FACTORS AFFECTING SOYBEAN OIL AND MEAL YIELDS

by

George W. Kromer

Reprinted from the Fats and Oils Situation, FOS-236, January 1967, by the Economic and Statistical Analysis Division, Economic Research Service

ERS-338

JANUARY 1967

FACTORS AFFECTING SOYBEAN OIL AND MEAL YIELDS

by
George W. Kromer

The sharp rise in U.S. soybean production in recent years has been attended by a rapid increase in the volume of soybeans processed by domestic mills. Crushings rose from 218 million bushels in the 1953/54 marketing year to an estimated 575 million for 1966/67. The balance of the soybean crop is exported or used for planting seed.

Variations in soybean oil and meal yields tend to cause changes in prices and total returns from marketing soybeans and soybean products. Changes in soybean oil supply tend to affect prices of food fats and oils. Changes in the supply of soybean meal impinge mainly on the feed-livestock economy.

This paper is concerned mainly with (1) a discussion of factors causing variations in the total value of products per bushel of soybeans processed; and (2) the oil and protein content of 1966-crop soybeans.

Oil Content Affects Value of Soybeans, But Less So Than Earlier Years

The oil and meal content of soybeans influence the value of products obtained from soybeans. Soybeans vary in oil and protein content not only from one large region to another, but from State to State, and even from farm to farm. In general, soybeans having a high percentage of protein, will have a low percentage of oil, and vice versa.

The amount of meal obtained from processing a bushel of soybeans far exceeds the amount of oil. During 1961-65, meal yield averaged 4.4 times that of oil (47.5 pounds of meal to 10.8 pounds of oil). But during this period, a pound of oil usually sold for about 3 times the price of meal (10.0 cents for oil vs. 3.5 cents for meal). The value of the meal (yield times price) during 1961-65 represented 61 percent of the total product value obtained from a bushel of soybeans, whereas soybean oil accounted for 39 percent of the value (table 21). During the 1950's, the oil and meal product value were more equally distributed. In most other oilseed crops, the meal usually represents a smaller percentage of total value than does the oil.

The U.S. average yield of soybean oil per bushel processed (as computed from Census data) trended upward from 9.5 pounds in 1947 to 11.0 pounds in 1953 and has since remained at about this level. This trend resulted partly from improvements in processing techniques (shift to solvent-extraction) and partly from the development and cultivation of soybeans that contain greater quantities of oil. During 1961-65, the yield of oil ranged between 10.7 and 10.9 pounds. Given efficient extraction processes, the yield of crude oil is determined primarily by the oil content of the soybean seed. The oil content of commercial varieties usually ranges between 18 to 22 percent on a moisture-free basis.

Table 21.--Soybean oil and meal: Yield, price per pound, and value per bushel of soybeans processed, 1947-65

Year beginning September	Yield 1/			Price 2/			Value			Percentage distribution of value	
	Meal	Oil	Meal/Oil	Oil	Meal	Oil/Meal	Oil	Meal	Total	Oil	Meal
	Pounds	Pounds	Ratio	Cents	Cents	Ratio	Dollars	Dollars	Dollars	Percent	Percent
1947	47.5	9.5	5.0	23.4	4.15	5.6	2.22	1.97	4.19	53	47
1948	47.2	9.8	4.8	14.0	3.29	4.3	1.37	1.55	2.92	47	53
1949	46.9	9.9	4.7	12.0	3.28	3.7	1.19	1.54	2.73	44	56
1950	46.8	9.7	4.8	17.9	3.16	5.7	1.74	1.48	3.22	54	46
Average	47.1	9.7	4.8	16.8	3.47	4.8	1.63	1.63	3.26	50	50
1951	46.7	10.0	4.7	11.6	4.07	2.8	1.16	1.90	3.06	38	62
1952	47.3	10.8	4.4	12.0	3.52	3.4	1.30	1.66	2.96	44	56
1953	47.4	11.0	4.3	13.4	3.90	3.4	1.47	1.85	3.32	44	56
1954	45.9	10.9	4.2	12.2	3.06	4.0	1.33	1.40	2.73	49	51
1955	46.2	11.1	4.2	12.5	2.68	4.7	1.39	1.24	2.63	53	47
Average	46.7	10.8	4.3	12.3	3.45	3.6	1.33	1.61	2.94	45	55
1956	47.5	10.9	4.4	12.7	2.36	5.4	1.38	1.12	2.50	55	45
1957	46.8	10.8	4.3	11.0	2.64	4.2	1.19	1.24	2.43	49	51
1958	47.3	10.6	4.5	9.6	2.82	3.4	1.02	1.33	2.35	43	57
1959	46.5	11.0	4.2	8.3	2.77	3.0	.91	1.29	2.20	41	59
1960	47.0	11.0	4.3	11.2	3.00	3.7	1.23	1.41	2.64	47	53
Average	47.0	10.9	4.3	10.6	2.72	3.9	1.15	1.28	2.43	47	53
1961	47.2	10.9	4.3	9.7	3.11	3.1	1.06	1.47	2.53	42	58
1962	46.9	10.7	4.4	8.8	3.57	2.5	.94	1.67	2.61	36	64
1963	48.0	10.9	4.4	8.4	3.58	2.3	.92	1.72	2.64	35	65
1964	47.7	10.9	4.4	11.2	3.48	3.2	1.22	1.66	2.88	42	58
1965	47.5	10.7	4.4	11.8	4.02	2.9	1.26	1.91	3.17	40	60
Average	47.5	10.8	4.4	10.0	3.55	2.8	1.08	1.69	2.77	39	61
1947-65 Average	47.1	10.6	4.4	12.2	3.29	3.7	1.28	1.55	2.83	45	55

1/ Industry averages computed from Census data.

2/ Simple average price per pound using the following quotations: Soybean oil, crude, tank cars, f.o.b., Decatur, Ill.; soybean meal, bulk, Decatur, Ill., quoted as 41 percent protein prior to July 1950, 44 percent beginning July 1950.

Most soybeans in the United States are traded on the basis of official grades. Grades are determined by test weight per bushel, and by percentages of moisture, splits, damaged kernels, and foreign materials. Oil and meal content of soybeans are not factors in the grading system for U.S. soybeans.

The U.S. average yield of soybean meal per bushel of soybeans processed has moved up from about 47 pounds during 1956-60 to 47.5 pounds in 1961-65, possibly reflecting the lower moisture content of soybeans in recent years. During 1961-65, meal yields ranged from 47 to 48 pounds per bushel of soybeans crushed (table 21). In commercial varieties of soybeans, the protein content usually ranges between 40 and 45 percent on a moisture-free basis. The actual yield of meal, like that of oil, is affected by the proportion of foreign material in a bushel of soybeans, as well as the moisture content. These factors are related to the amount of loss that occurs in crushing soybeans, which varies from season to season and from mill to mill.

Oil Content of 1966-Crop Soybeans Tends to be Higher in the South

The USDA published in the December 1966 Crop Production report the results of 1,242 soybean samples that were chemically analyzed for oil and protein content, on a dry-weight basis, by crop-reporting districts. Oil content for the 1966 soybean crop in 15 States averaged 20.4 percent and the protein content was 42.2 percent (table 22). These States accounted for 94 percent of the 1966 production in the United States.

This is the first year that the Statistical Reporting Service reported oil and protein content of soybeans taken from sample fields used in objective yield surveys. Therefore, benchmark data are not available. However, in December 1965, the State of Illinois published oil and protein content data for 1965-crop soybeans in that State. A comparison of 1965 and 1966 data indicates no significant difference in oil and protein content of the 1965 and 1966 Illinois soybean crops:

Illinois Soybeans--Oil and Protein Content

Crop	Composition-dry-weight basis	
	Oil	Protein
	Percent	Percent
1965 1/	21.1	42.8
1966 2/	21.1	42.6

1/ Illinois Special Soybean Bulletin, Illinois Cooperative Crop Reporting Service, December 20, 1965.
2/ December 1966 Crop Production, USDA, SRS.

Table 22.--1966 Crop Soybeans: Oil and protein content for selected states, percent dry weight basis 1/

Area and State	Number of samples	Oil content	Protein content	Area and State	Number of samples	Oil content	Protein content
	Number	Percent	Percent		Number	Percent	Percent
Corn Belt States:				Delta States:			
Illinois	118	21.1	42.6	Arkansas	116	19.8	41.7
Iowa	108	20.3	41.9	Mississippi	105	20.7	41.7
Indiana	118	21.0	43.7	Louisiana	53	21.5	41.5
Ohio	127	20.1	44.1	Tennessee	67	20.1	40.2
Missouri	118	20.0	41.2	Total	341	20.3	41.5
Total	589	20.6	42.5				
				Atlantic States:			
Lake States:				North Carolina	78	19.8	43.0
Minnesota	101	19.4	42.5	South Carolina	59	21.5	40.8
Michigan	24	19.2	43.4	Total	137	20.7	41.8
Total	125	19.4	42.6				
Plains States:							
Kansas	28	20.5	41.4				
Nebraska	22	20.5	39.2				
Total	50	20.5	40.0	Total--15 States	1,242	20.4	42.2

1/ Reported in December 1, 1966, Crop Production, SRS.

Table 23.--1966 Crop Soybeans: Oil and protein content, arrayed by selected states, percent dry weight basis

Arrayed by oil content			Arrayed by protein content		
State	Oil content	Protein content	State	Protein content	Oil content
	Percent	Percent		Percent	Percent
Louisiana	21.5	41.5	Ohio	44.1	20.1
South Carolina	21.5	40.8	Indiana	43.7	21.0
Illinois	21.1	42.6	Michigan	43.4	19.2
Indiana	21.0	43.7	North Carolina	43.0	19.8
Mississippi	20.7	41.7	Illinois	42.6	21.1
Kansas	20.5	41.4	Minnesota	42.5	19.4
Nebraska	20.5	39.2	Iowa	41.9	20.3
Iowa	20.3	41.9	Arkansas	41.7	19.8
Ohio	20.1	44.1	Mississippi	41.7	20.7
Tennessee	20.1	40.2	Louisiana	41.5	21.5
Missouri	20.0	41.2	Kansas	41.4	20.5
Arkansas	19.8	41.7	Missouri	41.2	20.0
North Carolina	19.8	43.0	South Carolina	40.8	21.5
Minnesota	19.4	42.5	Tennessee	40.2	20.1
Michigan	19.2	43.4	Nebraska	39.2	20.5
Range	2.3		Range	4.9	

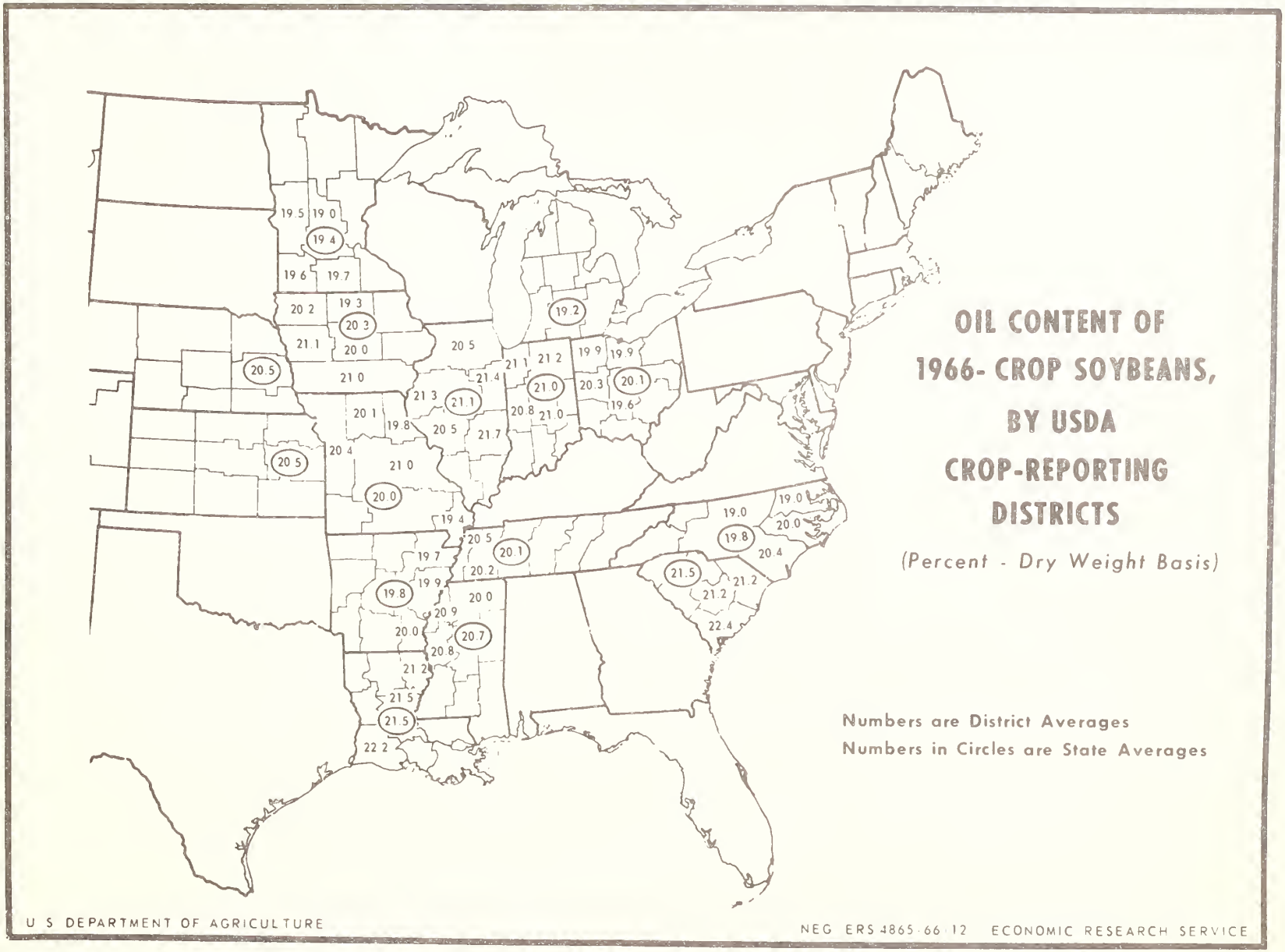
OIL CONTENT OF
1966- CROP SOYBEANS,
BY USDA
CROP-REPORTING
DISTRICTS
(Percent - Dry Weight Basis)
Numbers are District Averages
Numbers in Circles are State Averages
U S DEPARTMENT OF AGRICULTURE
NEG ERS 4865-66 12 ECONOMIC RESEARCH SERVICE

Figure 1

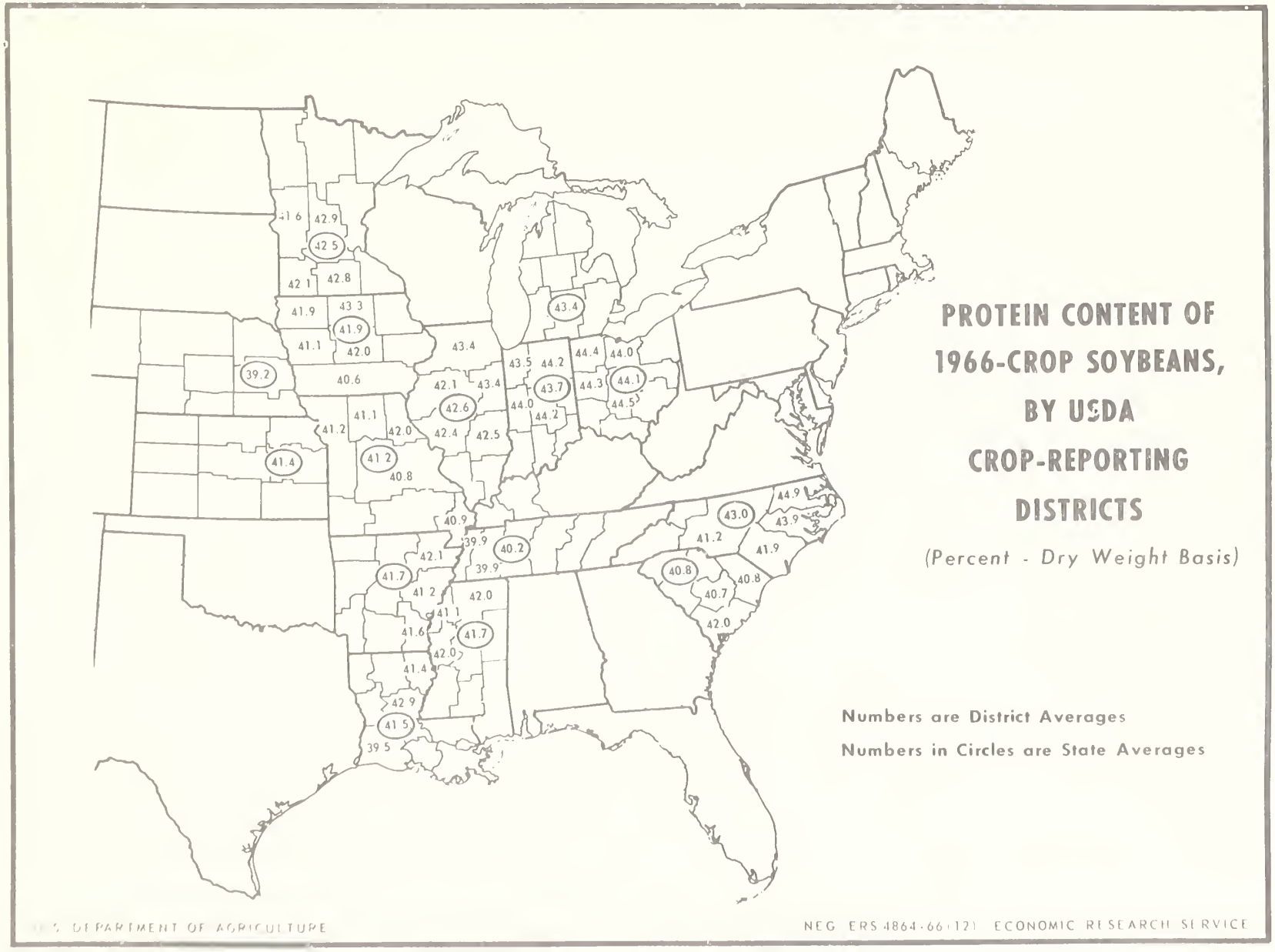
PROTEIN CONTENT OF
1966-CROP SOYBEANS,
BY USDA
CROP-REPORTING
DISTRICTS
(Percent - Dry Weight Basis)
Numbers are District Averages
Numbers in Circles are State Averages
U.S. DEPARTMENT OF AGRICULTURE
NEG. ERS 4864-66 (12) ECONOMIC RESEARCH SERVICE

Figure 2

Analysis of the SRS 1966 soybean data indicates that oil content shows a general tendency to increase from north to south. Conversely, protein content tends to increase from south to north. This is generally evident within the individual States and between States.

Oil content of 1966-crop soybeans was lowest in Minnesota and Michigan and highest in Louisiana and South Carolina--an average difference of about 11 percent. However, protein content in the 2 northern States was about 3 percent higher than in the 2 southern States. In the major soybean producing areas of the Corn Belt, Illinois and Indiana soybeans were highest in oil content while the eastern and western sectors of the Belt were lower. Figure 1 shows the average oil content of 1966 soybeans by crop-reporting districts.

In the Delta region, the oil content of 1966-crop soybeans was lowest in Arkansas and Tennessee and highest in Mississippi and Louisiana. In the Atlantic Coast States, oil content showed a steady uptrend from 19.0 percent in the northern districts of North Carolina to 22.4 percent in the southern districts of South Carolina--representing an 18 percent increase.

Protein content of 1966-crop soybeans generally decreased as areas of production extended from north to south. Among the major producing States, protein content was highest in Ohio and lowest in South Carolina and Tennessee. In the Corn Belt States, protein content declined as production areas extended from east to west--from 44.1 percent in Ohio to 41.2 percent in Missouri. Figure 2 shows the average protein content of 1966 soybeans by crop-reporting districts.

While the percentage of oil content is highest in the Southern soybean areas, the North Central States average higher in both seed yield and oil yield per acre. Acreage planted to soybeans is influenced more by seed yield per acre than by the percentage of oil content or oil yield per acre.

* * * * * * * * * * * * * * * * * * *