QUALITY OF THE UNITED STATES SOYEAN CROP 2012

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(MSR&PC)

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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.

2012 Acreage, Yields, and Total Production

According to the 9 November, 2012 United States Department of Agriculture, National Agricultural Statistics Service (USDA-NASS) crop report, the total US soybean harvested area increased 3 percent from last year to 30.7 million hectares harvested (Table 1). Average yields decreased, to 2.64 MT per ha. The lower yields brought total US soybean production to an estimated 80.9 million MT. The 2012 crop will be 4% smaller than the 2011 crop.

Quality of the 2012 US Soybean Crop

By 17 August, sample kits were mailed to 8,317 producers that were selected based on total land devoted to soybean production in each state, so that response distribution would closely match projected soybean production. By 29 November, 2012, 1,903 samples were received. These were analyzed for protein, oil, and amino acid concentration by near-infrared spectroscopy (NIRS) using a Perten DA7250 diode array instrument (Huddinge, Sweden) equipped with calibration equations developed by the University of Minnesota in cooperation with Perten. Regional and national average quality values were determined by computing weighted averages using state and regional soybean production values, so that average values best represent the crop as a whole. Results are in Tables 2 and 3.

Interpretation of Protein and Oil Results

Average protein concentrations for the 2012 US soybean crop dropped slightly from that of the 2011 US crop, while oil slightly increased. Average US soybean protein concentration was 0.5 percentage points lower in 2012, at 34.3%, and average oil concentration was 0.3 percentage points higher at 18.5% when compared with 2011 (Table 4). As is noted in most years, Western Corn Belt states showed lower protein concentrations than the US crop as a whole

(Table 2a). Soybeans grown in the Midsouth, Southeast, and East Coast states tended to have higher protein concentrations. Midsouth and Southeast states produced a soybean crop with higher oil concentration than the main soybean production regions of the Western and Eastern Corn Belt.

Compared with the 2011 crop, protein concentrations remained similar in the Western and Eastern Corn Belt and Midsouth. Protein levels decreased in the Southeast and East Coast regions. Oil concentrations in 2012 were higher in the Western and Eastern Corn Belt regions.

Seed from the 2012 crop had a large range in harvest moisture (Table 2b). The Western and Eastern Corn Belt sample had an average range of 10 percentage points. The average moisture of samples received in 2012 was 11.2%. The driest soybeans were found in the Western states (Minnesota, Nebraska, North Dakota and South Dakota). The Western Corn Belt region had average moisture levels of 9.8%. When protein levels are examined on an 'as-is' basis rather than adjusted to a 13% moisture basis, the protein in the Western Corn Belt jumped to 35.4% and the average US soybean increased from 34.3 to 35.3%. Similarly, national oil values increased from 18.5 to 18.9%, 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.

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In 2012, seed size was 8% larger than in 2011, with the average seed size increasing from 15.1 grams per 100 seeds in 2011 to 16.4 in 2012 (Table 2a). 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.

2012 Amino Acid Summary

The 2012 amino acid results supported results obtained from previous work in our laboratory. When analyzed as a percent of crude protein, lysine, the 5 primary limiting essential amino acids, and 10 essential amino acids did not appear to vary much between the regions. As noted previously, there was a tendency for soybeans from Western Corn Belt states to be slightly enriched in essential amino acids relative to other regions.

Weather and Crop Summaries

Planting: Warmer-than-normal weather in the Great Plains provided favorable growing conditions for row crops, and promoted rapid fieldwork. Much-needed rain dampened the northern half of the Plains, but little or no rain fell on the southern Plains. Much of the Southeast remained dry, compounding the effects of abnormally low soil moisture levels. By the end of April, 12 percent of the soybean crop was planted (Figure 1). This was 10 percentage points ahead of last year, and the quickest pace on record. By the last week of May, 94 percent of the nation's soybean crop was planted, 31 percentage points ahead of 2011.

Mid-Season: Rainfall was scarce for much of the country, with accumulations in many areas totaling less than 2 percent of normal. Any rain that fell across the Plains and Midwest was more than offset by an historic, early-season heat wave that boosted weekly temperatures as much as 3 to 8°C above normal. Devastatingly hot weather continued to bake the Great Plains in July, further dimming soybean prospects and increasing stress on the crop (Figure 2). Multiple days near or above 40°C were noted in parts of Indiana, Illinois, Iowa, Missouri, Arkansas, and on the Great Plains from South Dakota to Texas. Enough rain fell across the northern Corn Belt to help stabilize or even improve crop conditions in some locations. In late August, Hurricane Isaac produced rainfall totals of >10 cm in some drought-affected areas in

Arkansas, Missouri, and Illinois. Later, remnant tropical moisture spread across the remainder of the eastern Corn Belt and into the Mid-Atlantic States. Producers in parts of the Corn Belt hoped that late season rainfall would benefit pod fill in later-planted soybean fields. Late season heat across the nation's midsection promoted fieldwork and summer crop maturation. Harvest was underway in a limited number of areas by the last week of August.

Harvest: In the regions affected by tropical or frontal rains, including the southern half of the Plains and the Ohio Valley (the southern Midwest), wet weather helped to ease the drought conditions, but slowed fieldwork. Farther west, dry weather prevailed from the northern Plains into the northern and western Corn Belt (the upper Midwest), expanding and intensifying the drought conditions (Figure 3). According to the U.S. Drought Monitor, late-September drought coverage in the contiguous U.S. reached 65.5 percent, surpassing by 1.6 percent the previous high established on July 24, 2012. Freezes on September 23 and 24th officially ended the growing season across the upper Midwest (Iowa, Minnesota, and Wisconsin). By November 4th, 93 percent of the soybean crop was harvested, 7 percentage points ahead of the 5-year average.

Overall the 2012 season was marked by a very rapid planting pace because of warmer-than-normal temperatures and adequate rainfall in the northern Plains, but the southern Plains and Southeast stayed dry. During the growing season, extreme heat and drought in southern parts of the Midwest stressed the soybean crop; however, in the upper Midwest, crop conditions were improved by timely rainfall. Harvest started early and proceeded very quickly. Harvested yields tended to be significantly larger than forecast based on midsummer conditions throughout the US. Late season yield recovery was so great that total production in 2012 will be only a few percent short of the 2011 crop.

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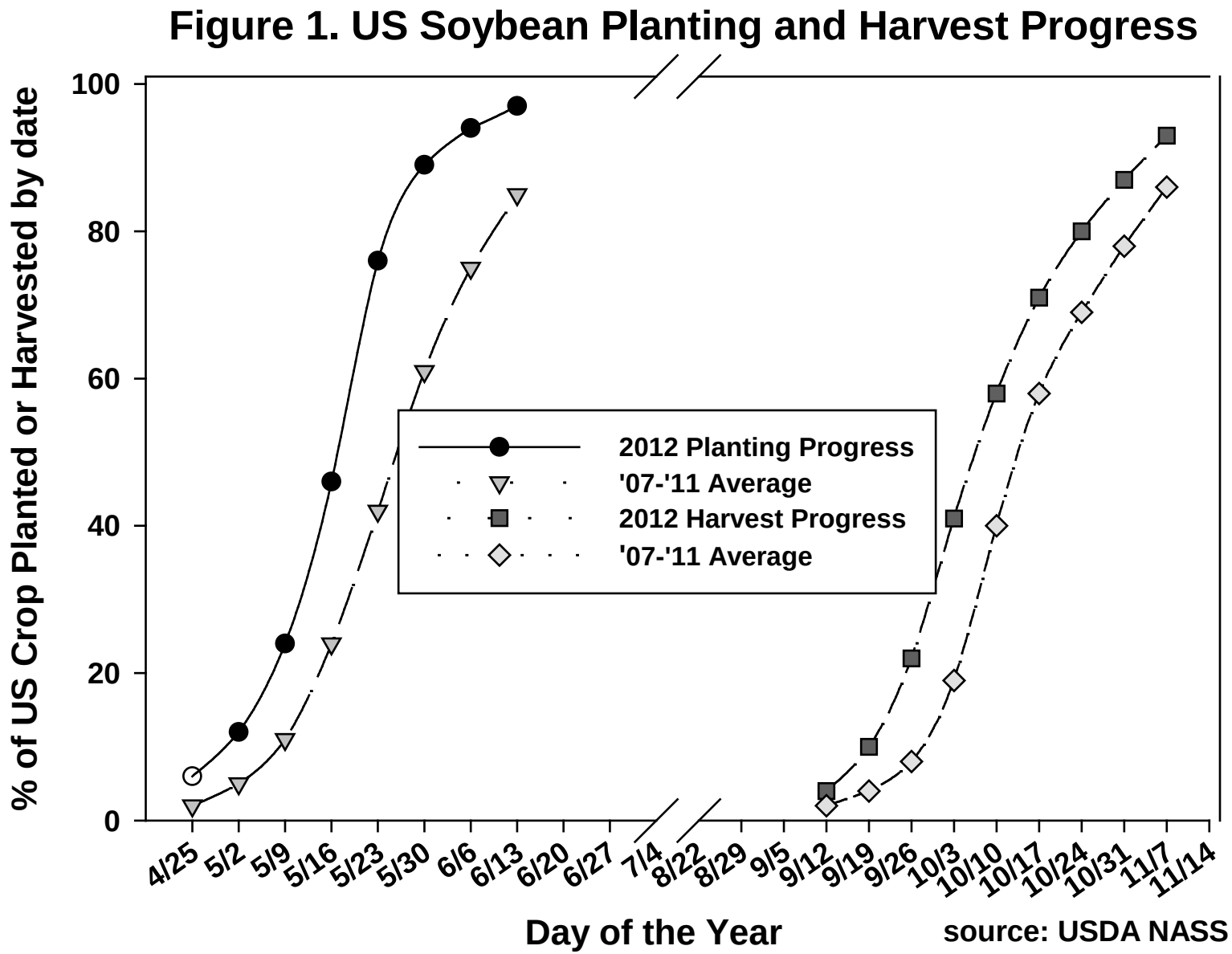

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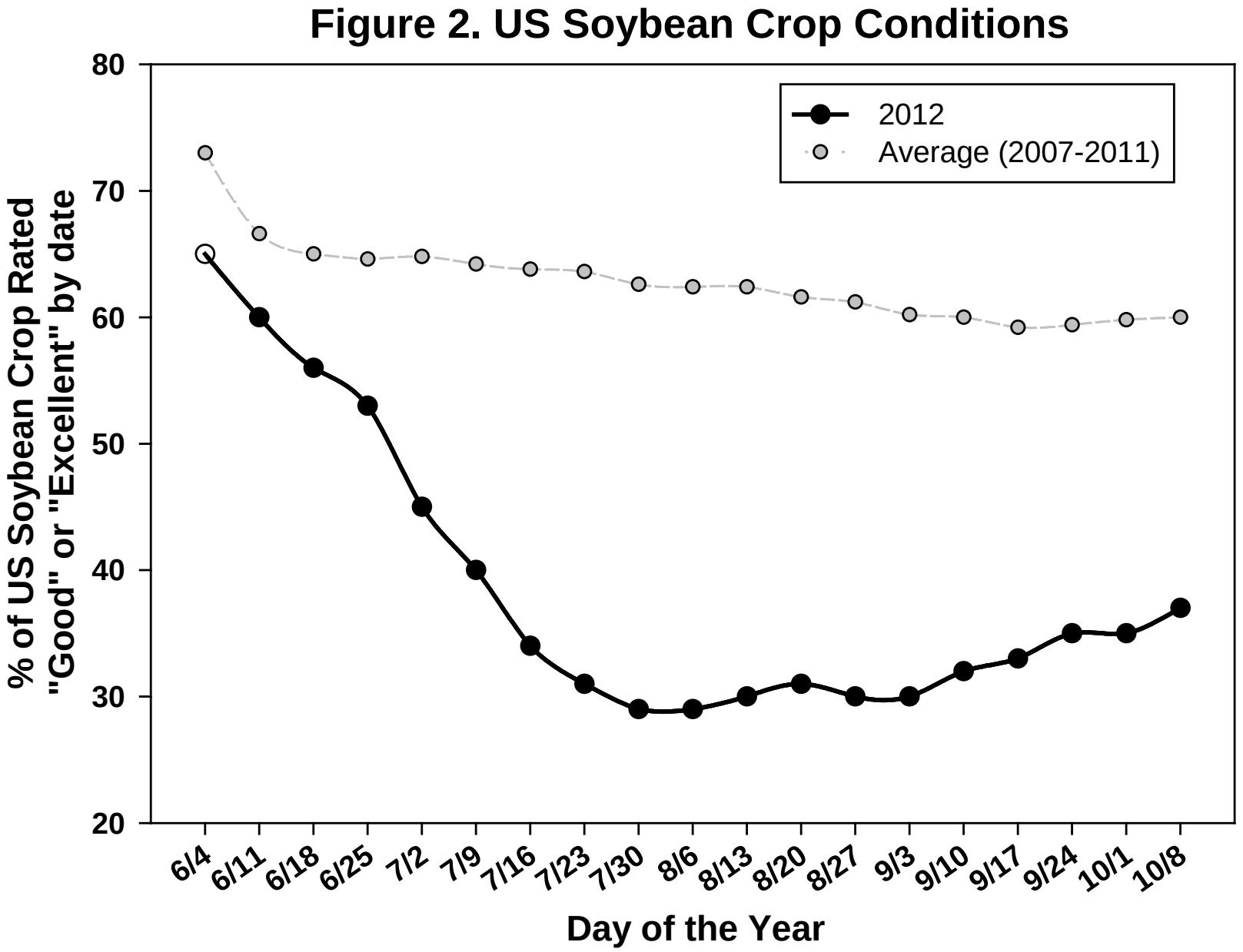

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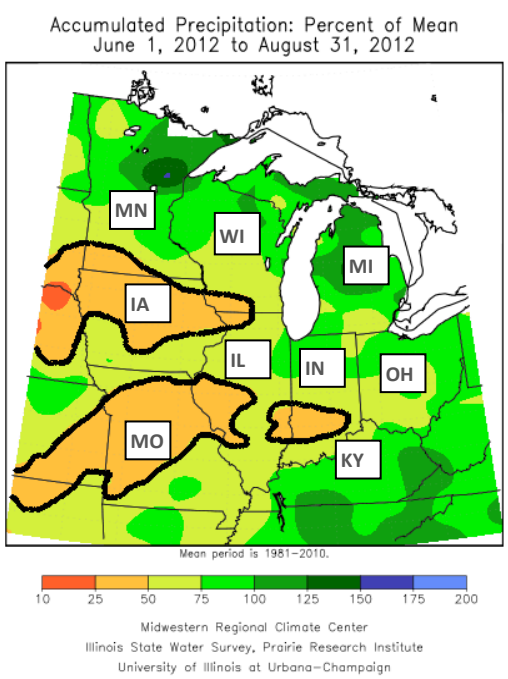
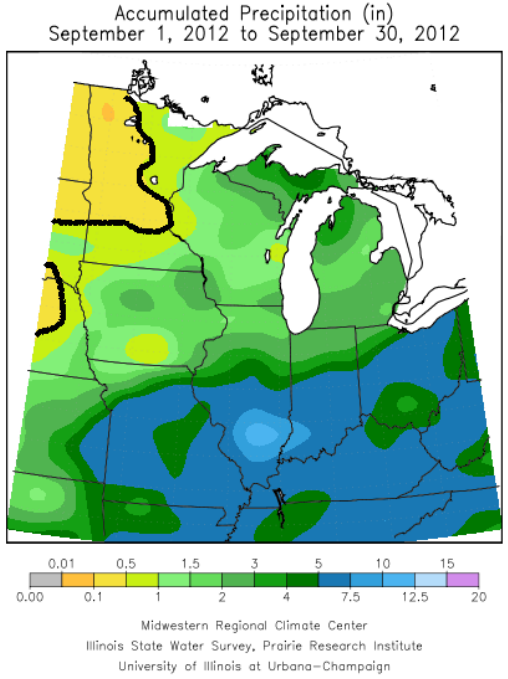
Figure 3. Areas outlined in black received less than 50% of average precipitation for the months indicated.





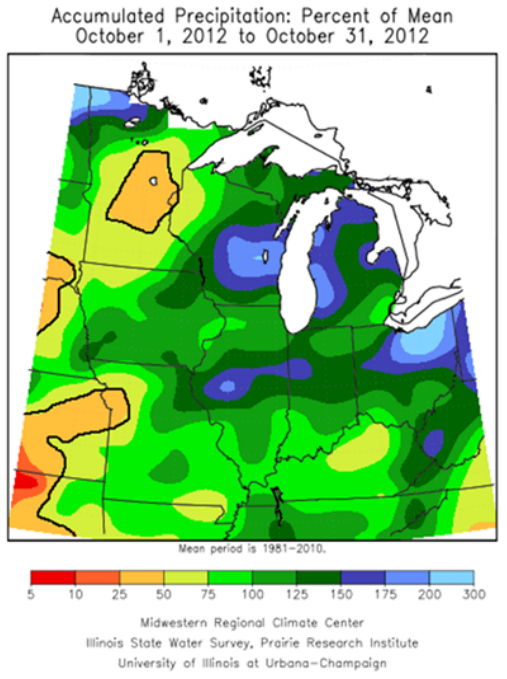


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Table 1. Soybean production data for the United States, 2012 crop

Region	State	Yield (MT ha^{-1})	Area Harvested (1000 ha)	Production (M MT)
Western Corn Belt (WCB)	Iowa	3.0	3,762	11.1
	Kansas	1.5	1,519	2.3
	Minnesota	2.9	2,823	8.2
	Missouri	2.1	2,126	4.4
	Nebraska	2.8	2,005	5.5
	North Dakota	2.3	1,904	4.4
	South Dakota	1.9	1,883	3.5
	Western Corn Belt	2.3	16,022	39.5
				46.9%
Eastern Corn Belt (ECB)	Illinois	2.9	3,564	10.3
	Indiana	3.0	2,082	6.2
	Michigan	2.8	806	2.3
	Ohio	3.2	1,855	5.9
	Wisconsin	2.6	689	1.8
	Eastern Corn Belt	2.9	8,995	26.4
				31.3%
Midsouth (MDS)	Arkansas	2.8	1,276	3.5
	Kentucky	2.6	587	1.5
	Louisiana	3.0	450	1.3
	Mississippi	2.8	794	2.2
	Oklahoma	1.1	122	0.1
	Tennessee	2.4	494	1.2
	Texas	1.8	43	0.1
	Midsouth	2.3	3,764	10.0
				11.9%
Southeast (SE)	Alabama	3.0	134	0.4
	Georgia	2.4	83	0.2
	North Carolina	2.4	624	1.5
	South Carolina	2.2	150	0.3
	Southeast	2.5	990	2.4
				2.9%
East Coast (EC)	Delaware	2.8	68	0.2
	Maryland	3.0	192	0.6
	New Jersey	2.7	38	0.1
	New York	3.0	124	0.4
	Pennsylvania	3.2	211	0.7
	Virginia	2.7	235	0.6
	East Coast	2.9	868	2.5
				3.0%
USA 2012		2.64	30,656	80.9
USA 2011		2.82	29,879	84.3

Source: United States Department of Agriculture, NASS 2012 Crop Production Report (November 9, 2012)

Table 2a. ASA-IM 2012 Soybean Quality Survey Data

Region	State	Number of Samples	Protein (%)*	Oil (%)*	Seed Wt. g/100 seeds
Western Corn Belt (WCB)	Iowa	271	33.8	18.9	16.5
	Kansas	64	35.0	18.4	16.3
	Minnesota	269	34.1	18.5	16.6
	Missouri	93	34.2	18.8	16.7
	Nebraska	131	34.1	18.4	16.0
	North Dakota	79	33.1	18.3	16.3
	South Dakota	84	34.1	18.4	15.3
Averages†	Western Corn Belt	991	34.0	18.6	16.3
Eastern Corn Belt (ECB)	Illinois	303	34.5	18.7	17.6
	Indiana	112	34.5	18.5	16.8
	Michigan	61	35.1	18.2	17.3
	Ohio	138	35.1	18.2	16.4
	Wisconsin	36	33.7	18.8	16.8
Averages†	Eastern Corn Belt	650	34.6	18.5	17.1
Midsouth (MDS)	Arkansas	76	35.3	19.0	14.9
	Kentucky	21	35.0	18.7	15.6
	Louisiana	18	36.8	19.1	14.9
	Mississippi	30	35.1	19.1	15.5
	Oklahoma	2	37.2	18.1	17.3
	Tennessee	24	34.5	19.2	14.9
	Texas	1	35.9	18.4	27.6
Averages†	Midsouth	172	35.4	19.0	15.3
Southeast (SE)	Alabama	2	36.3	18.6	15.0
	Georgia	1	33.3	20.2	14.9
	North Carolina	32	35.1	18.9	15.4
	South Carolina	7	35.2	19.0	14.6
Averages†	Southeast	42	35.2	19.0	15.3
East Coast (EC)	Delaware	6	35.8	18.6	17.9
	Maryland	13	36.0	18.3	17.4
	New Jersey	5	34.0	19.4	15.5
	New York	6	35.2	18.1	19.5
	Pennsylvania	10	36.3	17.2	16.6
	Virginia	8	34.7	19.0	17.5
Averages†	East Coast	48	35.5	18.2	17.5
USA	Averages	1903	34.4	18.6	16.5
	Average of 2012 Crop†		**34.3**	**18.5**	**16.4**
	US 1987-2012 avg.		35.2	18.6	

* 13% moisture basis

† Regional and US average values w eighted based on estimated production by state as estimated by USDA, NASS Crop Production Report (November 9, 2012)

Table 2b. ASA-IM 2012 Soybean Quality Survey Data- As-Is Moisture

Region	State	Number of Samples	Moisture (%)	Protein (%)*	Oil (%)*
Western Corn Belt (WCB)	Iowa	271	9.9	35.2	19.6
	Kansas	64	10.6	36.2	18.9
	Minnesota	269	9.4	35.7	19.3
	Missouri	93	12.1	34.6	19.0
	Nebraska	131	9.3	35.8	19.1
	North Dakota	79	9.0	34.8	19.1
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Averages†	Western Corn Belt	991	9.8	35.4	19.3
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	Ohio	138	13.0	35.1	18.2
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	Maryland	13	13.6	35.8	18.2
	New Jersey	5	13.9	33.6	19.3
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	Pennsylvania	10	13.3	36.1	17.2
	Virginia	8	11.9	35.2	19.2
Averages†	East Coast	48	13.2	35.4	18.2
USA	Averages	1903	11.1	35.3	19.0
	Average of 2012 Crop†		**11.2**	**35.1**	**18.9**

* As-Is moisture basis

† Regional and US average values weighted based on estimated production by state as estimated by USDA, NASS Crop Production Report (November 9, 2012)

Table 3. ASA-IM 2012 Soybean Quality Survey Data

Region	State	Number of Samples	Protein (%)*	Lysine (as % of P)	5 Essential Amino Acids‡ (as % of P)	10 Essential Amino Acids § (as % of P)
Western Corn Belt (WCB)	Iowa	271	33.8	4.7	12.5	39.7
	Kansas	64	35.0	4.7	12.4	39.2
	Minnesota	269	34.1	4.7	12.5	39.5
	Missouri	93	34.2	4.7	12.5	39.4
	Nebraska	131	34.1	4.7	12.5	39.5
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	Indiana	112	34.5	4.6	12.3	39.3
	Michigan	61	35.1	4.7	12.3	39.2
	Ohio	138	35.1	4.6	12.3	39.0
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	South Carolina	7	35.2	4.6	12.3	39.0
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	Maryland	13	36.0	4.7	12.1	38.5
	New Jersey	5	34.0	4.6	12.5	39.8
	New York	6	35.2	4.7	12.2	38.9
	Pennsylvania	10	36.3	4.5	12.2	38.8
	Virginia	8	34.7	4.7	12.3	39.2
Averages†	East Coast	48	35.5	4.6	12.2	38.9
USA	Averages	1903	34.4	4.7	12.4	39.4
	Average of 2012 Crop†		**34.3**	**4.6**	**12.3**	**39.2**

* 13% moisture basis

† Regional and US average values weighted based on estimated production by state as estimated by USDA NASS Crop Production Report November 9, 2012)

‡ 5 Essential amino acids: lysine, methionine, threonine, tryptophan, and cysteine

§ 10 Essential amino acids: leucine, histidine, isoleucine, lysine, methionine, phenylalanine, threonine, tryptophan, valine, and cysteine

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

Year	Yield (kg ha^{-1})	Protein* (%)	Oil* (%)	Sum† (%)	Harvested (M ha)	Production (M MT)	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	18.7	53.9	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‡	2950	35.0	18.6	53.6	31.1	91.9	1.38	1.19
2011‡	2788	34.8	18.2	53.0	29.8	83.4	2.20	1.79
2012‡	2641	34.3	18.5	52.9	30.7	80.9	1.60	0.93
Averages (1986-2012)	**2537**	**35.2**	**18.7**	**53.9**	**27.2**	**69.6**	**1.50**	**0.93**

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 - 2012 quality estimates are weighted by yearly production estimates by state

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