QUALITY OF THE 2004 SOYBEAN CROP FROM THE UNITED STATES [1/]
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Quality continues to be an important soybean marketing issue. This report summarizes current knowledge on the following soybean quality topics:

- protein and oil composition of the 2004 U.S. soybean crop,
- the 2004 crop in historical perspective,
- weather conditions affecting the 2004 crop,
- Asian soybean rust and its possible impact on the U.S. soybean crop,
- programs by growers and U.S. processors to improve quality,
- a study being funded by ASA to examine foreign material in soybean shipments, and
- the production of low-linolenic soybeans.

The data and analyses in this report are intended to assist customers in the sourcing and use of U.S. soybeans.

The Quality Survey

Since 1986, Iowa State University (ISU) and the American Soybean Association (ASA) have been surveying the quality of new crop soybean harvests. U.S. soybean producers, representing 30 soybean production states, in response to a mailed request, provided samples of 2004 crop soybeans for analysis. Samples received by November 5, 2004 were analyzed for protein and oil contents using an Infratec near-infrared instrument (Foss North America, Eden Prairie, Minn.). From other sources, data on the yield and physical quality (U.S. Grade factors) of U.S. soybeans have been collected. Data were organized by state and region (groups of states). Weather data for the 2004 growing season were collected to demonstrate the impact on soybean composition.

The 2004 U.S. Soybean Crop

The United States produced 3.15 billion bushels (85.9 million metric tons) of soybeans in 2004, according to the November 12, 2004 USDA production estimates (USDA, 2004). This is an increase of 28 percent from 2003, and the highest production on record. The average soybean yield was 42.3 bushels per acre, up from 33.9 bushels per acre in 2003 and the highest per acre yield since 1986. An estimated 74.0 million acres (29.9 million hectares) of soybeans were harvested, a 2% increase from 2003. Table 1 summarizes production statistics for the 2004 crop, by state and growing region. Production increases occurred in every soybean growing region.

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Composition data are given in Table 2. Average U.S. protein and oil contents for 2004 were 35.16% and 18.70% respectively (on a 13% moisture basis). The protein content is approximately 0.2 percentage points below, and the oil approximately 0.1 percentage points above, the long-term U.S. averages of 35.40 % protein and 18.61 % oil. The soybeans from the 2004 crop will produce, on average, 43.0 lbs of 48% protein meal and 10.9 lbs of oil per bushel from soybeans at 13% moisture. The variability (standard deviation) within states, regions, and the U.S. was approximately equal to the long-term averages for variability.

Weather Conditions in 2004

Weather conditions across all growing regions were generally ideal for soybean production. Planting and emergence was well ahead of the previous year, and equal to or better than the four-year average. Despite concerns about wet conditions in late May and early June, the soybean crop faired well. The drought conditions of the previous year were completely eliminated – soybeans had adequate moisture throughout the growing season. Temperatures were also ideal for growth with no excessively hot or cool weather throughout the season. It was unusual that nearly all soybean production regions experienced good growing conditions.

On August 20, parts of Minnesota, North Dakota, South Dakota and even northern Iowa experienced frost. Although there was some concern that the soybean crop in these regions would be negatively impacted, this appears not to have been the case. The cold conditions were localized and not as wide-spread as feared, and were of short duration. In general, green pods can tolerate -1 to -2 C, yellow pods -3 to -4 C and brown pods -15 C or lower (Brolley, 2004).

A number of soybean production regions experienced wet conditions in October. Soybeans remaining to be harvested stopped drying or absorbed moisture. Better weather conditions allowed the crop to dry adequately with little impact on quality, but some wetter soybeans (>12.5% moisture) were harvested. Buyers, who in the past might have specified higher moisture contents (e.g., 14%) in their purchasing contracts to take advantage of an overall dry crop, should exercise caution with this year's purchases.

Historical Performance

Soybean yields and acreage, which increased steadily in the 1990s, appeared to have stabilized in recent years. The 2004 crop, however, returned to the 1990s trend. This resulted from the good growing conditions across most soybean growing regions.

Table 3 shows a combination of USDA production and survey composition data. The yield, and protein and oil data is shown graphically in Figure 1. In the 1990s, yields increased by 0.5 bushels/acre/year, with little change in average protein and oil content. In 2004, there was a large yield increase but protein and oil levels were near historical averages. Breeding programs continue to emphasize yield, apparently without creating quality loss. The net result is a steady increase in the production of protein and oil per unit of area (Figure 2). From a consumer perspective, this has meant a steadier, more abundant supply from the same inputs (land, seed, fertilizer and so on).

Figure 3 shows the long-term variability (standard deviation) of the protein and oil measurements in the survey. 2004 saw a decrease in variability relative to 2003. The average long-term standard deviation for protein is 1.50 percentages points, 0.88 for oil. The 2004 variability is just slightly above the long-term average. The ratio of the standard deviations of protein to oil did not change significantly from 2003 – the relative variability of the two components remained about the same.

GIPSA collects results from Official soybean export inspections (GIPSA, 2004). Official inspections establish Grade based on a set of physical factors and, on request, will report protein and oil contents. Historical data is given in Table 4. The majority of inspections (>92%) were for U.S. No. 2 soybeans in 2003. There is some evidence to suggest that the average foreign material (FM) content of U.S. exports is decreasing – a level of 1.4% in 2003 was the lowest in ten years. The GIPSA composition measurements (protein and oil) agree with the ASA-USB-ISU Quality Survey data. This means that exports are generally an average of the U.S. production.

The GIPSA data is not separated by export location. The Gulf South ports are generally served by the corn belts state areas along the Mississippi-Ohio-Illinois-Missouri river system. Pacific Northwest ports are more likely to receive grain from the states classified as Western Corn Belt in the survey. Export quality at any port will tend to mirror the quality of production areas that serve it. Over the 19 years of the survey, the percentage of U.S. crop produced in the Western Corn Belt has gradually increased from about 40% to just over 50%. This shift is toward areas of potentially lower protein content. The previous data showing a constant level of U.S. average protein and oil continues to be a real credit to the U.S. soybean genetics industry when viewed in the context of this geographic shift in production.

The processing chart in Figure 4 shows the combinations of protein and oil content that will produce 47.5% to 48.5% protein soybean meal. Only once (1997) did U.S. soybeans fall to the left of the optimal area, shown by the shading. Soybeans from individual states and regions often fall to the far right, above 48.5% meal, and the U.S. averages are regularly in the middle of this area. In 2004, the U.S. average is close to the 19-year average of the survey.

Asian Soybean Rust

U.S. soybean producers have recently been concerned about the possibility of an outbreak of Asian soybean rust. This soybean disease is found in every soybean growing region in the world except North America (Figure 5) and has just spread to the United States. On November 10, the USDA confirmed the presence of Asian soybean rust in Louisiana (APHIS, 2004a). There have been reports of up to 80% reduction in yield in infected and untreated fields in Brazil and Africa.

Asian soybean rust (*Phakopsora pachyrhizi*) is a fungal disease that can quickly defoliate plants and reduce pod set, pod fill, seed quality and yield (ISU, 2004a). It is spread by wind-borne spores that can travel 10 to 20 miles per day. Seed is not a significant means of transmitting the spores. Over 30 species of legumes can serve as host to this fungus, the most notable being kudzu (*Pueraria lobata*), an invasive species found across the southern United States. The severity of the infection and resultant yield reduction is a function of the timing of infection – the earlier in the soybean's life cycle, the more severe the impact. It is a very difficult disease to diagnose as there are a number of other more benign soybean diseases with similar symptoms. Asian soybean rust can multiply quickly once a field is infected, resulting in major impact in just a few days.

The spores cannot survive the cold winter weather of the major soybean growing regions in the U.S. Any sustained infection in the U.S. crop would require a migration of the spores from warmer climates each year. Experts believe that it is highly unlikely that the U.S. could experience the reduction losses seen in more tropical soybean growing regions. It is also unlikely that large reductions in yield on the order of 80% would occur in infected fields in the Midwest – infection would not occur early enough for that to happen.

There is an extensive effort underway to screen existing varieties and exotic germplasm to find sources of rust resistance. However, it is not yet possible, either through traditional breeding or biotechnology, to confer resistance to soybean varieties. The only means of combating the disease today is by applying fungicides, a practice not common in the U.S. There are a number of effective fungicides available for use on soybeans. Brazilian soybean producers routinely spray their crop to control this disease. The cost of treatment is approximately $25 per acre.

Despite the fact that the impact in the U.S. will likely be much less severe than in other soybean growing regions in the world, the U.S. soybean industry is taking the threat of soybean rust very seriously. Early detection is the key to limiting the impact of the disease. The Animal and Plant Health Inspection Service (APHIS), an agency of the U.S. Department of Agriculture, individual states, and land-grant universities have research and early detection programs in place (APHIS, 2004b; ISU 2004a; and ILDA, 2004). Many states have formulated emergency plans for responding to verified infections.

Grower and Processor Premium Programs

A number of companies in the U.S. domestic soybean market have incentives for improving protein and oil contents. At least four major soybean processors have followed the lead of AgProcessing Inc. (AGP), in offering some form of premium for higher composition levels. The AGP premium scale has been described in previous discussion papers (Brumm and Hurburgh, 2003; Hurburgh, 2001). The AGP scale rewards above average oil content, and then provides a protein premium in cases where both the oil and protein are above average (AGP, 2004a). They also have an approved variety list, where farmers earn a minimum premium of $0.05 per bushel by delivering a single variety, identity-preserved, to an AGP designated location (AGP, 2004b). Consolidated Grain and Barge uses the same premium schedule as AGP.

The three other processors have similar programs. CHS (Cenex Harvest States Cooperatives) is offering a $0.05 per bushel minimum premium for two Asgrow varieties under contracted production (CHS, 2004.) Producers may earn a higher premium under a protein/oil premium schedule. The Minnesota Soybean Processors and South Dakota Soybean Processors both offer a Quality Premium Program which pays premiums based on protein and oil content (MnSP, 2004; SDSP, 2004). A summary of the premium schedules is given in Table 4.

The premium schedules are not equivalent. Some use a 13% moisture basis, while others use the as-is moisture. Taiwan specifies minimum protein and oil levels on a 13% basis (Table 4). Differences among premium scales and specifications cause some difficulty for plant breeders and handlers, both of whom need consistent long-term targets. In the face of conflicting signals about quality, plant breeders will always choose to emphasize yield only.

The variety list concept has advantages in that testing of each delivery is not required; the program assumes that the varieties on the list will always be above average in composition for the year. Variety trial data support that assumption; the relative ranking of varieties stays the same regardless of the overall changes created by year-to-year weather conditions. In all cases, the objective of the processor is to raise the overall average composition of soybeans purchased.

It is not necessary to segregate high protein and/or oil beans for separate processing runs. A solvent extract plant recovers the amounts of protein and oil present on a mass balance basis.

The United Soybean Board continues to fund two programs to increase producer awareness and improve measurement methods for soybean composition. The Select Yield and Quality program (SYQ) is a producer education effort targeted at the Western Corn Belt, to increase understanding of the possibilities for improved composition with improved or constant grain yield (USB, 2004a). SYQ is a print and media education program targeted at processors, to illustrate the benefits of including composition in pricing policies, and at growers, to demonstrate the potential for composition increase without yield loss. In the growers' case, USB is also explaining the benefits to U.S. competitiveness of increasing composition with or without price incentives, as South American production shifts toward the equator (probable higher protein). The major emphasis is on variety selection to favor varieties that average at least 35% protein and 19% oil (basis 13% moisture) over many growing conditions. Unless price incentives expand to support the information, the long term success of SYQ is uncertain. Premium programs offered by domestic processors support the SYQ concept, but only for those soybeans processed in the U.S.

In an effort to identify, develop and commercialize value-adding soybean compositional traits, the United Soybean Board worked with members of the soybean industry – from seed companies to processors – to establish Qualisoy™. The Qualisoy™ program certifies compositionally enhanced soybean varieties through their Better Bean Initiative (USB, 2004b). Qualisoy™ defines the characteristics of soybean varieties that will ultimately lead to enhanced oil and meal products and is representative of the important role the food, feed and seed industries have played in forming this initiative.

An offshoot of the Qualisoy™ program is the SQT (Soybean Quality Traits) analytical effort. Fair trade requires consistent analytical methods that are uniformly applied, and professionally accepted. For example, there are markets that do not accept GIPSA oil and protein data because the GIPSA NIR calibrations are not based on refereed AOCS/JOCS reference methods. Differences are slight, and the GIPSA data would allow much greater control over cargo uniformity when loading vessels. The SQT program is working to combine methods so that contracts specifying AOCS/JOCS testing can use Official USDA GIPSA results.

Foreign Material Study

The American Soybean Association is funding a study at Iowa State University to examine the amount and type of foreign material (FM) in U.S. soybeans. Some anecdotal evidence suggests that the composition of FM has changed in the last ten years due to the advent of Roundup Ready™ soybeans. Similar studies have been conducted in the past, most recently in 1994. This study is designed to build on those studies, updating them for current market conditions. Results are expected in October of 2005.

The project objective is to analyze the level and composition of foreign material at various stages in the soybean market channel, from farms to export elevator, to determine if there are cost effective efficiencies that could be captured by exporting a more competitive (lower foreign material) product.

Official samples of the 2004 crop from three interior and three export inspection points will be hand-divided into eight material categories (soybeans, soybean pieces, weed seed, dirt, plant parts, pods, corn and other). Company data for soybean FM at country elevators will be collected. Time series FM data from GIPSA and country elevators will be analyzed. The system FM production and cleaning model used in the 1994 study will be updated to current conditions. Export contract terms and interior discount practices will be surveyed. All data will be used to identify positive and negative impacts of FM on soybean producers and buyers, and to propose actions that will reduce negative impacts.

Low-Linolenic Soybeans

Trans-fatty acids are an increasing health concern in a number of countries. Oil is commonly hydrogenated to reduce the relative amount of poly-unsaturated fatty acids, and in particular, linolenic acid, to make the oil less susceptible to oxidation (more stable) and to change the melting point (more solid). The process of hydrogenation creates trans-fatty acids, thought to have a negative impact on human health similar to saturated fats. Beginning in January, 2006, U.S. food manufacturers must list the amount of trans-fatty acids on the labels of all their products. The U.S. Food and Drug Administration is one of many resources for information on trans-fatty acids (FDA, 2004a)

A number of organizations have developed, and are promoting, soybeans that are low in linolenic acid, and thus, in many uses, do not require hydrogenation. Monsanto has developed the VISTIVE™ low-linolenic soybean, to be processed by Cargill. They expect to contract 50,000 acres of VISTIVE™ production in Iowa in 2005 (Monsanto, 2005). Iowa State University has long been involved in the development of soybeans with altered fatty acid contents and has licensed low-linolenic varieties that are being grown under contract. Table 6 lists the fatty-acid profile of two of those varieties, with the linolenic acid content of approximately 1%.

Low-linolenic soybeans are generally grown under contract in identity preserved systems. In 2003, premiums of $0.35 per bushel were paid by Zeeland Mills, Zeeland, Michigan, to producers to grow, segregate, and store low-linolenic varieties (UIUC, 2004).

Summary

The 2004 U.S. soybean crop has slightly lower than average protein (35.2%) and slightly higher than average oil (18.7%) contents. The variability in protein and oil content was lower than 2003 and similar to the long-term average variability. Yields and total production were the highest on record due mainly to good growing conditions. There are continuing efforts on the part of many U.S. groups to improve soybean quality through education, price premiums and inspections. Soybean rust has not yet been found in North America, and U.S. and state government agencies, universities, and producer groups have action plans in place to deal with any outbreak. Low-linolenic soybean varieties are being grown and processed in the U.S. to address health concerns about trans-fatty acids.

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Table 1. Soybean production data for the United States, 2004 crop

Region	State	Yield (bu/a)	Acreage (1000 acres)	Production (1000 bu)
Western Corn Belt (WCB)	Iowa	49.0	10,150	497,350
	Kansas	41.0	2,700	110,700
	Minnesota	34.0	7,200	244,800
	Missouri	46.0	4,940	227,240
	Nebraska	48.0	4,750	228,000
	North Dakota	25.0	3,670	91,750
	South Dakota	34.0	4,090	139,060
	Western Corn Belt	41.0	37,500	1,538,900
				48.8%
Eastern Corn Belt (ECB)	Illinois	50.0	9,850	492,500
	Indiana	53.0	5,430	287,790
	Michigan	36.0	1,990	71,640
	Ohio	47.0	4,420	207,740
	Wisconsin	35.0	1,550	54,250
	Eastern Corn Belt	47.9	23,240	1,113,920
				35.4%
Midsouth (MDS)	Arkansas	40.0	3,150	126,000
	Kentucky	40.0	1,290	54,180
	Louisiana	31.0	1,070	33,170
	Mississippi	39.0	1,630	63,570
	Oklahoma	30.0	290	8,700
	Tennessee	40.0	1,180	47,200
	Texas	31.0	275	8,525
	Midsouth	38.4	8,885	341,345
				10.8%
Southeast (SE)	Alabama	37.0	195	7,215
	Florida	n/a	16	n/a
	Georgia	30.0	260	7,800
	North Carolina	33.0	1,470	48,510
	South Carolina	27.0	520	14,040
	Southeast	31.5	2,461	77,565
				2.5%
East Coast (EC)	Delaware	42.0	207	8,694
	Maryland	42.0	490	20,580
	New Jersey	42.0	101	4,242
	New York	36.0	173	6,228
	Pennsylvania	47.0	395	18,565
	Virginia	37.0	520	19,240
	East Coast	41.1	1,886	77,549
				2.5%
USA		42.6	73,990	3,150,441
USA 2003		33.9	72,476	2,453,665

Source: United States Department of Agriculture (12-Nov-04)
n/a = not available

Table 2. United Soybean Board/American Soybean Association 2004 Soybean Quality Survey Data.

Region	State	Number of Samples	Protein Percent Average	Protein Std. dev.	Oil Percent Average	Oil Std. dev.
Western	Iowa	297	34.97	1.39	18.75	0.76
Corn	Kansas	30	35.30	1.35	18.91	1.03
Belt	Minnesota	115	35.02	1.60	17.90	0.90
(WCB)	Missouri	65	34.67	1.22	19.16	0.70
	Nebraska	111	34.62	1.33	18.99	0.84
	North Dakota	33	34.90	1.40	17.48	0.90
	South Dakota	54	34.31	1.35	18.62	1.00
Averages	Western Corn Belt	705	34.85	1.41	18.62	0.94
Ranges	Western Corn Belt		(30.9 - 39.8)		(14.2 - 21.1)	
Eastern	Illinois	248	34.86	1.54	18.92	0.81
Corn	Indiana	138	35.94	1.35	18.53	0.85
Belt	Michigan	27	35.79	1.37	18.44	0.70
(ECB)	Ohio	78	36.26	1.48	18.53	0.79
	Wisconsin	19	35.77	1.16	17.88	0.56
Averages	Eastern Corn Belt	510	35.45	1.57	18.69	0.84
Ranges	Eastern Corn Belt		(26.9 - 41.7)		(15.6 - 21.2)	
Midsouth	Arkansas	25	35.56	1.55	19.41	0.90
(MDS)	Kentucky	6	35.48	1.06	19.55	0.60
	Louisiana	6	35.90	0.98	19.47	1.04
	Mississippi	19	35.23	1.63	18.83	0.94
	Oklahoma	4	35.88	1.35	19.23	1.20
	Tennessee	10	34.95	1.64	20.13	0.83
	Texas	3	36.17	2.17	19.27	0.81
Averages	Midsouth	73	35.45	1.50	19.36	0.96
Ranges	Midsouth		(31.2 - 38.6)		(17.2 - 21.3)	
Southeast	Alabama	3	36.30	1.21	19.33	1.60
(SE)	Florida	0	–	–	–	–
	Georgia	1	36.40	–	19.70	–
	North Carolina	4	35.98	1.37	19.43	0.92
	South Carolina	2	35.25	0.78	18.90	0.28
Averages	Southeast	10	35.97	1.09	19.32	0.96
Ranges	Southeast		(34.3 - 37.6)		(17.8 - 21.0)	
East	Delaware	3	35.23	1.33	19.50	0.87
Coast	Maryland	7	36.80	1.62	18.97	0.60
(EC)	New Jersey	3	37.40	1.65	18.37	1.05
	New York	2	39.20	2.55	16.65	1.77
	Pennsylvania	5	37.62	1.36	18.36	0.94
	Virginia	1	35.80	–	19.70	–
Averages	East Coast	21	37.04	1.76	18.63	1.12
Ranges	East Coast		(33.7 - 41.0)		(15.4 - 20.5)	
USA	Averages	1319	35.16	1.53	18.70	0.92
	Ranges		(26.9 - 41.7)		(14.2 - 21.3)	
	US 1986-2004 avg.		35.40		18.61	

Basis 13% moisture

Data as of November 5, 2004

Table 3. Historical Summary of Yield and Quality Data for U.S. Soybeans.

Year	Yield (bu/a)	Protein (%)	Oil (%)	Sum (%)	Protein Std. Dev.	Oil Std. Dev.	Harvested (000 acres)	Production (000 bu)
1986	33.3	35.76	18.54	54.30	1.39	0.70	58,312	1,941,790
1987	33.9	35.46	19.11	54.57	1.59	0.71	57,172	1,938,131
1988	27.0	35.13	19.27	54.40	1.50	0.83	57,373	1,549,071
1989	32.3	35.18	18.73	53.91	1.51	0.82	59,538	1,923,077
1990	34.1	35.40	19.18	54.58	1.22	0.66	56,512	1,927,059
1991	34.2	35.48	18.66	54.14	1.38	0.86	58,011	1,983,976
1992	37.6	35.56	17.27	52.83	1.38	0.97	58,233	2,189,561
1993	32.6	35.73	18.03	53.76	1.24	0.87	57,307	1,868,208
1994	41.4	35.39	18.20	53.59	1.36	0.93	60,809	2,517,493
1995	35.3	35.45	18.19	53.64	1.39	0.86	61,544	2,172,503
1996	37.6	35.57	17.90	53.47	1.25	0.87	63,349	2,381,922
1997	38.9	34.55	18.47	53.02	1.51	0.96	69,110	2,688,379
1998	38.9	36.13	19.14	55.27	1.50	0.81	70,441	2,740,155
1999	36.5	34.55	18.61	53.16	1.88	1.05	72,476	2,645,374
2000	38.0	36.22	18.65	54.87	1.68	0.94	73,024	2,774,912
2001	39.4	34.98	18.97	53.95	1.95	1.07	74,100	2,922,914
2002	37.0	35.42	19.38	54.80	1.58	0.93	71,800	2,650,000
2003	34.0	35.65	18.66	54.31	1.71	1.19	72,538	2,468,390
2004	42.6	35.16	18.70	53.86	1.53	0.92	73,990	3,150,441
Averages	36.0	35.41	18.61	54.02	1.50	0.89	64,507	2,338,598
Std. Dev.	3.7	0.43	0.53	0.66	0.20	0.13	6,996	434,378

Sources: United States Department of Agriculture and Iowa State University
Protein and oil contents basis 13% moisture
Yield Data for 2004 estimated November 12, 2004
Protein and oil data for 2004 as of Nov 5, 2004

Table 4. Protein and oil premium schedules and specifications being used.

Minnesota Soybean Processors and South Dakota Soybean Processors				
	Oil content (%)[a]	Premium $/bu	Protein Content (%)[a]	Premium $/bu
	19.4	$0.01	34.5	$0.01
	19.5	$0.02	35.0	$0.02
	19.6	$0.03	35.5	$0.03
	19.7	$0.04	36.0	$0.04
	19.8	$0.05	36.5	$0.05
	19.9	$0.06	37.0	$0.06
	20.0	$0.07	37.5	$0.07
Ag Processing, Inc., Consolidated Grain and Barge				
	Oil Content (%)[b]	Premium $/bu	Protein Content (%)[b]	Premium $/bu
	19.5 to 19.8	$0.02	37.0% minimum, no maximum	$0.03
	19.9 to 20.1	$0.03		
	20.2 to 20.4	$0.04		
	20.5 to 20.7	$0.05		
	20.8 to 21.0	$0.06		
	> 21.0	$0.07		
Taiwan minimum specifications				
	Oil Content (%)[b]: 19.0%		Protein Content (%)[b]: 35%	

[a] Basis 13% moisture
[b] As-is moisture basis
Source: MnSP, 2004; SDSP, 2004; AGP, 2004; CGB, 2004.

Table 5. Summary of GIPSA Grain Inspection Data for Soybeans.

Calendar Year	Crop Years	GIPSA Export Inspection Data: Percent No. 2YSB	Moisture (%)	Foreign Material (%)	Damaged Kernels (%)	Protein (%)	Oil (%)	ISU Survey Results: Protein (%)	Oil (%)
1994	93,94	90.3	12.6	1.7	1.1	35.5	18.4	35.5	18.1
1995	94,95	92.3	12.2	1.7	1.0	35.2	18.5	35.4	18.2
1996	95,96	92.2	12.1	1.7	1.1	35.1	18.5	35.5	18.0
1997	96,97	90.9	12.6	1.6	0.8	35.3	18.4	35.0	18.2
1998	97,98	90.0	12.2	1.6	1.0	35.5	18.8	35.3	18.8
1999	98,99	89.4	12.0	1.6	0.9	35.3	18.8	35.3	18.9
2000	99,00	90.0	11.4	1.7	1.0	35.0	18.5	35.4	18.6
2001	00,01	89.5	11.5	1.7	1.3	35.8	18.5	35.6	18.8
2002	01,02	93.1	12.1	1.5	1.4	35.2	18.8	35.5	19.0
2003	02,03	92.6	12.2	1.4	1.5	35.3	18.9	35.5	19.0
2004	03,04							35.2	18.7
Averages		91.0	12.1	1.6	1.1	35.3	18.6	35.4	18.6

Source: USDA Grain Inspection Packers and Stockyards Administration, Iowa State University
Protein and oil basis 13.0% moisture

Table 6. Fatty acid profile of two low-linolenic soybean varieties (ISU, 2004b).

Variety	Fatty acid (% of oil)				
	Palmitic	Stearic	Oleic	Linoleic	Linolenic
IA 2064	9.7	5.2	27.9	56.2	1.0
Conventional Variety grown under the same conditions	11.5	4.5	25.4	50.9	7.7
IA3017	10.4	4.9	27.3	56.3	1.1
Conventional variety grown under the same conditions	9.5	4.7	24.9	54.3	6.6

Figure 1. Historical Summary of Yield and Quality Data for U.S. Soybeans.

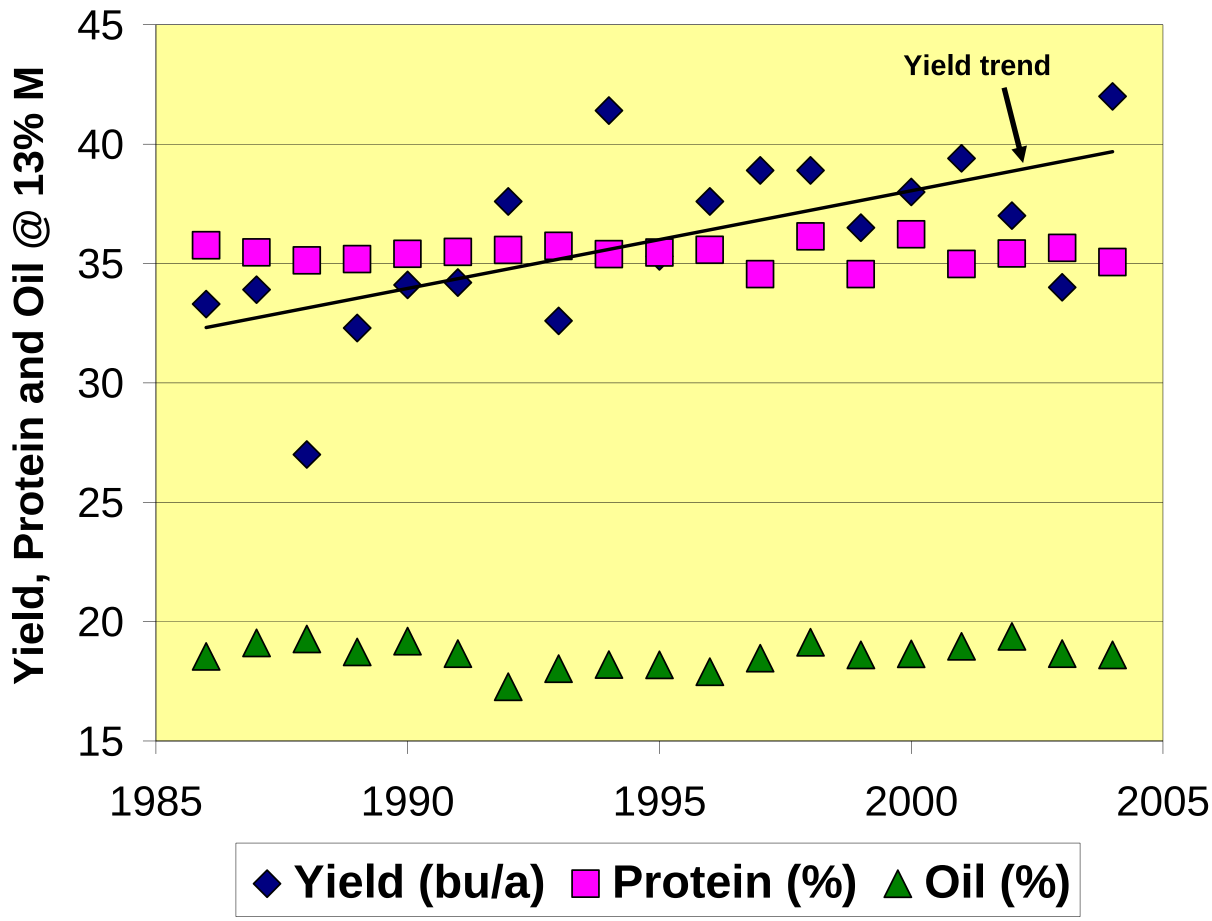

Figure 2. U.S. Production of Soybean Protein and Oil per unit area.

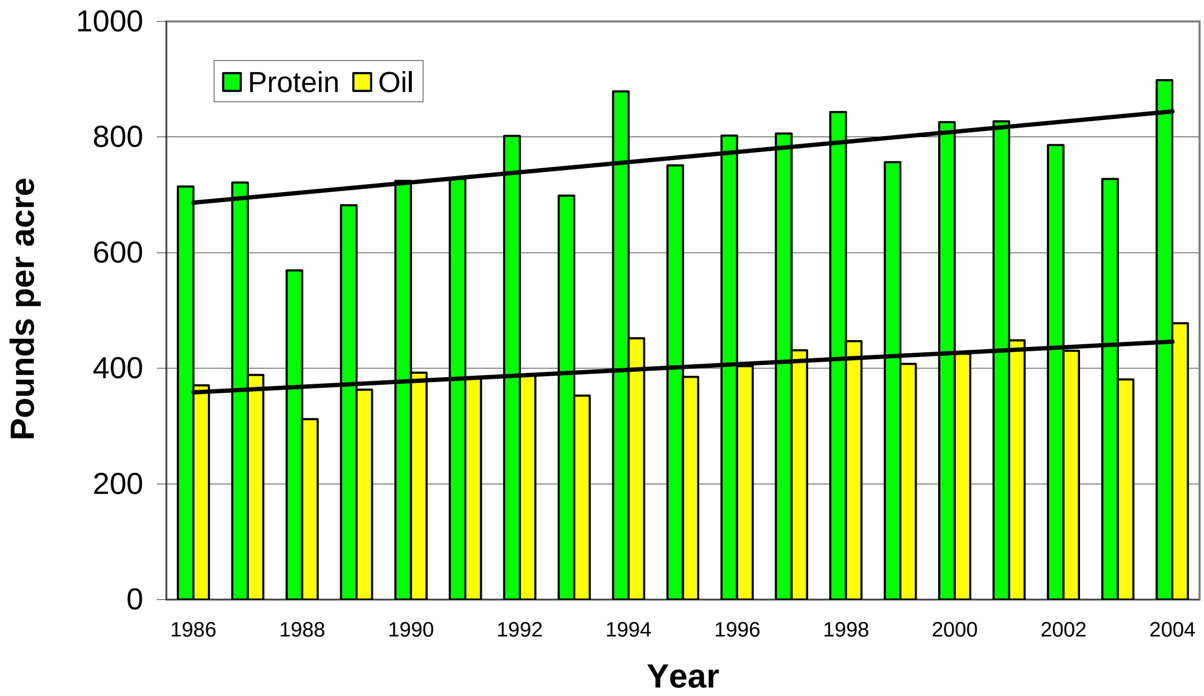

Figure 3. Historical Summary of Protein and Oil Variability in the Survey.

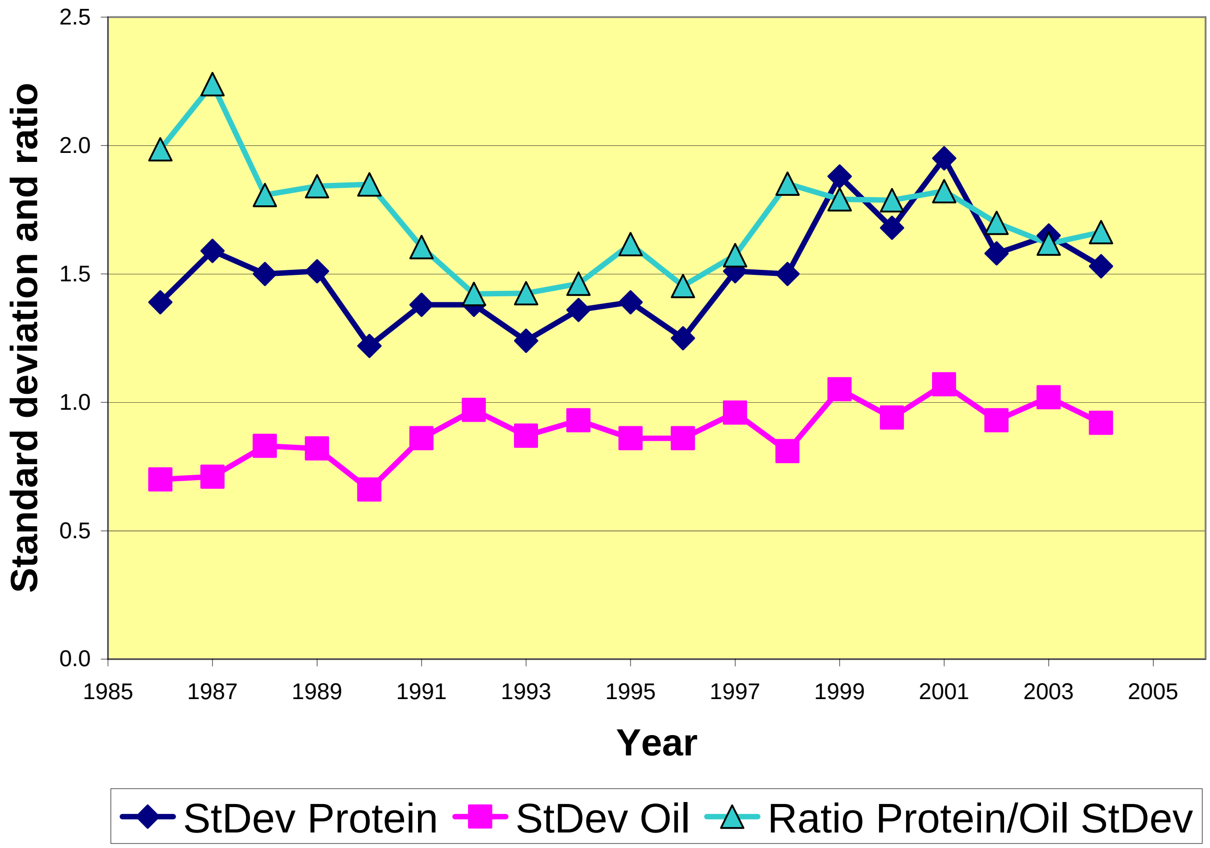

Figure 4. Protein and oil combinations that will produce 47.5% to 48.5% protein meal.

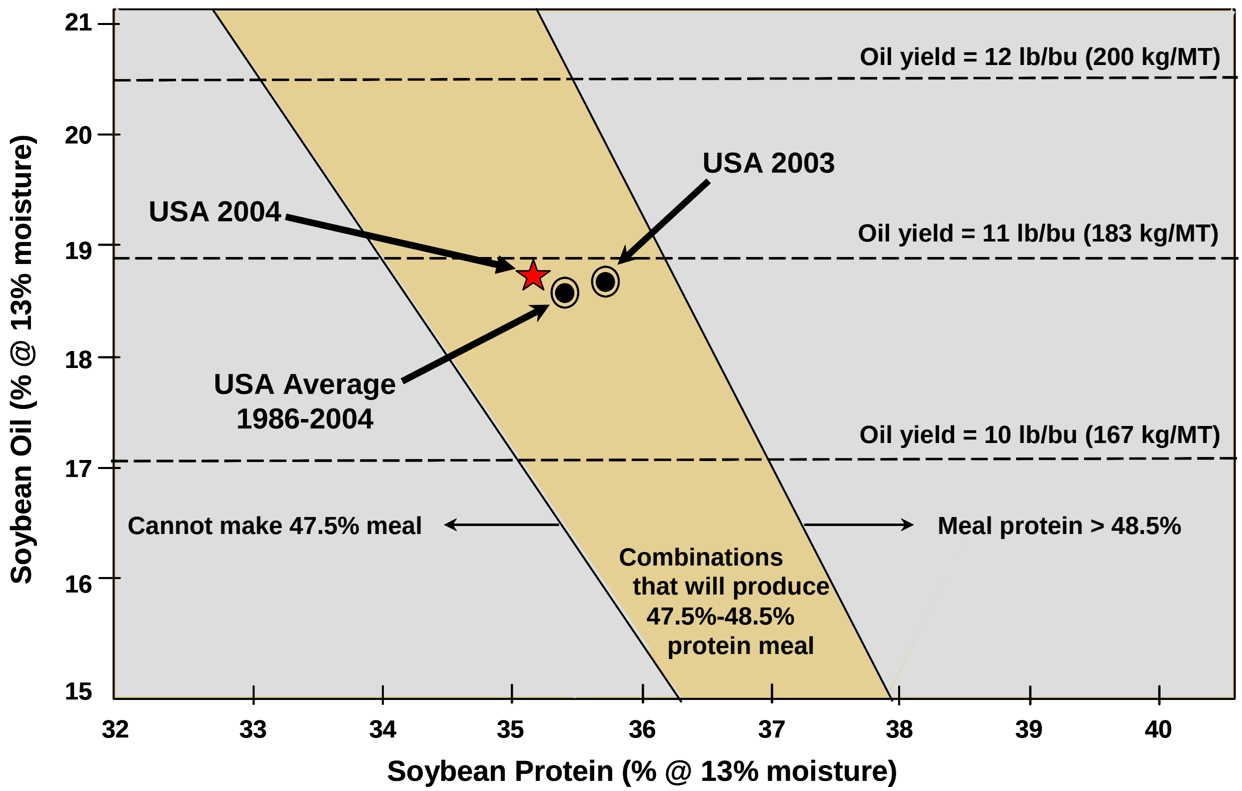

Figure 5. Regions where Asian soybean rust is currently found (ISU, 2004a).