

Quality of the United States Soybean Crop: 2008¹

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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 for the upcoming year.

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 (Figure 1). 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.

Quality of the 2008 US Soybean Crop

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 eight hundred and seven (1,807) samples were received by January 1, 2009. These were analyzed for protein and oil 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 protein 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 can be found in Table 2.

Foreign Material (FM) was estimated by sieving and handpicking non-soybean material from each sample according to Federal Grain Inspection Service (FGIS) standards where, "Foreign material is defined as all material that readily passes through an 8/64 inch (3.2 mm), round-hole, perforated sieve and any material other than soybeans remaining atop the sieve." For this analysis, splits and otherwise broken soybeans were not considered. Foreign material is simply provided on a percentage basis. Seed weights were estimated by counting and weighing 1000 seeds from each sample. Foreign material and seed weight summaries can be found in Table 3.

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Some international customers have expressed interest in soluble sugar concentrations within the US soybean crop. Soluble sugars are difficult to accurately quantify by traditional wet chemical analysis and NIRS technology. A small subset of samples (77) were randomly selected to represent total soybean production by state, and analyzed for soluble sugar concentrations using high performance liquid chromatography (HPLC) at the University of Missouri Analytical Laboratories. Results can be found in Table 4.

Interpretation of Protein and Oil Results

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 1.1% lower in 2008, at 34.1%, and average oil was 0.5% higher, at 19.1%, when compared with 2007 (Table 5). 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 0.7 or more percentage points over 2007.

Interpretation of Foreign Material Results

Foreign material found in samples was on average very low. Foreign material (FM) among the 1734 farmer collected samples evaluated for FM averaged 0.32%, with an overall range of 0 to 32.2%. Of 1734 samples, 1642 had FM below 1%, and 92 (5.3%) had FM greater than 1%. Only 36 (2.1%) had FM above 2%. While there was a tendency for samples harvested from Southern states to have somewhat above average FM, individual samples with above 2% FM could be found in all regions.

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 later 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 2008, seed size tended to be similar across the entire US. While the Western soybean producing states tended to have the lowest average seed size the difference was virtually insignificant.

Interpretation of Soluble Sugar Results

A large sample-to-sample variability in all soluble sugar values was identified (Table 4). This indicates that local environmental conditions may play a large role in determining relative concentrations of important soluble sugars. On average, samples contained 4.9% sucrose, 0.6% raffinose, and 3.5% stachyose (Table 4). As has been noted in past years, Southern states tended to have lower concentrations of sucrose than samples from more northern states. Stachyose and raffinose concentrations did not appear to be higher in Southern soybeans as in past years.

Climate Summary

Crop conditions through the summer (Figure 2) 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 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.

References

National Agricultural Statistics Service. 2008. Available at (verified 8 January, 2009). <http://usda.mannlib.cornell.edu/usda/nass/CropProd//2000s/2008/CropProd-11-10-2008.pdf>
USDA-NASS, Washington, DC.

Federal Grain Inspection Service. 2004. [Test Weight](#). In *Grain Inspection Handbook II* (Chapter 10). Washington DC: USDA-GIPSA-FGIS.

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	2.62	2,795	7.3
	Missouri	2.55	2,045	5.2
	Nebraska	3.09	1,964	6.1
	North Dakota	1.95	1,507	2.9
	South Dakota	2.22	1,636	3.6
	Western Corn Belt	2.6	15,131	40 50.7%
Eastern Corn Belt (ECB)	Illinois	3.09	3,665	11.3
	Indiana	2.96	2,187	6.5
	Michigan	2.49	765	1.9
	Ohio	2.42	1,814	4.4
	Wisconsin	2.28	632	1.4
	Eastern Corn Belt	2.6	9,064	26 32.1%
Midsouth (MDS)	Arkansas	2.69	1,316	3.5
	Kentucky	2.28	563	1.3
	Louisiana	2.08	401	0.8
	Mississippi	2.55	802	2.0
	Oklahoma	1.68	146	0.2
	Tennessee	2.08	591	1.2
	Texas	1.48	85	0.1
	Midsouth	2.1	3,904	9 11.7%
Southeast (SE)	Alabama	2.08	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	1.81	211	0.4
	Southeast	2.0	1,191	2 3.1%
East Coast (EC)	Delaware	1.81	78	0.1
	Maryland	2.02	198	0.4
	New Jersey	1.75	36	0.1
	New York	3.02	92	0.3
	Pennsylvania	2.55	178	0.5
	Virginia	2.02	231	0.5
	East Coast	2.2	813	2 2.3%
Other States		2.53	19	0.05 0.06%
USA 2008		2.64	30,121	79.6
USA 2007		2.80	25,977	72.9

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

Table 2. United Soybean Board/American Soybean Association 2008 Soybean Quality Survey Data.

Region	State	Number of Samples	Protein (%)*		Oil (%)*	
			Percent Average	Std. dev.	Percent Average	Std. dev.
Western Corn Belt (WCB)	Iowa	286	33.4	1.4	19.1	0.7
	Kansas	48	33.6	1.6	19.1	1.0
	Minnesota	271	33.3	1.5	19.0	0.7
	Missouri	81	34.1	1.5	19.0	0.9
	Nebraska	146	33.0	1.3	19.2	0.9
	North Dakota	62	33.5	1.6	18.5	0.8
	South Dakota	86	33.7	1.2	18.6	0.7
Averages† Ranges	Western Corn Belt Western Corn Belt	980	33.5 (29.2-38.1)	1.5	19.0 (16.0-21.0)	0.8
Eastern Corn Belt (ECB)	Illinois	258	34.3	1.3	19.0	0.8
	Indiana	105	34.8	1.3	19.0	0.8
	Michigan	46	34.3	1.9	19.4	1.0
	Ohio	123	34.4	1.3	19.5	0.8
	Wisconsin	43	33.9	1.7	19.0	0.7
Averages† Ranges	Eastern Corn Belt Eastern Corn Belt	575	34.4 (29.6-40.3)	1.4	19.1 (16.6-21.8)	0.8
Midsouth (MDS)	Arkansas	44	35.2	1.3	19.4	0.8
	Kentucky	27	34.5	1.3	19.4	0.8
	Louisiana	7	36.6	1.2	19.7	1.3
	Mississippi	33	35.7	1.3	19.7	1.0
	Oklahoma	4	35.6	1.7	18.9	1.3
	Tennessee	34	34.2	1.4	19.9	0.9
	Texas	3	33.3	1.9	20.2	0.1
Averages† Ranges	Midsouth Midsouth	152	35.2 (31.1-38.3)	1.3	19.6 (17.1-22.0)	0.9
Southeast (SE)	Alabama	9	35.8	2.1	19.9	1.2
	Florida					
	Georgia	5	35.7	1.3	19.1	0.4
	North Carolina	27	34.3	2.0	19.5	0.9
	South Carolina	4	35	1.3	19.3	1.8
Averages† Ranges	Southeast Southeast	45	34.8 (30.0-40.8)	1.4	19.4 (16.9-21.4)	0.7
East Coast (EC)	Delaware	5	34.6	0.4	19.1	1.2
	Maryland	14	35.4	1.2	19.0	0.9
	New Jersey	4	37.0	1.1	19.2	0.5
	New York	8	36.2	1.4	17.9	0.4
	Pennsylvania	14	34.9	1.5	18.9	0.9
	Virginia	10	34.1	1.2	19.3	1.2
Averages† Ranges	East Coast East Coast	55	35.0 (32.3-39.2)	1.2	18.9 (16.8-21.0)	0.9
USA	Averages	1807	34.0	1.6	19.1	0.9
	Ranges		(29.2-40.8)		(16.0-22.0)	
	Average of 2008 Crop† US 1986-2008 avg.		34.1 35.3	1.4 1.5	19.1 18.7	0.8 0.9

* 13% moisture basis

† Regional and US average values weighted based on estimated production by state as estimated by USDA, NASS Crop Production Report (November 10, 2008).

**Table 3. United Soybean Board/American Soybean Association 2008
Soybean Quality Survey Data.**

Region	State	Number of Samples [‡]	FM		Seed Wt.	
			Percent Average	Std. dev.	g/100 seeds	Std. dev.
Western Corn Belt (WCB)	Iowa	286	0.21	0.45	15.4	1.3
	Kansas	48	0.89	4.63	15.3	1.5
	Minnesota	271	0.24	0.48	15.3	1.4
	Missouri	81	0.37	0.62	15.1	1.5
	Nebraska	146	0.18	0.27	15.2	1.1
	North Dakota	62	0.16	0.23	14.9	1.9
	South Dakota	86	0.48	1.29	14.4	1.7
Averages [†] Ranges	Western Corn Belt Western Corn Belt	980	0.31 (0 -32.2)	0.84	15.2 (8.2-20.1)	1.4
Eastern Corn Belt (ECB)	Illinois	258	0.22	0.40	15.6	1.6
	Indiana	105	0.34	0.73	15.4	1.4
	Michigan	46	0.17	0.24	14.8	1.4
	Ohio	123	0.32	1.03	15.3	1.4
	Wisconsin	43	0.24	0.46	15.4	1.8
Averages [†] Ranges	Eastern Corn Belt Eastern Corn Belt	575	0.27 (0 -10.5)	0.58	15.4 (10.0-19.9)	1.5
Midsouth (MDS)	Arkansas	44	0.35	0.59	15.6	1.5
	Kentucky	27	0.32	0.32	14.5	2.1
	Louisiana	7	0.45	0.36	14.4	1.8
	Mississippi	33	0.94	1.17	15.4	1.7
	Oklahoma	4	0.75	1.14	15.8	2.3
	Tennessee	34	0.46	0.61	15.6	1.3
	Texas	3	0.15	0.14	14.7	0.7
Averages [†] Ranges	Midsouth Midsouth	152	0.51 (0 - 4.8)	0.67	15.3 (10.0-22.0)	1.6
Southeast (SE)	Alabama	9	0.54	0.68	15.5	2.3
	Florida					
	Georgia	5	0.21	0.32	15.1	2.4
	North Carolina	27	0.31	0.48	14.8	1.5
	South Carolina	4	0.14	0.14	15.3	0.9
Averages [†] Ranges	Southeast Southeast	45	0.30 (0 - 2.5)	0.43	15.0 (12.0-20.4)	1.6
East Coast (EC)	Delaware	5	0.73	1.15	14.1	3.2
	Maryland	14	0.21	0.28	17.4	1.5
	New Jersey	4	0.14	0.16	14.8	1.8
	New York	8	0.23	0.33	16.4	1.5
	Pennsylvania	14	0.20	0.25	15.7	1.8
	Virginia	10	1.30	2.34	16.6	2.2
Averages [†] Ranges	East Coast East Coast	55	0.47 (0 - 6.00)	0.75	15.8 (8.9-20.2)	2.0
USA	Averages	1807	0.30	1.00	15.3	1.5
	Ranges		(0 - 32.2)		(8.2 - 22.0)	
	Average of 2008 Crop[†]		0.32	0.72	15.3	1.5

* 13% moisture basis

[‡] Missing 73 samples for foreign material (FM) analysis.

[†] Regional and US average values weighted based on estimated production by state as estimated by USDA, NASS Crop Production Report (November 10, 2008).

Table 4. Carbohydrate Analysis of a Small Number of 2008 Soybean Quality Survey Samples.

Region	State	Number of Samples	Protein*	Oil*	Fiber*	Sucrose‡	Raffinose‡	Stachyose‡
			Percent Average	Percent Average	Percent Average	Percent Average	Percent Average	Percent Average
Western Corn Belt (WCB)	Iowa	5	32.9	18.9	5.2	6.0	0.7	4.1
	Kansas	5	33.7	18.4	5.1	5.2	0.7	3.7
	Minnesota	5	33.4	18.7	5.1	5.9	0.6	3.9
	Missouri	5	32.7	19.7	5.1	5.5	0.6	3.7
	Nebraska	5	33.6	18.8	5.0	5.8	0.7	3.9
	North Dakota	5	33.8	18.1	5.0	6.1	0.6	3.8
	South Dakota	5	34.1	17.9	5.1	5.8	0.6	4.1
Averages†	Western Corn Belt	35	33.5	18.7	5.1	5.7	0.7	3.9
Ranges	Western Corn Belt		(30.6-37.5)	(15.5-20.6)	(4.4-5.5)	(4.5-7.2)	(0.5-0.9)	(3.0-4.7)
Eastern Corn Belt (ECB)	Illinois	5	34.6	18.3	5.3	5.8	0.6	3.9
	Indiana	5	34.8	18.6	5.4	4.7	0.7	3.8
	Michigan	5	34.7	19.2	4.9	5.5	0.5	3.6
	Ohio	5	35.2	19.7	5.1	4.4	0.6	3.8
	Wisconsin	4	34.2	18.4	5.2	5.8	0.7	3.7
Averages†	Eastern Corn Belt	24	34.7	18.8	5.2	5.2	0.6	3.8
Ranges	Eastern Corn Belt		(32.8-36.6)	(16.6-20.5)	(4.6-5.7)	(3.7-6.6)	(0.4-0.8)	(3.4-4.2)
Midsouth (MDS)	Arkansas	5	35.6	18.9	5.2	3.0	0.7	3.6
	Kentucky							
	Louisiana							
	Mississippi	5	35.9	19.6	5.2	1.9	0.6	3.1
	Oklahoma							
	Tennessee	3	35.4	20.1	5.0	4.1	0.8	3.8
Texas	2	33.6	19.9	5.3	3.6	0.9	3.2	
Averages†	Midsouth	15	35.4	19.5	5.2	2.9	0.7	3.4
Ranges	Midsouth		(31.7-36.9)	(17.8-21.8)	(4.8-5.7)	(0.2-4.5)	(0.4-0.9)	(2.4-4.3)
Southeast (SE)	Alabama	3	35.0	19.4	5.1	4.6	0.8	3.7
	Florida							
	Georgia							
	North Carolina							
	South Carolina							
Averages†	Southeast	3	35.0	19.4	5.1	4.6	0.8	3.7
Ranges	Southeast		(35.0-35.1)	(18.0-20.3)	(4.8-5.4)	(3.1-5.6)	(0.7-0.9)	(3.6-3.9)
East Coast (EC)	Delaware	0						
	Maryland	0						
	New Jersey	0						
	New York	0						
	Pennsylvania	0						
	Virginia	0						
Averages†	East Coast	0						
Ranges	East Coast							
USA	Averages	77	34.3	18.9	5.1	5.0	0.7	3.7
	Ranges		(30.6-37.5)	(15.5-21.8)	(4.4-5.7)	(0.2-7.2)	(0.4-0.9)	(2.4-4.7)
Average of 2008 Crop†			30.5	16.9	4.6	4.9	0.6	3.5

* 13% moisture basis

‡ Dry Matter (DM) basis

† Regional and US average values weighted based on estimated production by state as estimated by USDA, NASS Crop Production Report (November 10, 2008).

Table 5. Historical Summary of Yield and Quality Data for US Soybeans.

Year	Yield (bu/a)	Protein* (%)	Oil* (%)	Sum† (%)	Harvested (1000 acres)	Production (1000 bu)	Protein Std. Dev.	Oil Std. Dev.
1986	33.3	35.8	18.5	54.3	58,312	1,941,790	1.39	0.70
1987	33.9	35.5	19.1	54.6	57,172	1,938,131	1.59	0.71
1988	27.0	35.1	19.3	54.4	57,373	1,549,071	1.50	0.83
1989	32.3	35.2	18.7	53.9	59,538	1,923,077	1.51	0.82
1990	34.1	35.4	19.2	54.6	56,512	1,927,059	1.22	0.66
1991	34.2	35.5	18.7	54.1	58,011	1,983,976	1.38	0.86
1992	37.6	35.6	17.3	52.8	58,233	2,189,561	1.38	0.97
1993	32.6	35.7	18.0	53.8	57,307	1,868,208	1.24	0.87
1994	41.4	35.4	18.2	53.6	60,809	2,517,493	1.36	0.93
1995	35.3	35.5	18.2	53.6	61,544	2,172,503	1.39	0.86
1996	37.6	35.6	17.9	53.5	63,349	2,381,922	1.25	0.87
1997	38.9	34.6	18.5	53.0	69,110	2,688,379	1.51	0.96
1998	38.9	36.1	19.1	55.3	70,441	2,740,155	1.50	0.81
1999	36.5	34.6	18.6	53.2	72,476	2,645,374	1.88	1.05
2000	38.0	36.2	18.7	54.9	73,024	2,774,912	1.68	0.94
2001	39.4	35.0	19.0	54.0	74,100	2,922,914	1.95	1.07
2002	37.0	35.4	19.4	54.8	71,800	2,650,000	1.58	0.93
2003	34.0	35.7	18.7	54.3	72,538	2,468,390	1.71	1.19
2004	42.0	35.1	18.6	53.7	73,990	3,106,861	1.47	0.90
2005	43.0	34.9	19.4	54.3	72,032	3,063,237	1.46	0.87
2006‡	42.7	34.5	19.2	53.7	74,602	3,188,247	1.64	1.01
2007‡	41.7	35.4	18.7	53.9	64,141	2,675,822	1.24	0.76
2008‡	39.3	34.1	19.1	53.2	74,374	2,920,589	1.40	0.82
Averages (1986-2008)	37.0	35.3	18.7	54.0	65686.4	2,445,116.1	1.49	0.89

Sources: United States Department of Agriculture
Iowa State University
University of Minnesota

*Protein and oil concentrations expressed on a 13% basis moisture

†Sum represents sum of protein and oil concentrations

‡2006 - 2008 quality estimates are weighted by yearly production estimates by state

Figure 1. Soybean, Corn, and Wheat in the US (planted ha)

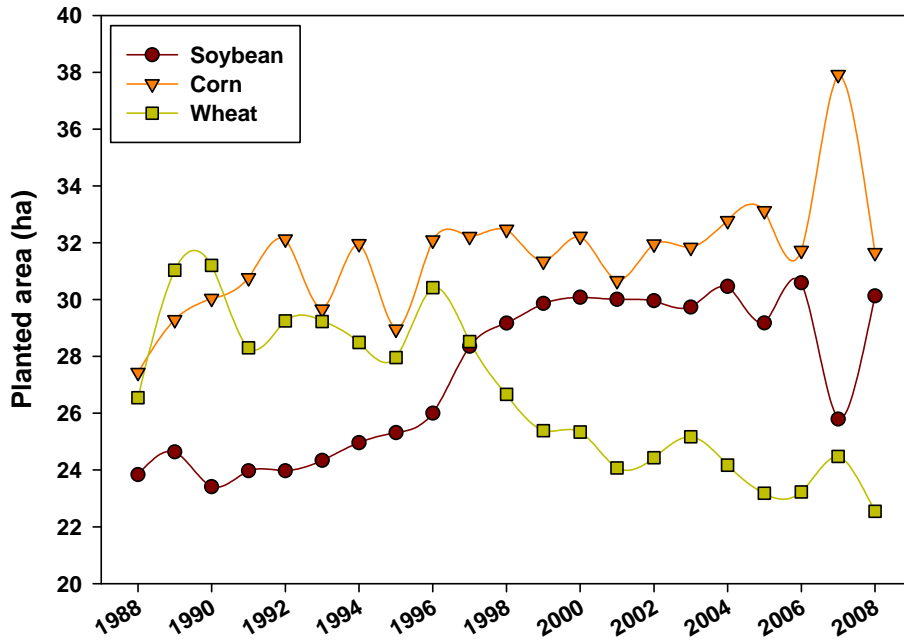


Figure 2. US Soybean Crop Conditions (2005-2008)

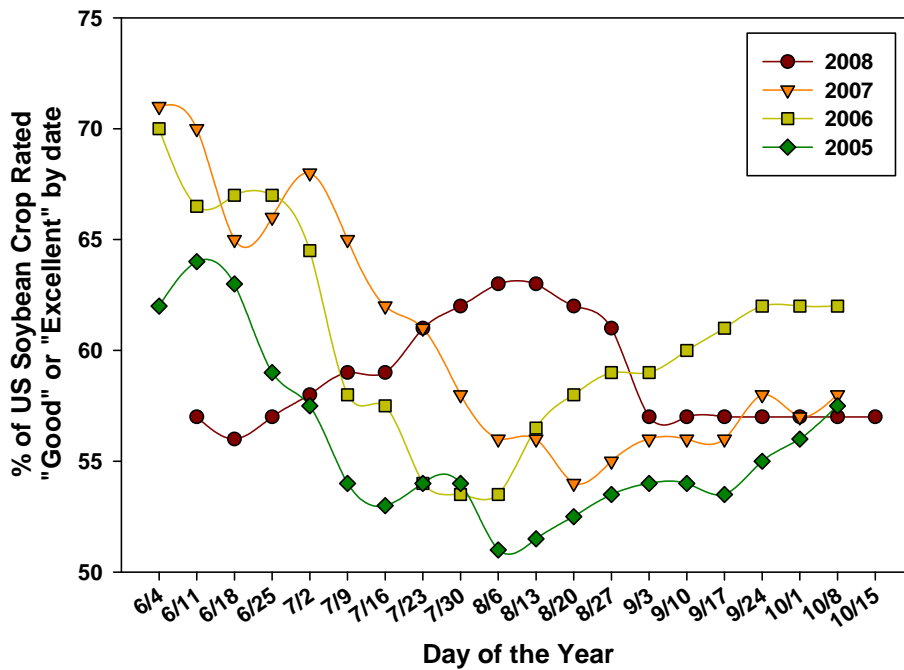


Figure 3. Average protein, oil, and sample number by state.

