightly higher in the Southern region.

Table 5 presents quality data from 77 commodity soybean samples collected for the US Commodity Soybean Survey (see next section). These data are from wet chemistry analysis conducted at the University of Missouri Analytical Laboratories. Providing commodity soybean quality profiles here (Table 5) gives an indication of food type soybean quality profiles had samples from throughout the US been available.

US Commodity Soybean Survey

The quality of the overall US soybean crop is estimated yearly by a separate project supported by the international marketing committee of the American Soybean Association (ASA-IM). By August 29, 2008, sample kits were mailed to 8,987 producers. Producers were selected based on total land devoted to soybean production in each state, so that response distribution would closely match soybean production. One thousand four hundred forty-seven (1,447) samples were received by October 28, 2008. Average protein and oil concentrations for the overall US soybean crop differed from those described in the 2007 quality survey. Average US soybean protein concentration was 1.2% lower in 2008, at 34.0%, and average oil was 0.6% higher, at 19.2%, when compared with 2007. Western Corn Belt states tended to have larger than average reductions in protein concentration relative to 2007. This is especially true for the states of Nebraska, Kansas, Missouri, and Iowa where protein levels were more than 1.5 percentage points lower than in 2007. Nebraska, Michigan, and Ohio saw oil concentrations increase by 0.8 percentage points over 2007.

Climate Summary

Crop conditions through the summer reflect the influence of the weather. Excess rainfall early in the season lowered the average soybean crop condition through the spring, while localized drought and excess rainfall from August through October reduced late season crop conditions.

Excess rainfall in some states delayed soybean harvest and reduced the number of samples available for inclusion in this first draft of the 2008 US Food Soybean Quality Survey. Additional samples are currently being analyzed and these will be included in an updated and final report available before January 1, 2009.

April precipitation in the Midwest was 150-200% of normal from southern Missouri north to Minnesota and the Upper Peninsula (UP) of Michigan, while precipitation was 60-75% of normal from eastern Illinois to Ohio and lower Michigan. Higher than normal precipitation coincided with colder areas in the Midwest, and the drier places were in the warmer eastern Midwest. April snowfall was well above normal in the upper Midwest (Minnesota, northern Wisconsin, and the UP of Michigan), and heavy snow fell as late as the end of April. Strong spring storms with very heavy rainfall caused flash flooding in the southern Midwest (Kentucky, southern Illinois and Indiana, Missouri, and Iowa). Widespread rains in the Southeast and Mid-Atlantic brought short-term drought relief.

May was cooler than average across the entire Midwest. Precipitation was at or well above normal for the southern two-thirds of the Midwest, and from 50-75% of normal across the northern third. The cool, wet weather in May slowed spring planting in the Midwest until later in May, when drier weather prevailed.

June saw record flooding in Iowa, Wisconsin, Indiana, and Illinois. Precipitation was >200% of normal across Missouri, Iowa, southern Wisconsin, central Illinois, southern Indiana, central Ohio, and lower Michigan. Kentucky and southeastern Missouri, however, received <50% of normal rainfall for June. Temperatures were cooler than average in the western Midwest and warmer than average to the east (eastern Ohio and western Kentucky). Conditions in North Carolina, South Carolina, Georgia, and into Alabama were very dry. Most of Georgia was in severe drought or worse.

In *July*, the Midwest continued to experience very wet weather, especially central Iowa through the northeastern half of Missouri into western Illinois. January-July precipitation for Missouri, Illinois, and the Midwest overall was the greatest on record. Temperatures in July were generally below average.

In *August*, precipitation patterns reversed; whereas June and July had seen above normal rainfall, August precipitation was below normal across the entire Midwest region. For most of the region, rainfall was well below 2". Rainfall was <25% of normal from northern Minnesota to northwestern Ohio and the Ohio Valley. Temperatures across the Midwest were below normal in August. In the Southeast, Tropical Storm Fay brought widespread relief for large areas of the region, but drought conditions still remained in place for much of the region.

In *September*, Hurricanes Gustav and Ike dumped heavy rainfall and brought wind damage to the central Midwest. Gustav made landfall on the Louisiana Gulf Coast then drifted northward, producing heavy rain from Missouri through Illinois and into southern Michigan. A week later, Hurricane Ike made landfall along the Texas Gulf Coast and followed a path similar to Gustav's. Remnants of Ike produced wind damage from southern Missouri through Kentucky, southern Indiana, and Ohio. In contrast, northwestern and southeastern parts of the Midwest were very dry. In Kentucky and southern Ohio, precipitation was only 20-40% of normal.

In *October*, precipitation was normal to 300% of normal across much of Iowa, Minnesota, Wisconsin, and Illinois. Nonetheless, drought conditions continued across large parts of Minnesota and Wisconsin. Nearly all of Kentucky experienced drought conditions. Georgia, eastern Tennessee, North Carolina, and South Carolina received some rain, but were still under exceptional drought conditions. The first snowfall in the Midwest occurred the third week of October. The soybean harvest was behind schedule for most of the Midwest, but Ohio, Michigan, Kentucky, and Indiana were actually ahead of schedule.

Soybean Rust

Soybean rust (*Phakopsora pachyrhizi*) is a fungal pathogen of soybean that is known to cause very large yield losses in South America; it was first reported in the continental US in November of 2004. Soybean rust is spread by spores, but it requires a living host to remain viable over winter periods. In the US it is known to overwinter on a weedy plant - kudzu - in large areas of Florida and extreme southern Texas. Outbreaks of soybean rust on commercially produced soybean crops were noted since 2005. Each year, soybean rust has spread further into the central soybean producing regions of the US. As of October 31, 2008, soybean rust has been reported in 15 states (Alabama, Arkansas, Georgia, Florida, Illinois, Louisiana, Kentucky, Mississippi, Missouri, North Carolina, Oklahoma, South Carolina, Tennessee, Texas, and Virginia). Rust was also reported in 10 municipalities (counties) in Mexico. Soybean rust is expected to spread northward until frost.

Reference

National Agricultural Statistics Service. 2008. Available at <http://usda.mannlib.cornell.edu/usda/current/CropProg/CropProg-10-27-2008.pdf> (verified 1 November, 2008). USDA-NASS, Washington, DC.

Table 1. Soybean production data for the United States, 2008 crop

Region	State	Yield (MT ha ⁻¹)	Area Harvested (1000 ha)	Production (M MT)
Western Corn Belt (WCB)	Iowa	3.09	3,888	12.0
	Kansas	2.42	1,296	3.1
	Minnesota	2.69	2,795	7.5
	Missouri	2.49	2,045	5.1
	Nebraska	3.16	1,964	6.2
	North Dakota	2.08	1,507	3.1
	South Dakota	2.42	1,636	4.0
	Western Corn Belt	2.6	15,131	41 51.3%
Eastern Corn Belt (ECB)	Illinois	3.02	3,665	11.1
	Indiana	2.82	2,187	6.2
	Michigan	2.49	765	1.9
	Ohio	2.55	1,814	4.6
	Wisconsin	2.42	632	1.5
	Eastern Corn Belt	2.7	9,064	25 31.7%
Midsouth (MDS)	Arkansas	2.62	1,316	3.5
	Kentucky	2.28	563	1.3
	Louisiana	2.35	401	0.9
	Mississippi	2.55	802	2.0
	Oklahoma	1.81	146	0.3
	Tennessee	2.02	591	1.2
	Texas	1.48	85	0.1
	Midsouth	2.2	3,904	9 11.6%
Southeast (SE)	Alabama	1.95	142	0.3
	Florida	n/a	n/a	n/a
	Georgia	2.02	166	0.3
	North Carolina	2.15	672	1.4
	South Carolina	1.88	211	0.4
	Southeast	2.0	1,191	2 3.1%
East Coast (EC)	Delaware	1.88	78	0.1
	Maryland	2.02	198	0.4
	New Jersey	1.88	36	0.1
	New York	2.96	92	0.3
	Pennsylvania	2.62	178	0.5
	Virginia	1.88	231	0.4
	East Coast	2.2	813	2 2.2%
Other States		2.53	19	0.05 0.06%
USA 2008		2.65	30,121	80.0
USA 2007		2.80	25,977	72.9

Source: United States Department of Agriculture, NASS 2008 Crop Production Report (October 10, 2008)
n/a = not available

Table 2. USSEC/ASA 2008 Food Soybean Quality Survey by State and Region[‡]

State (number of samples)	Region	Protein Average* (%)	Protein Range	Regional Average	Oil Average* (%)	Oil Range	Regional Average
Michigan (58)	Northern	36.2	32.2 – 42.3		18.1	15.5 – 19.7	
Minnesota (51)	Northern	35.9	31.0 – 40.7		18.1	15.7 – 19.5	
North Dakota (6)	Northern	34.5	32.3 – 37.4		18.5	17.9 – 19.0	
Wisconsin (15)	Northern	34.0	32.4 – 35.8	35.8	18.9	18.0 – 19.9	18.2
Iowa (24)	Central	35.5	32.6 – 41.2		18.3	15.6 – 20.0	
Illinois (29)	Central	34.9	31.8 – 37.3		19.2	17.6 – 20.5	
Indiana (4)	Central	35.2	34.4 – 35.8		19.2	18.6 – 19.7	
Nebraska (3)	Central	35.1	34.2 – 36.3		18.2	17.3 – 18.8	
Ohio (22)	Central	36.5	33.5 – 39.4	35.5	18.9	17.7 – 20.3	18.8
Arkansas (1)	Southern	33.7			19.3		
Missouri (2)	Southern	36.6	35.4 – 37.7	35.6	18.5	18.2 – 18.7	18.7

Data as of October 29, 2008

[‡] Northern region = Michigan, Minnesota, North Dakota, and Wisconsin

Central region = Iowa, Illinois, Indiana, Nebraska, and Ohio

Southern region = Arkansas and Missouri

* 13% moisture basis

Table 3. USSEC/ASA 2008 Food Soybean Quality Survey by Seed Size[§] & Region[‡]

Region	Seed Size	Number Samples	Seed Size Average (g/100 seeds)	Protein Average* (%)	Range	Oil Average* (%)	Range
Northern	Small	12	11.4	35.6	32.3 – 42.3	18.3	17.1 – 19.0
	Average + Large	118	18.0	35.8	31.0 – 41.8	18.2	15.5 – 19.9
Central	Small	3	10.8	34.2	32.6 – 35.0	18.7	17.8 – 19.4
	Average + Large	79	17.5	35.6	31.8 – 41.2	18.8	15.6 – 20.5
Southern	Small	0			33.7 – 37.7		
	Average + Large	3	16.1	35.6		18.7	18.2 – 19.3

Data as of October 29, 2008

[§] Small seed: ≤13.0 g/100 seeds; Average: 13.1-21.0 g/100 seeds; Large: >21 g/100 seeds (unofficial categories)

[‡] Northern region = Michigan, Minnesota, North Dakota, and Wisconsin

Central region = Iowa, Illinois, Indiana, Nebraska, and Ohio

Southern region = Arkansas and Missouri

* 13% moisture basis

Table 4. USSEC/ASA 2008 Food Soybean Quality Survey - Carbohydrates[§] by Region[‡]

Region	Seed Size*	Number Samples	Seed Size Average (g/100 seeds)	Fiber Average[†] (%)	Sucrose[†] (%)	Raffinose[†] (%)	Stachyose[†] (%)
Northern	Small	12	11.4	6.8	4.7	0.7	3.4
	Average + Large	118	18.0	6.4	4.8	0.7	3.3
Central	Small	3	10.8	7.0	5.2	0.8	3.3
	Average + Large	79	17.5	6.6	4.5	0.7	3.2
Southern	Average	3	16.1	6.8	4.6	0.8	3.4

Data as of October 29, 2008

[§] Data for carbohydrates are predicted from Near Infrared Spectroscopy (NIRS)

[‡] Northern region = Michigan, Minnesota, North Dakota, and Wisconsin

Central region = Iowa, Illinois, Indiana, Nebraska, and Ohio

Southern region = Arkansas and Missouri

* Small seed: ≤13.0 g/100 seeds; Average: 13.1-21.0 g/100 seeds; Large: >21 g/100 seeds (unofficial categories)

[†] Percent dry matter

Table 5. USSEC/ASA 2008 Commodity Soybean Quality Survey - Carbohydrates[§] by Region[‡]

Region	Number Samples	Protein Average* (%)	Oil Average* (%)	Fiber Average[†] (%)	Sucrose[†] (%)	Raffinose[†] (%)	Stachyose[†] (%)
Northern	24	34.0	18.5	5.9	5.8	0.6	3.8
Central	25	34.2	18.9	6.0	5.3	0.6	3.9
Southern	28	34.6	19.3	5.9	4.0	0.7	3.6

Data as of October 29, 2008

[§] Data for carbohydrates are from wet chemistry analysis conducted at the University of Missouri Analytical Laboratories

[‡] Northern region = Michigan, Minnesota, North Dakota, South Dakota, and Wisconsin

Central region = Iowa, Illinois, Indiana, Nebraska, and Ohio

Southern region = Alabama, Arkansas, Kansas, Mississippi, Missouri, Tennessee, and Texas

* 13% moisture basis

[†] Percent dry matter basis