1996

Technical Notes: U.S. Soybean Quality Related to Costs and Benefits of Soybean Cleaning

Charles R. Hurburgh Jr.
Iowa State University, tatry@iastate.edu

Technical Notes: U.S. Soybean Quality Related to Costs and Benefits of Soybean Cleaning

Abstract
oybean quality reports identify that foreign material (FM) levels of southern soybeans were 1 to 2 percentage points greater than FM levels of midwestern soybeans. The 1 to 2 percentage point protein advantage of southern soybeans offsets the FM differences for domestic processors. Random blending of midwestern soybeans with southern soybeans normally produces export soybeans having nearly 2% FM without net removal of cleanings and contributes $20 million or more to net soybean handling margins.

Keywords
Soybeans, Quality, Costs

TECHNICAL NOTES:

U.S. SOYBEAN QUALITY RELATED TO COSTS AND BENEFITS OF SOYBEAN CLEANING

C. R. Hurburgh Jr.

ABSTRACT. *Soybean quality reports identify that foreign material (FM) levels of southern soybeans were 1 to 2 percentage points greater than FM levels of midwestern soybeans. The 1 to 2 percentage point protein advantage of southern soybeans offsets the FM differences for domestic processors. Random blending of midwestern soybeans with southern soybeans normally produces export soybeans having nearly 2% FM without net removal of cleanings and contributes $20 million or more to net soybean handling margins.* ***Keywords.*** *Soybeans, Quality, Costs.*

An evaluation of standards or market practice changes must begin with an assessment of current patterns of quality. Although the purpose of grades is only to describe grain quality (Hill et al., 1993), concerns inevitably focus on the potential for uneven effects across regions or among market participants.

In recent years there have been several studies that reported soybean quality data by market or geographic location. An analysis of these data can be used to estimate the impact of the changes in particle-size (foreign material) standards as proposed by the Federal Grain Inspection Service (FGIS, 1991). FGIS has been reorganized as the Grain Inspection Packers and Stockyards Administration. Presumably any grain handling operational (non-marketing) benefits of cleaning would be available to all market participants.

OBJECTIVES

This article addresses the following using a compilation and analysis of published reports on soybean quality.

- Compile a profile of U.S. soybean quality by market location with emphasis on particle size factors.
- Form a similar profile by geographic region.
- Relate the quality data to the potential for discounts and/or grain-handling operational benefits if particle-size standards are changed, as proposed by the FGIS (FGIS, 1991).

DATA AND ANALYSIS

The FGIS collected survey data from its interior locations from 1987 to 1990 (FGIS, 1988, 1989a, 1990b, 1991). Annual official inspection data from approximately 2,000 samples inspected early in the harvest season were published. There was no attempt to control the distribution by state of these samples. In the same years, the American Soybean Association sponsored a survey of protein and oil content of farm soybeans involving approximately 1,500 samples per year (Hurburgh et al., 1990), collected in approximate proportion to state production of soybeans.

Table 1 gives the year-by-year averages for these data. Variation in the particle size factors (FM and splits) is evident. The splits levels were negatively correlated ($r \approx -0.4$) with moisture. Foreign material (FM) was not related to moisture. Foreign material was clearly the only factor close to the grade limits for No. 2 Grade soybeans.

Table 2 shows the results of the data when analyzed by region. The overall averages in both tables 1 and 2 were regionally weighted with the production percentages listed.

Data in table 2 indicate that Midwest soybeans were cleaner (less FM by 1 to 2 percentage points) than southern soybeans across all years of data. There was no economically relevant difference among regions in splits percentages. Predictably, splits levels were greater in export soybeans which would have received several additional handlings. When the greater amount of FM in southern soybeans is combined with midwest soybeans, the average level is within the limits for No. 2 Grade soybeans. In an analysis of processing value, the greater amount of FM in southern soybeans was completely offset, economically, by the higher sum of protein and oil (Hurburgh, 1994). Thus, domestic processors are not

Table 1. Quality of U.S. domestic soybeans by year, 1987-1990 (28 states)

Year	Moisture (%)	Test Weight (lb/bu)	FM (%)	Splits (%)	Total Damage (%)	Protein* (%)	Oil* (%)
1987	11.8	56.4	1.9	8.0	1 3	35.5	19.1
1988	12.9	56.2	2.3	5.6	1 7	35.1	19.3
1989	12.1	56.1	1.6	7.6	2.0	35.2	18.7
1990	12.4	56.3	1.3	4.5	2 1	35.4	19.2
All	12 3	56.3	1.8	6.4	1.8	35.3	19 1

Source: Federal Grain Inspection Service (1988, 1989a, 1990, 1991)
* Basis 13.0% moisture. American Soybean Association Survey, respective years.

Article was reviewed and approved for publication by the Food and Process Engineering Inst. of ASAE

Research supported by the USDA-Economic Research Service and the Iowa Agriculture and Home Economics Experiment Station. Journal Paper J-16086 of the Iowa Agriculture and Home Economics Experiment Station, Iowa State University, Ames, Project 3261.

The author is **Charles R. Hurburgh Jr.,** ***ASAE Member Engineer,*** Professor, Agricultural and Biosystems Engineering Dept., Iowa State University, Ames, IA; telephone: 515-294-8629; e-mail: <tatry@iastate.edu>.

Table 2. Quality of U.S. soybeans by state and region, 1987-1990

Region	State	Percent of U.S. Crop	Moisture (%)	Test Weight (lb/bu)	FM (%)	Splits (%)	DKT (%)	Grade Distribution* 1-2-3-4-S (%)	Protein (%)†	Oil (%)†
WCB	Iowa	16.9	11.1	56.4	0.9	7.0	1.2	49-41-5-2-2		
	Kans.	2.9	10.8	55.8	1.6	8.3	3.0	24-46-13-8-7		
	Minn.	9.1	12.6	57.0	3.8	9.2	5.0	17-19-17-6-42		
	N.D.	7.0	11.4	56.3	1.5	7.0	1.4	30-46-14-6-5		
	Nebr	0.8	10.2	57 5	1.2	5.4	2.4	38-32-19-6-5		
	S.D.	2.6	—	—	—	—	—	—		
Average‡	WCB	43 7	11.1	56.5	1.8	7.7	2.3	30-38-16-6-11	34.8	19.3
ECB	Ill.	17.3	12.4	55.9	1.2	7.1	1.6	30-40-18-5-6		
	Ind	8.6	12.7	56.3	1.4	4.8	1.6	22-42-17-7-2		
	Mich.	2.1	—	—	—	—	—	—		
	Ohio	7.0	13 0	56.3	1.4	4.4	1.3	44-34-13-6-3		
	Wis.	0.7	11.6	57.5	2.5	4.6	0.5	37-34-7-13-9		
Average‡	ECB	35.7	12.4	56.5	1.3	5.9	1.6	36-38-14-8-5	35.6	19.0
MDS	Ark.	4.4	11.7	55.9	2.4	6.6	3 2	§		
	Ky.	1.7	12.2	55.5	2.7	18 0	3.0	23-45-17-10-6		
	La.	2.3	12.3	54.4	4.7	4.3	2.9	0-8-44-16-32		
	Miss	2.5	13.4	55 8	3.3	3.5	1 9	1-13-59-19-8		
	Okla.	0.3	—	—	—	—	—	—		
	Tenn.	1.8	12.7	55.5	2.2	9.2	1.8	16-37-15-11-11		
	Tex.	0 4	10.6	55.8	3 0	10 7	4.9	36-20-20-13-12		
Average‡	MDS	13.4	12 3	55 5	3 1	8 3	2.7	17-23-32-14-14	35.9	18.8
SE	Ala.	0.6	12.8	56.0	2.9	7.0	2 5	21-33-17-14-14		
	Fla	0.1	—	—	—	—	—	§		
	Ga.	1.1	12.6	56.3	3.1	11.8	1.9	13-26-22-20-19		
	N.C	2.0	12.6	57.1	2.6	5.2	1.1	§		
	S.C.	0.9	13.4	56 2	3.2	—	2.8	9-24-25-20-22		
Average‡	SE	4.7	12.9	56 4	3.0	8 0	2.1	15-28-21-17-18	36 0	18 8
EC	Del.	0.3	—	—	—	—	—	—		
	Md.	0 8	13.6	56 3	2.3	12.4	10 0	8-50-25-0-17		
	N J.	0 2	—	—	—	—	—	—		
	Pa.	0.5	—	—	—	—	—	—		
	Va.	0.8	13 4	56.3	2.0	5.3	0.9	7-61-28-3-2		
Average‡	EC	2 6	13.5	56.3	2.2	8.8	5 2	7-56-26-1-8	36.0	18.8
USA		100 0	12.3	56.3	1.8	6 4	1.8	33-36-14-9-7	35.3	19.1

* Percent of samples with a full grade.
† Basis 13.0% moisture. American Soybean Association Survey, respective years.
‡ Weighted by production percentage.
§ All inspections were factor only.
NOTE: WCB = Western Corn Belt; ECB = Eastern Corn Belt; MDS = Midsouth; SE = Southeast; EC = East Coast

disadvantaged in the regions with greater FM. Soybean meal marketing practices do not reward protein in excess of specifications. Therefore, reductions in FM, which would increase meal protein, would not generate additional income.

The FGIS data were combined with a country elevator study conducted by Iowa State University (Hurburgh et al., 1987). Tables 3 and 4 show soybean FM and splits data by market location. The export data were taken from FGIS data (FGIS, 1989b).

Export FM is about the same as interior FM. For Iowa origin samples only, the FGIS survey shows 1.0% FM at interior inspections. This is close to the 0.8% reported by the Iowa State University (ISU) study for country elevator inbound soybeans. Evidently, inbound FM at country elevators is roughly the same as outbound FM. The conclusion is that most soybean FM originates on the farm. The market channel evens FM out among lots, regions, and growing seasons. Also, the distribution of overall grade levels becomes progressively narrower at successive market points. The FGIS interior data generally represent shipments from country elevators to processors or terminals. In most instances, FM is the grade-determining factor.

Splits, which contribute to oil rancidity in export shipments (Nicholas and Whitten, 1978), increase during handling. However, current factor limits allow leeway against either No. 1 or No. 2 Grade specifications. Both growers and handlers will have a more difficult time reducing splits levels and/or avoiding increases in splits than they will in reducing FM.

Splits are not determined by a mechanical separation. The $10/64 \times 3/4$ in. slot sieve (10S sieve) is only an aid in sorting splits. Splits are defined as all beans with 25% or more missing, and must be hand-sorted. Therefore, with the present definition of splits, a grain handler will not be able to clean splits from soybean lots, without incurring significant loss of small whole beans. If both FM and splits are limiting, exporters in particular will have to monitor two particle size factors, one of which is not controllable

Table 3. Foreign material content of U.S. soybeans by grade

Data Source		Grade Distribution 1-2-3-4-S by %	Foreign Material (%) by Grade 1	2	3	4	S	All
Country elevator inbound, ISU study, Iowa	1983-1984	55-36-7-1-1	—	—	—	—	—	0.8
FGIS new crop, interior, Iowa	1987-1990	49-41-6-2-2	0.6	1.1	1.8	3.4	2.2	1.0
FGIS new crop, interior,U.S.	1987	32-37-13-8-9	0.6	1.3	2.3	3.6	8.1	1.9
	1988	21-34-20-14-11	0.6	1.3	2.2	3 7	8.1	2.3
	1989	32-39-14-9-6	0.6	1.2	1.9	3.4	6.3	1.6
	1990	48-35-8-5-4	0.6	1.2	2.0	3.1	5.8	1.3
Average		33-36-14-9-8	0.6	1.3	2.2	3.4	7.1	1 8
FGIS exports U.S.	1984	1-88-10-1-0	0.8	1.8	2.4	4.5	2.6	1.9
	1985	3-85-12-1-0	0.8	1.8	2.4	2.6	1.6	1.9
	1986	3-85-9-2-1	0.8	1.8	2.5	2.8	2.9	1.9
	1987	4-88-7-0-1	0.9	1.6	2 6	1.4	13.9	1.7
	1988	4-90-5-0-1	0.9	1.8	2.5	3.1	21.1	1.9
Average		4-87-7-1-1	0.9	1.8	2 5	3.6	10.5	1.9

by mechanical means. Splits are time-consuming to measure in any inspection. The splits determination takes about 35% of the estimated inspection time for a soybean sample (FGIS, 1980).

The inspection data show that U.S. soybeans exported as No. 2 Grade probably do not require a net removal of cleanings, because interior soybeans averaged slightly less than 2% FM. On the other hand, any large-scale reduction in export contract limits for FM (or a redefinition of FM procedures to include more material) would create the need for net cleaning of soybeans. Although small changes in splits limits or splits determination practices would have little effect on exporters, major changes would.

Interior markets, being processor-dominated, do not price on the same basis as export markets. Table 5 is a common discount scale used by domestic processors. Typically, domestic processors do not follow the limits of any one grade. The less important factors, splits and test

Table 4. Splits content of U.S. soybeans by grade

Data Source		Grade Distribution 1-2-3-4-S by %	Splits (%), by Grade 1	2	3	4	S	All
Country elevator inbound, ISU study, Iowa	1983-1984	55-36-7-1-1	—	—	—	—	—	3.0
FGIS new crop, interior, Iowa	1987-1990	49-41-6-2-2	5 3	8.3	12.4	12.6	9.9	7.0
FGIS new crop, interior, U.S.	1987	32-37-13-8-9	5.4	9.6	11.9	11.2	9.1	8.0
	1988	21-34-20-14-11	4.1	5.8	6.6	6.7	7.3	5.6
	1989	32-39-14-9-6	4.9	8.2	10.9	11.1	10.8	7 7
	1990	48-35-8-5-4	3.2	5.3	6.9	6.8	8.0	4.5
Average		33-36-14-9-8	4.4	7.2	9.1	9.0	8.8	6 5
FGIS exports	1984	1-88-10-1-0	5.3	7.3	7.8	8.0	13.0	7.4
	1985	3-85-12-1-0	3.7	5.9	6.7	2.7	0.8	5.9
	1986	3-85-9-2-1	7.4	9.2	10.6	12.6	14.1	9.4
	1987	4-88-7-0-1	6.9	9.2	10.4	8.6	23.8	9.3
	1988	4-90-5-0-1	7.8	10.9	13.3	22.4	42.2	11.1
Average		4-87-7-1-1	7.5	8.5	9.8	10.9	18.8	8.6

Table 5. Processors scale of soybean discounts

Factor	Limit Before Discount	Grade Level of Limit	Approximate Discount Rate
FM	1.0%	1	1% of price per point over 1.0% FM
Splits	20.0%	2	0.5¢/bu/10% over 20% splits (0.05¢/bu/pt)
Test weight	54.0 lb/bu	2	0.5¢/bu/lb under 54 lb/bu
Total damage	2.0%	1	2¢/bu/%pt. over 2.0%
Heat damage	0.2%	1	4¢/bu/%opt. over 0.2%

Source: Ag. Processing, Inc., personal communication.

weight, carry low discounts that begin when No. 2 levels are exceeded. Foreign material and damage are more important because discounts are higher and begin at No. 1 levels.

The splits discount is extremely low. Splits, while rarely grade-determining, are also not an important operational problem for processors. This was verified by Brumm et al. (1990) in studies of processing value of the shriveled, drought-damaged soybeans in 1988. Clearly, the expenditure of significant time for splits determination is not warranted.

Elevator discounts to farmers generally reflect the usual processors scales. Therefore, it is reasonable to assume that the blending of high and low FM soybeans to make export No. 2 soybeans is contributing significantly to net grain handling margins.

Excluding the far northern Minnesota and Wisconsin samples, the data in table 2 indicate that approximately 70% of U.S. soybeans (from the midwest) arrive at their second or third handling location at an average of 1.3% FM. The country elevator data suggest that these beans were delivered to their first point of sale at less than 1% FM, on average.

About 30% of U.S. soybeans are exported; about 600 million bushels. If 70% of these beans come from midwest origins, then the blending of midwest origin beans up to 1.8% FM provides an annual margin contribution of approximately $21 million (0.7 × 600 million bu × 0.008 × $6.00/bu), distributed competitively among participants. This does not mean a net profit of over $20 million because benefits may be lost by competition in other areas, such as bid prices or services.

Any change in grade limits would reduce the $20 million margin contribution to the extent that export contracts tracked the changes. If contract terms were not changed, any additional cleaning on farms or at country elevators to capture operational cost savings (e.g., aeration, spoilage reduction, etc.) would, in the long term, increase the margin contribution of FM because more blending opportunities would be opened to exporters and other intermediate handlers.

CONCLUSIONS

- Soybean FM and splits increase as soybeans move through market channels.
- Midwestern soybeans contain 1 to 2 percentage points less FM than southern soybeans, but random blending is sufficient to make an export average of 2% FM without significant net removal of cleanings.
- Splits levels are well below U.S. No. 2 Grade limits, and splits are not heavily discounted by domestic processors. Therefore, small modifications in splits

procedures for determining splits or changes in factor limits would not have an appreciable economic impact. Tighter limits for splits, or the high proportion of inspector time for splits determination, may not be justified.

- Domestic processors' discount practices for FM and the low FM levels in midwestern soybeans are probably combining to contribute $20 million or more annually to margins in the export handling network. This contribution would be removed or reduced by reductions in FM limits in export contracts.

REFERENCES

Brumm, T. J., C. R. Hurburgh Jr. and L. A. Johnson. 1990. Cracking and dehulling shriveled and wrinkled soybeans. *JAOCS* 67(11):750.

Federal Grain Inspection Service. 1980. Work measurement project report. Washington, D.C.: FGIS, USDA, Room 0642-S, Box 96454.

————. 1988, 1989a, 1990b, 1991, 1987, 1988, 1989, 1990. U.S. soybean crop quality. Washington, D.C.: FGIS, USDA, Room 0642-S, Box 96454.

————. 1989b. 1988 U.S. grain quality report. Washington, D.C.: FGIS, USDA, Room 0642-S, Box 96454.

————. 1991. United States standards for soybeans – Notice of proposed rule-making. *Fed. Reg.* 56(July 2):30342.

Hill, L. D., K. Bender and K. Beachy. 1993. Costs and benefits of cleaning grain. Final Rep. of Spec. Coop. Agreement 58-3AEK-0-80093. Washington, D.C.: ERS, USDA.

Hurburgh Jr., C. R. 1994. Long-term soybean composition patterns and their effects on processing. *JAOCS* (In press).

Hurburgh Jr., C. R., T. J. Brumm, J. M. Guinn and R. A. Hartwig. 1990. Protein and oil patterns in U.S. and world soybean markets. *JAOCS* 67(12):966.

Hurburgh Jr., C. R., L. N. Paynter and S. G. Schmitt. 1987. Quality characteristics of midwestern soybeans. *Applied Engineering in Agriculture* 3(2):159.

Nicholas, C. J. and M. E. Whitten. 1978. Analysis of soybean shipments of U.S. origin and overseas destination. Marketing Research Rep. 1090. Washington, D.C.: ARS-USDA.