

# Quality of the United States Soybean Crop: 2010<sup>1</sup>

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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.

## 2010 Acreage, Yields, and Total Production

According to the 8 October, 2010 United States Department of Agriculture, National Agricultural Statistics Service (USDA-NASS) crop report, the total US soybean production area is expected to increase slightly (1%) from last year to 31.1 million hectares harvested (Table 1). Average yields are also expected to increase slightly, to 2.98 Mg ha<sup>-1</sup>. With greater yields than in 2009, total US soybean production is expected to be 92.9 million MT. If realized this will be the largest soybean crop in history.

## Quality of the 2010 US Soybean Crop

By August 30, 2010 sample kits were mailed to approximately 9,325 producers. Producers were selected based on total land devoted to soybean production in each state, so that response distribution would closely match soybean production. By October 25, 2010, 1,850 samples were received. 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.

## Interpretation of Protein and Oil Results

Average protein and oil concentrations for the 2010 US soybean crop differed only slightly from that of the 2009 US crop or from the long-term average values. Average US soybean protein

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concentration was 0.4% lower in 2010, at 34.9%, and average oil was virtually unchanged (0.1% higher at 18.7%), when compared with 2009 (Table 2). As is noted in most years, Western Corn Belt states showed lower protein concentrations than the US crop as a whole. Midsouth states commonly have higher protein concentrations than other regions. In 2010, protein levels in this region were not significantly different than regions other than the Western Corn Belt. Southeastern states produced a soybean crop with higher oil concentration than other regions. The other regions did not differ from one another.

Protein concentrations from the Eastern and Western Cornbelt regions, as well as from the Midsouth, decreased slightly from 2009 to 2010. Protein levels increased slightly in the East Coast region. Oil concentrations were much lower in the Midsouth in 2010, but higher in the Eastern Corn Belt, the Southeast, and the East Coast.

### Interpretation of Foreign Material Results

Foreign material (FM) found in samples was, on average, quite low (Table 3). Foreign material among the 1,850 farmer-collected samples evaluated for FM averaged 0.4%, with an overall range of 0 to 39.1%. Of 1,850 samples, 1,741 (94%) had FM below 1%, and 99 (5%) had FM greater than 1%. Only 32 (1.7%) had FM above 2%. While there was a tendency for samples harvested from the Midsouth to have somewhat above average FM, individual samples with more than 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, 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 2010, seed size was significantly smaller than in 2009 with the average seed size decreasing from 16.0 grams per 100 seeds in 2009 to 14.3 in 2010 (Table 3). Seed size tended to be smallest in the Midsouth and Southeast regions where late season drought conditions reduced yields.

### Climate Summary

Planting: *April* precipitation was below normal for most of the Midwest, expanding moderate and severe drought classifications into the upper Midwest. However, in northern Missouri and

parts of Iowa, Illinois, and Wisconsin experienced above normal rainfall. Temperatures in the Midwest were well above normal, particularly in the early part of the month. At least four Midwest states recorded record high monthly temperatures. For the first time since modern weather record keeping began in 1891, there was no measurable snow in Minnesota in April of 2010. *May* allowed soybean planting to proceed well ahead of normal, though temperatures were below normal for the first two weeks of the month (Figure 1). During the second half of *May*, temperatures were well above normal. Most of the Midwest received normal to well above normal amounts of rain. Spring in the Midwest was, with a few exceptions, warmer and wetter than normal.

Mid-season: *June* was a very wet month for most of the Midwest, although Missouri was quite dry. The high rainfall caused flooding in many states, however, the negative impact on crops varied depending on how well-drained fields were. Temperatures in the Midwest during *June* were normal in northern regions to above normal in southern regions. In *July*, very heavy rain fell, causing river flooding over large parts of Illinois, Iowa, Missouri, and Wisconsin. Temperatures were slightly above normal, particularly minimum temperatures. *August* was a warmer month and rainfall varied; southern Kentucky, areas in Iowa, and parts of Minnesota and Wisconsin were quite wet, whereas southern Missouri, Indiana, and Michigan were very dry (these areas received less than fifty percent of normal precipitation). August temperatures in the Midwest were slightly higher than normal, particularly in southern and eastern parts of the Midwest, which contributed to drought conditions there. In *September*, the northwest half of the Midwest (Minnesota, Wisconsin, and the Upper Peninsula of Michigan) experienced cooler and wetter than average conditions, while the southeastern half was warm and dry. The growing season in some of the largest soybean-producing areas of the Midwest was, with some exceptions, warmer and wetter than average.

Harvest: *October* in the upper Midwest was slightly above normal for temperature, and below normal for precipitation. This combination of weather conditions helped farmers harvest what may be a record soybean crop. As of October 24, 2010, 91% of the US soybean crop had been harvested; this percentage is vastly higher than that in 2009, when just over 50% of the crop had been harvested by November 1, and higher than the 72% harvested by October 24 which is the 2005 to 2009 average (Figure 1).

### Soybean Disease Impact

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 have been noted since 2005. Each year, soybean rust has spread further into the central soybean producing regions of the US. In 2010, soybean rust was found in 27 US counties across seven states and in three states and 13 municipalities in Mexico. In contrast, in 2009, soybean rust was found in 16 states and over 576 counties in the United States, and in three states and nine municipalities in Mexico.

The growing conditions in the upper Midwest in 2010 were very conducive to development of a soybean disease called Sudden Death Syndrome (SDS). Cool, wet weather at planting sets the stage for the causal fungus, *Fusarium virguliforme*, to infect soybean roots. Warm and wet conditions around seed set favor SDS development. A toxin produced by the fungus eventually causes leaf death and yield reduction of perhaps 20–40%, or more, depending on the variety, when the plants were infected, and at which growth stage symptoms begin to show. Many soybeans grown in poorly-drained, low-lying fields or compacted soils in the upper Midwest suffered yield loss due to SDS during the 2010 season because of favorable environmental conditions. SDS was seen at unusually widespread and high levels in southern MN and much of IA, IL, WI, and IN due, in part, to wet weather conditions in July and early August.

### References

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

National Agricultural Statistics Service. 2010. Available at (verified 25, October, 2010) <<http://usda.mannlib.cornell.edu/usda/nass/CropProg//2000s/2010/CropProg-10-25-2010.pdf>>. USDA-NASS, Washington, DC.

Midwestern Regional Climate Center (MRCC) <<http://mcc.sws.uiuc.edu/cliwatch/watch.htm>>. Champaign, IL.

Soybean rust information <<http://sbr.ipmPIPE.org/cgi-bin/sbr/public.cgi>>

**Table 1. Soybean production data for the United States, 2010 crop**

Region	State	Yield (MT ha <sup>-1</sup> )	Area Harvested (1000 ha)	Production (MMT)
Western Corn Belt (WCB)	Iowa	3.49	3,989	14.0
	Kansas	2.28	1,721	3.9
	Minnesota	3.02	2,961	9.0
	Missouri	2.75	2,078	5.7
	Nebraska	3.70	2,066	7.6
	North Dakota	2.49	1,640	4.1
	South Dakota	2.69	1,681	4.5
	Western Corn Belt	2.9	16,135	49 52.6%
Eastern Corn Belt (ECB)	Illinois	3.49	3,665	12.8
	Indiana	3.36	2,159	7.3
	Michigan	2.96	846	2.5
	Ohio	3.23	1,895	6.1
	Wisconsin	3.29	660	2.2
	Eastern Corn Belt	3.3	9,226	31 33.3%
Midsouth (MDS)	Arkansas	2.35	1,268	3.0
	Kentucky	2.42	559	1.4
	Louisiana	2.96	405	1.2
	Mississippi	2.55	790	2.0
	Oklahoma	1.55	186	0.3
	Tennessee	2.22	571	1.3
	Texas	2.08	75	0.2
	Midsouth	2.3	3,854	9 10.0%
Southeast (SE)	Alabama	1.95	142	0.3
	Georgia	2.08	103	0.2
	North Carolina	1.68	628	1.1
	South Carolina	1.78	182	0.3
	Southeast	1.9	1,055	2 2.0%
East Coast (EC)	Delaware	2.28	70	0.2
	Maryland	2.22	186	0.4
	New Jersey	2.22	37	0.1
	New York	3.29	114	0.4
	Pennsylvania	2.89	196	0.6
	Virginia	1.61	223	0.4
	East Coast	2.4	827	2 2.1%
USA 2010		2.98	31,113	92.8
USA 2009		2.96	30,931	91.5

Source: US Department of Agriculture, NASS 2010 Crop Production Report (October 8, 2010)

**Table 2. United Soybean Board/American Soybean Association 2010 Soybean Quality Survey Data**

Region	State	Number of Samples	Protein (%)*		Oil (%)*	
			Percent Average	Std. dev.	Percent Average	Std. dev.
Western	Iowa	240	35.2	1.3	18.7	1.1
Corn Belt (WCB)	Kansas	49	34.5	1.7	18.9	1.2
	Minnesota	256	34.4	1.1	18.8	1.0
	Missouri	105	34.4	1.3	18.7	1.1
	Nebraska	134	34.5	1.2	18.7	1.1
	North Dakota	74	33.6	1.5	18.4	1.2
	South Dakota	85	34.2	1.5	18.1	0.9
Averages†	Western Corn Belt	943	34.5	1.3	18.6	1.1
Ranges	Western Corn Belt		(30.3-39.0)		(15.9-22.2)	
Eastern	Illinois	270	35.0	1.3	18.9	1.2
Corn Belt (ECB)	Indiana	136	35.3	1.4	18.6	1.2
	Michigan	58	35.3	1.5	18.7	1.3
	Ohio	129	35.6	1.3	18.4	1.1
	Wisconsin	47	35.1	1.6	18.6	1.1
Averages†	Eastern Corn Belt	640	35.2	1.4	18.7	1.2
Ranges	Eastern Corn Belt		(30.9-39.1)		(15.9-23.6)	
Midsouth (MDS)	Arkansas	73	35.7	1.6	18.8	1.3
	Kentucky	29	34.6	1.6	19.2	1.2
	Louisiana	19	36.8	1.3	18.9	1.3
	Mississippi	51	35.7	1.4	18.6	1.5
	Oklahoma	3	35.6	1.6	18.3	1.1
	Tennessee	29	34.7	1.4	18.8	1.2
	Texas	4	33.9	1.2	20.3	2.0
Averages†	Midsouth	208	35.5	1.5	18.8	1.3
Ranges	Midsouth		(31.5-39.6)		(14.8-22.2)	
Southeast (SE)	Alabama	17	35.5	1.2	18.7	1.5
	Georgia	0	n/a	n/a	n/a	n/a
	North Carolina	10	35.9	1.8	19.3	1.2
	South Carolina	1	35	.	21.0	.
Averages†	Southeast	28	35.6	1.4	19.5	1.0
Ranges	Southeast		(33.6-39.6)		(15.9-22.1)	
East Coast (EC)	Delaware	2	36.2	0.1	19.8	3.0
	Maryland	7	36.2	1.1	18.7	1.7
	New Jersey	3	35.6	1.3	18.4	1.0
	New York	5	36.8	0.9	17.7	0.8
	Pennsylvania	9	34.7	1.1	19.1	1.0
	Virginia	5	35.7	0.9	18.3	1.9
Averages†	East Coast	31	35.8	0.9	18.6	1.6
Ranges	East Coast		(33.3-38.3)		(15.5-21.9)	
USA	Averages	1850	34.9	1.5	18.7	1.2
	Ranges		(30.3-39.6)		(14.8-23.6)	
	<b>Average of 2010 Crop†</b>		<b>34.9</b>	<b>1.4</b>	<b>18.7</b>	<b>1.1</b>
	US 1986-2010 avg.		35.3	1.5	18.7	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 (October 8, 2010).

**Table 3. United Soybean Board/American Soybean Association 2010 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	240	0.4	2.5	14.1	1.5
	Kansas	49	0.3	0.4	14.5	1.7
	Minnesota	256	0.2	0.3	14.4	1.6
	Missouri	105	0.3	0.4	14.2	1.4
	Nebraska	134	0.3	0.5	14.0	1.2
	North Dakota	74	0.3	0.6	14.7	1.7
	South Dakota	85	0.4	1.8	13.9	1.3
Averages† Ranges	Western Corn Belt Western Corn Belt	943	0.3 (0-39.1)	1.1	14.2 (10.5-21.2)	1.5
Eastern Corn Belt (ECB)	Illinois	270	0.3	1.9	14.6	1.3
	Indiana	136	0.3	0.3	13.6	1.5
	Michigan	58	0.2	0.2	14.8	1.4
	Ohio	129	0.2	0.3	14.4	1.7
	Wisconsin	47	0.5	0.9	16.4	1.9
Averages† Ranges	Eastern Corn Belt Eastern Corn Belt	640	0.3 (0-30.1)	1.0	14.5 (9.4-21.5)	1.5
Midsouth (MDS)	Arkansas	73	0.7	0.7	13.9	1.6
	Kentucky	29	0.4	0.8	13.9	2.0
	Louisiana	19	0.8	0.8	14.7	1.4
	Mississippi	51	0.6	0.7	13.6	1.7
	Oklahoma	3	0.7	0.5	13.7	2.5
	Tennessee	29	0.5	0.4	12.7	1.3
	Texas	4	0.3	0.4	14.5	2.1
Averages† Ranges	Midsouth Midsouth	208	0.6 (0-4.0)	0.7	13.7 (9.4-21.4)	1.7
Southeast (SE)	Alabama	17	1.5	1.4	12.4	2.2
	Georgia	0	n/a	n/a	n/a	n/a
	North Carolina	10	0.3	0.3	14.3	2.1
	South Carolina	1	0	.	13.6	.
Averages† Ranges	Southeast Southeast	28	0.4 (0-4.9)	0.4	13.9 (8.1-17.3)	1.7
East Coast (EC)	Delaware	2	0.3	0.1	13.5	1.7
	Maryland	7	0.3	0.2	14.9	2.5
	New Jersey	3	0.2	0.1	14.0	1.6
	New York	5	0.0	0.0	17.3	1.9
	Pennsylvania	9	0.3	0.4	15.3	1.4
	Virginia	5	0.1	0.1	13.8	1.9
Averages† Ranges	East Coast East Coast	31	0.2 (0-1.4)	0.2	14.9 (11.3-20.0)	1.9
USA	Averages Ranges	1850	0.4 (0-39.1)	1.3	14.3 (8.1-21.5)	1.6
	<b>Average of 2010 Crop†</b>		<b>0.3</b>	<b>1.0</b>	<b>14.3</b>	<b>1.5</b>

† Regional and US average values weighted based on estimated production by state as estimated by USDA, NASS Crop Production Report (October 8, 2010).

**Table 4. Historical Summary of Yield and Quality Data for US Soybeans**

Year	Yield (kg ha <sup>-1</sup> )	Protein* (%)	Oil* (%)	Sum† (%)	Harvested (Mha)	Production (MMT)	Protein Std. Dev.	Oil Std. Dev.
1986	2237	35.8	18.5	54.3	23.6	52.9	1.39	0.70
1987	2278	35.5	19.1	54.6	23.2	52.8	1.59	0.71
1988	1814	35.1	19.3	54.4	23.2	42.2	1.50	0.83
1989	2170	35.2	18.7	53.9	24.1	52.4	1.51	0.82
1990	2291	35.4	19.2	54.6	22.9	52.5	1.22	0.66
1991	2298	35.5	18.7	54.1	23.5	54.0	1.38	0.86
1992	2526	35.6	17.3	52.8	23.6	59.6	1.38	0.97
1993	2190	35.7	18.0	53.8	23.2	50.9	1.24	0.87
1994	2782	35.4	18.2	53.6	24.6	68.6	1.36	0.93
1995	2372	35.5	18.2	53.6	24.9	59.2	1.39	0.86
1996	2526	35.6	17.9	53.5	25.7	64.9	1.25	0.87
1997	2614	34.6	18.5	53.0	28.0	73.2	1.51	0.96
1998	2614	36.1	19.1	55.3	28.5	74.6	1.50	0.81
1999	2452	34.6	18.6	53.2	29.4	72.1	1.88	1.05
2000	2553	36.2	18.7	54.9	29.6	75.6	1.68	0.94
2001	2647	35.0	19.0	54.0	30.0	79.6	1.95	1.07
2002	2486	35.4	19.4	54.8	29.1	72.2	1.58	0.93
2003	2284	35.7	18.7	54.3	29.4	67.2	1.71	1.19
2004	2822	35.1	18.6	53.7	30.0	84.6	1.47	0.90
2005	2889	34.9	19.4	54.3	29.2	83.4	1.46	0.87
2006‡	2869	34.5	19.2	53.7	30.2	86.8	1.64	1.01
2007‡	2802	35.2	18.6	53.8	26.0	72.9	1.23	0.76
2008‡	2641	34.1	19.1	53.2	30.1	79.6	1.40	0.82
2009‡	2956	35.3	18.6	53.9	30.9	91.5	1.23	0.88
2010‡	2983	34.9	18.7	53.6	31.1	92.8	1.35	1.15
<b>Averages (1986-2010)</b>	<b>2524</b>	<b>35.3</b>	<b>18.7</b>	<b>53.9</b>	<b>27.0</b>	<b>68.7</b>	<b>1.47</b>	<b>0.90</b>

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 - 2010 quality estimates are weighted by yearly production estimates by state.



**Figure 1. US Soybean Planting and Harvest Progress**

