## 2022 NORTH DAKOTA SOYBEAN QUALITY SURVEY

**Northern Crops Institute** 





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North Dakota Soybean Council



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### SUMMARY

North Dakota generally experienced dry and warm weather conditions for soybean crops throughout much of 2022. North Dakota saw below to above average precipitation following the previous dry fall harvest. Spring started the year off on the cool side with precipitation above average. With the wet conditions, spring planting was later than average which resulted in later than average emergence. Summer brought warm and dry conditions allowing for crops to bloom at a rate similar to the five-year average. With continued warm and dry summer conditions the setting of pods and dropping of leaves lagged behind the five-year average. Weather conditions continued to be warm and dry into the fall which allowed for a swift soybean harvest ending in early November.

Due to wet spring planting conditions, 2022 had a decrease in acres planted and harvested from the previous year. With a cool wet spring followed by generally dryer and warmer than average conditions in summer and autumn, yield, production, test weight and moisture all increased from 2021. Palmitic, stearic, oleic and linolenic fatty acids increased, and linoleic was lower than 2021. Sucrose, raffinose and stachyose were lower than 2021. Protein was higher than 2021 while oil and fiber were lower and ash was the same.

In comparison to the 10-year average, 2022 soybeans had higher test weight, protein, oil, palmitic acid, stearic acid and stachyose. Fiber, ash, oleic acid, linoleic acid, linolenic acid, sucrose and raffinose were lower than the 10-year average.

The total amino acids were slightly lower than 2021 and slightly lower than the 10-year average. The Critical Amino Acid Value (CAAV) of the 2022 soybean crop is lower than the previous year and the 10-year average.

# **SAMPLE COLLECTION**

Nine agricultural districts serve as the basis for a comparison of crop quality data (Figure 1). A total of 254 samples were collected from 44 counties and nine agricultural districts in North Dakota by the United States Department of Agriculture-National Agricultural Statistics Service (USDA-NASS). The number of samples collected from each county is determined based on the soybean production from previous year which is calculated by the NASS.



Figure 1. North Dakota agricultural districts

Table 1. North Dakota agricultural districts, number of samples and percent distribution

District	Abbreviation	Number of Sample	% Distribution
Central	CENT	37	15
East Central	EC	50	20
North Central	NC	25	10
North East	NE	41	16
North West	NW	21	8
South Central	SC	15	6
South East	SE	51	20
West Central	WC	10	4
South West	SW	4	2
	Total	254	100

## **ANALYSIS METHOD**

Moisture, color, test weight, proximate (protein, oil, ash, and fiber), soluble sugar, fatty acid profile, and amino acid profile were analyzed as quality attributes that characterize North Dakota soybeans. Test weight and moisture were analyzed using a DICKEY-John Grain Analysis Computer GAC 2500 UGMA (Auburn, IL), employing the AACC method 55-10 (AACC, 1999). These tests were analyzed immediately after the soybean samples were received.

Color analyses were performed with a Minolta Color Analyzer CR-410 (Ramsey, NJ). CIE 1976 (L\*, a\*, b\*) color space, where brightness (L\*), redness (a\*) and yellowness (b\*) values were determined. Proximate, soluble sugar, fatty acid and amino acid profiles were evaluated using a Perten DA7250 Near-InfraRed Analyzer (NIRS) (Huddinge, Sweden), with a calibration developed at the University of Minnesota and funded by the United Soybean Board. A subset of 15 samples in duplicate was sent to two laboratories for analysis by AOCS-approved analytical methods to adjust the bias of the NIR and validate the constituent predictions. Submitted soybean samples were ground into coarse flour using a Perten Laboratory Mill 3610, and analyzed on the NIR to obtain proximate (protein, oil, fiber and ash), soluble sugar, fatty acid and amino acid profiles. Whole beans were analyzed on the GAC 2500 to obtain initial moisture, and test weight.

The NIR method was also utilized by Miller-Garvin and Naeve (2020) for the United States Soybean Crop Quality Report funded by the United States Soybean Export Council (USSEC). Through a collaborative effort as a soybean consortium, the North Dakota soybean quality data collected from the Perten DA 7250 contributes to the soybean calibration along with various universities in the nation. The calibration is updated annually reflecting the data collected from the previous crop year's samples.



Image 1: Perten Lab Mill 3610 used to grind soybeans in preparation for NIR analysis

## **2022 SOYBEAN PRODUCTION**

According to the USDA National Agricultural Statistics Service (USDA-NASS), the national soybean production for 2022, was 4.3 billion bushels (Bu) or 116.4 million metric tons (MT), which is 3.6% lower than the previous year and 3.4% lower than the 2018 record production. Nationally, soybean acres planted increased 0.3% from the previous year to 87.5 million or 35.4 million hectare (HA) and acres harvested stayed the same from the previous year at 86.3 million (34.9 million HA).

Soybean yields in the U.S. had been steadily increasing since 2012 to a record high in 2017 at 51.9 bushels per acre. The national soybean yield average in 2022 was 49.5 bushels per acre compared to 51.4 bushels per acre in 2021 and 51.0 bushels per acre in 2020.

North Dakota acres planted increased in 2022. Production and yield in North Dakota increased in 2022. The 2022 North Dakota production, acres harvested, and yield data are presented in Figure 2. North Dakota soybean production in 2022 was 198 million Bu or 5.4 million MT which is a 9.3% increase from 2021. Acres planted was 5.7 million (2.3 million HA), a decrease of 27.2% from 2021 and acres harvested was 5.7 million or 2.3 million HA, a decrease of 20.7% from the previous year. This resulted in a yield of 35 Bu per acre (2.4 MT per HA), an increase of 37.3% from the previous year. In 2022, North Dakota moved ahead to 8th place among states in soybean production, dropped to 7th in acres of soybeans harvested, and moved up to 25th in bushels per acre. (USDA-NASS, 2022)



Figure 2. North Dakota soybean yield, harvest and production data between 2013 and 2022.\*

### **2022 NORTH DAKOTA WEATHER AND CROP SUMMARY**

While much of the U.S. experienced below to much below average precipitation, most major soybean production regions in North Dakota experienced above average precipitation. Figure 3 below (National Oceanic and Atmospheric Administration - NOAA) shows that much of North Dakota saw between below average to above average precipitation, following below average precipitation in the previous year.



Figure 3. 2022 Percent Precipitation Compared to Long-Term Average

According to the USDA-NASS Crop Progress and Condition report, North Dakota generally experienced fair to good weather conditions throughout the year. The 2022 season started with a cold and wet spring. According to the North Dakota State Climate Office (NDSCO), the average temperature of 2022 spring was 37.8°F (3.2°C), which was 2.8°F (1.6°C) colder than the 29-year average from 1991 to 2020. The average precipitation was 7.8 inches (19.81cm), which was 3.09 inches (7.85cm) more than the 29-year average. In contrast, summer months brought warmer than average temperatures. The average temperature and precipitation of 2022 summer were 68.2°F (20.1°C) and 6.57 inches (16.69cm) which were 1.5°F (0.8°C) warmer and 2.05 inches (5.21cm) less than the 29-year average, respectively (NDSCO). The average fall temperature and precipitation was 43.5°F (6.4°C) and 1.97 inches (5.00cm), which were 0.5°F (0.3°C) warmer and 2.03 inches (5.16cm) less than the 29-year average, respectively.

Soybean planting progress lagged behind the 5-year average in most areas as shown in Figure 4. According to the USDA-NASS, June 5, 2022 Crop Progress and Condition Report, soybeans at that time were 41% planted, compared to 94% the previous year and 85% five-year average. Emergence also lagged behind with the USDA-NASS June 26 Crop Progress Report showing 80% of the soybeans emerged, compared to 96% the previous year and a five-year average of 94%.



Figure 4. Planting progress of 2022 North Dakota soybeans presented by % completion

During the warmer but dryer than average summer season, crops showed quick progress with bloom following the five-year average. Setting of pods lagged behind the five-year in mid-summer but caught up to the five-year average by late August. This was followed by slightly slower than average dropping of leaves and a swift harvest. According to the USDA-NASS November 6 Crop Progress Report, harvest was 100% completed, which was 2% further than the previous year and 11% further than the five-year average (Figure 5).



Figure 5. Harvest progress of 2022 North Dakota soybeans presented by % completion

#### **2022 NORTH DAKOTA SOYBEAN** QUALITY RESULTS

A summary of the 2022 North Dakota soybean quality results is presented in Table 2 with average, maximum, minimum and standard deviation (STDEV) of each parameter. The initial moisture content of samples received varied from a minimum of 7.1% to a maximum of 19.4%, with six samples above 15% moisture content.

**Table 2.** Summary of 2022 North Dakota soybean with average, maximum, minimum and standarddeviation (STDEV)

Proximate Analysis	Average	Maximum	Minimum	STDEV
Moisture (%)	11.0	19.4	7.1	1.8
Test weight (lb/bu)	57.7	60.3	54.5	1.0
Protein <sup>1</sup>	34.2	38.4	26.7	1.2
Oil <sup>1</sup>	17.8	21.3	16.1	0.7
Fiber <sup>2</sup>	5.2	6.7	4.6	0.4
Ash <sup>2</sup>	5.0	5.5	4.5	0.2
Color				
L*	62.0	65.5	58.6	1.1
a*	3.3	5.2	1.4	0.8
b*	19.6	23.3	15.0	1.2
Fatty Acid				
Palmitic acid <sup>2</sup>	11.9	13.2	10.0	0.5
Stearic acid <sup>2</sup>	4.8	5.6	4.0	0.3
Oleic acid <sup>2</sup>	19.1	28.3	13.0	2.9
Linoleic acid <sup>2</sup>	52.5	58.8	43.5	2.7
Linolenic acid <sup>2</sup>	8.6	11.2	5.7	1.1
Soluble Sugars				
Sucrose <sup>2</sup>	3.3	5.1	1.8	0.6
Raffinose <sup>2</sup>	0.3	0.8	0.1	0.2
Stachyose <sup>2</sup>	4.2	5.3	3.5	0.4
Amino Acid	-	No. alat		
Aspartic acid <sup>2</sup>	4.3	4.8	3.3	0.2
Threonine <sup>2</sup>	1.5	1.6	1.2	0.0
Serine <sup>2</sup>	1.8	2.0	1.4	0.1
Glutamic acid <sup>2</sup>	6.8	7.7	5.1	0.3
Proline <sup>2</sup>	2.0	2.2	1.5	0.1
Glycine <sup>2</sup>	1.6	1.8	1.3	0.1
Alanine <sup>2</sup>	1.6	1.8	1.4	0.0
Cysteine <sup>2</sup>	0.6	0.7	0.5	0.0
Valine <sup>2</sup>	1.9	2.1	1.5	0.1
Methionine <sup>2</sup>	0.5	0.6	0.5	0.0
Isoleucine <sup>2</sup>	1.8	2.0	1.5	0.1
Leucine <sup>2</sup>	2.9	3.3	2.4	0.1
Tyrosine <sup>2</sup>	1.3	1.5	1.1	0.0
Phenylalanine <sup>2</sup>	1.9	2.2	1.5	0.1
Lysine <sup>2</sup>	2.5	2.8	1.3	0.1
Histidine <sup>2</sup>	1.0	1.1	0.8	0.0
Arginine <sup>2</sup>	2.8	3.3	2.0	0.1
Tryptophan <sup>2</sup>	0.4	0.5	0.4	0.0
1-13% moisture basis.	2-percent	dry matter ba	isis	

### SOYBEAN QUALITY RESULTS COMPARISON BY YEAR

Comparison of soybean quality by crop year from 2013 to 2022 is presented in Table 3. Average moisture of initially submitted 2022 crop is 11.0%, 11.1% higher and 5.8% lower than the previous year and the 10-year average, respectively. Test weight is 57.7 pounds per Bu (743 Kg/m3), 0.9 and 0.5% higher than the previous year and the 10-year average, respectively. Protein content is 34.2%, which is 7.0 and 2.7% higher than the previous year and the 10-year average respectively. Oil content is 17.8%, 2.6% lower than the previous year and 0.3% higher than the 10-year average.

Proximate Analysis	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	AVG <sup>3</sup>	STDEV
Moisture (%)	13.2	12.7	10.6	12.3	11.5	12.3	14.5	10.5	9.9	11.0	11.7	1.6
Test weight (lb/bu)	56.8	57.6	57.6	57.8	57.3	57.4	57.2	58.2	57.2	57.7	57.4	0.4
Protein <sup>1</sup>	32.9	33.7	33.4	33.7	33.5	33.2	33.5	33.8	31.9	34.2	33.3	0.5
Oil <sup>1</sup>	18.1	16.5	17.1	16.8	19.4	16.6	18.0	18.2	18.2	17.8	17.7	0.9
P + O average <sup>1</sup>	51.0	50.2	50.6	50.5	52.9	49.8	51.5	51.9	50.2	51.9	51.0	0.9
Fiber <sup>2</sup>	11.4	13.7	7.0	6.9	6.4	7.9	5.5	5.8	5.9	5.2	7.6	2.8
Ash <sup>2</sup>	5.3	5.1	5.4	5.1	5.1	4.9	5.1	5.0	5.0	5.0	5.1	0.1
<sup>1-</sup> 13% moisture basis,	<sup>2</sup> -percent	dry matt	er basis <sup>3</sup>	-10-year	average							

Table 3. Proximate content of 2021 North Dakota soybean between 2013 and 2022 with average and standard deviation (STDEV)

## **AMINO ACIDS**

Comparison of 18 amino acids between 2021 and 2022 along with 10-year average and standard deviation (STDEV) is presented in Table 4 while Table 10 presents amino acids by North Dakota agricultural districts. Table 4 presents total amino acids as well as sums of 5 and 10 essential amino acids (EAA) and Critical Amino Acid Value (CAAV). The formulae for the amino acid calculations are as follows:

5-EAA = Sum of % Threonine, % Cysteine, % Methionine, % Lysine, % Tryptophan, 10-EAA = Sum of the 5-EAA plus % Valine, % Isoleucine, % Leucine, % Phenylalanine and % Histidine, CAAV = % Lysine + % Threonine + % Tryptophan + (% Methionine + % Cysteine) divided by (/) Total Amino Acids = Critical Amino Acid Value (CAAV)

These values can be used as an indicator of protein quality whereas crude protein percentage indicates protein quantity.

Northern-grown soybeans tend to have a favorable essential amino acid profile. Research indicates that soybeans with lower crude protein content tend to have a higher proportion of 5 critical amino acids (5-EAA: Threonine, Cysteine, Methionine, Lysine, and Tryptophan) (Miller-Garvin and Naeve, 2021). The combined sum for 5-EAA in 2022 is 14.9% which is 0.2% lower than 2021 and the same as the 10-year average. The CAAV is 0.2% greater than the previous year and the 10-year average.

**Table 4.** Amino acid contents of 2022 North Dakota soybean in 2021 and 2022 with average and standard deviation (STDEV)

	2021	2022	AVG⁵	STDEV⁵					
Aspartic acid <sup>1</sup>	4.2	4.3	4.3	0.1					
Threonine <sup>1</sup>	1.4	1.5	1.5	0.0					
Serine <sup>1</sup>	1.6	1.8	1.7	0.1					
Glutamate <sup>1</sup>	6.3	6.8	6.6	0.3					
Proline <sup>1</sup>	1.8	2.0	1.9	0.1					
Glycine <sup>1</sup>	1.6	1.6	1.7	0.1					
Alanine <sup>1</sup>	1.6	1.6	1.6	0.0					
Cysteine <sup>1</sup>	0.6	0.6	0.6	0.0					
Valine <sup>1</sup>	1.9	1.9	1.9	0.1					
Methionine <sup>1</sup>	0.5	0.5	0.5	0.0					
Isoleucine <sup>1</sup>	1.9	1.8	1.8	0.1					
Leucine <sup>1</sup>	2.8	2.9	2.9	0.1					
Tyrosine <sup>1</sup>	1.4	1.3	1.4	0.1					
Phenylalanine <sup>1</sup>	1.9	1.9	2.0	0.1					
Lysine <sup>1</sup>	2.5	2.5	2.5	0.1					
Histidine <sup>1</sup>	1.0	1.0	1.0	0.1					
Arginine <sup>1</sup>	2.6	2.8	2.7	0.1					
Tryptophan <sup>1</sup>	0.3	0.4	0.4	0.1					
Total AA <sup>2</sup>	36.1	37.5	37.0	1.1					
5 EAA <sup>3</sup> (% of 18 AA)	15.1	14.9	14.9	0.4					
10 EAA <sup>4</sup> (% of 18 AA)	41.5	40.5	40.8	0.6					
Critical amino acid value <sup>6</sup>	4.3	4.5	4.4	0.1					
<sup>1</sup> -Percent dry matter basis, <sup>2</sup> -Sum of 18AA, <sup>3</sup> -Sum of threonine, cysteine, methionine, lysine, tryptophan, <sup>4</sup> -Sum of the 5 EAA plus valine, isoleucine, leucine, phenylalanine and histidine, <sup>5</sup> -10-year average and standard deviation, <sup>6</sup> -Sum of lysine, threonine, tryptophan pluse the sum of methionine and cysteine divided by total AA									

## PROTEIN

A summary of crude protein percentages between 2013 and 2022 along with 10-year average of the U.S. and North Dakota soybeans is presented in Figure 6. The North Dakota 2022 soybean protein content average was 34.2% which is 7.0% higher than the previous year, 2.7% higher than the 10-year average and the same as the U.S. 10-year average. Soybean protein content in 2022 by agricultural districts is shown in Table 7.



**Figure 6.** Percent protein (13% moisture basis) of North Dakota soybean between 2013 and 2022 and the 10-year average of North Dakota and the U.S.

# OIL

A summary of oil content between 2013 and 2022 along with the 10-year average of the U.S. and North Dakota soybeans is presented in Figure 7. The North Dakota 2022 oil content was 17.8% which is 2.6% lower than samples measured in 2021, 0.3% higher than the North Dakota 10-year average and 7.3% lower than the U.S .10-year average. Soybean oil content in 2022 by agricultural districts is shown in Table 7.



**Figure 7.** Percent oil (13% moisture basis) of North Dakota soybean between 2013 and 2022 and the 10-year averages of North Dakota and the U.S.

## FATTY ACIDS

Table 5 indicates the 2022 crop had an increase in palmitic, stearic, oleic and linolenic fatty acid contents and a decrease in linoleic fatty acid content compared to the previous year. Palmitic acid is 1.1% greater than the previous year and 0.1% more than the 10-year average. Stearic acid is 0.5% and 0.2% greater than the previous year and the 10-year average respectively. Oleic acid is 2.1% greater than the previous year and 0.3% less than the 10-year average. Linoleic acid has a decrease of 5.2% and 2.3% from the previous year and the 10-year average respectively. Linolenic increased 1.3% from the previous year and is 0.6% less than the 10-year average.

Unsaturated fatty acids (oleic, linoleic and linolenic) are the major fatty acids that impact nutrition through the consumption of soybeans (Huth, 1995). As shown in Table 8, unsaturated fatty acids were more variable across districts than the saturated fatty acids (palmitic and stearic).

**Table 5.** Fatty Acid content of 2022 North Dakota soybean between 2013 and 2022 with average and standard deviation (STDEV)

Fatty Acids	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	AVG <sup>2</sup>	STDEV
Palmitic <sup>1</sup>	11.4	11.0	12.4	12.6	11.4	12.2	12.5	11.1	10.8	11.9	11.8	0.7
Stearic <sup>1</sup>	4.6	3.8	4.3	5.3	4.7	5.3	4.4	4.4	4.3	4.8	4.6	0.5
Oleic <sup>1</sup>	19.2	15.8	20.3	20.8	19.5	22.9	18.6	18.7	17.0	19.1	19.4	2.1
Linoleic <sup>1</sup>	51.9	55.0	51.5	59.0	50.9	57.4	59.4	53.6	57.7	52.5	54.8	3.3
Linolenic <sup>1</sup>	9.4	10.7	8.4	9.5	8.8	9.4	12.3	8.8	7.3	8.6	9.2	1.4
<sup>1</sup> -percent drv n	natter ba	sis <sup>2</sup> -10-	vear ave	erade								

### **SOLUBLE SUGARS**

Table 6 indicates that the 2022 North Dakota sucrose content was 3.3%, 0.9% less than the previous year and 2.8% less than the 10-year average. Raffinose content was 0.3%, 0.1% less than the previous year and 0.2% less than the 10-year average. Stachyose content was 4.2%, 0.4% less than the previous year and 0.2% greater than the 10-year average. Comparison by districts in Table 9 shows sucrose values of 2022 crops ranged from 3.0 - 4.2%, raffinose ranged from 0.2 - 0.6% and stachyose values ranged from 3.9 - 4.7%.

**Table 6.** Soluble Sugar content of 2022 North Dakota soybean between 2013 and 2022 with average and standard deviation (STDEV)

Soluble Sugars	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	AVG <sup>2</sup>	STDEV	
Sucrose <sup>1</sup>	6.1	7.3	6.1	6.4	6.4	7.2	7.0	4.9	4.2	3.3	6.1	1.0	
Raffinose <sup>1</sup>	0.6	0.6	0.6	0.5	0.5	0.5	0.6	0.5	0.4	0.3	0.5	0.1	
Stachyose <sup>1</sup>	5.9	3.6	2.8	4.3	2.9	6.0	4.1	3.5	4.6	4.2	4.0	1.3	
<sup>1</sup> -percent dry matter basis <sup>2</sup> -10-year average													

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#### 2022 NORTH DAKOTA SOYBEAN QUALITY RESULTS BY AGRICULTURAL DISTRICTS

**Table 7.** Proximate of 2022 North Dakota soybeans as well as 10-year average and standard deviation (STDEV) by the North Dakota agricultural districts

	District	CENT	EC	NC	NE	NW	SC	SE	SW	WC
Protein <sup>1</sup>	2022	34.1	33.8	33.9	34.1	34.5	33.2	34.7	34.4	34.2
	Average <sup>3</sup>	33.5	33.4	33.1	33.1	33.5	33.2	33.6	33.2	33.5
	STDEV	0.6	0.7	0.6	0.7	1.1	0.7	0.7	1.4	0.8
Oil <sup>1</sup>	2022	17.7	17.8	17.7	17.7	17.5	18.1	17.9	17.3	17.5
	Average <sup>3</sup>	17.8	18.0	17.8	17.8	17.4	18.1	18.1	18.4	17.9
	STDEV	1.2	1.3	1.3	1.1	1.3	1.4	1.3	0.8	1.5
Fiber <sup>2</sup>	2022	5.4	5.2	5.0	5.0	5.1	5.9	4.9	5.5	5.1
	Average <sup>3</sup>	7.6	7.6	7.6	7.6	7.1	7.7	7.5	5.8	7.6
	STDEV	2.7	2.7	2.6	2.6	2.5	2.6	2.7	0.3	2.7
Ash <sup>2</sup>	2022	4.9	5.0	5.1	5.1	5.1	4.8	5.2	4.9	5.1
	Average <sup>3</sup>	5.1	5.1	5.1	5.1	5.0	5.1	5.1	5.1	5.1
	STDEV	0.1	0.1	0.1	0.1	0.2	0.2	0.1	0.2	0.1
<sup>1</sup> -13% m	oisture basis	, <sup>2</sup> - Percer	nt dry mat	ter basis	<sup>3</sup> -10-yea	r average	2			

**Table 8.** Fatty acids of 2022 North Dakota soybeans along with 10-year average and standard deviation (STDEV) by North Dakota agricultural districts

	District	CENT	EC	NC	NE	NW	SC	SE	SW	WC
Palmitic <sup>2</sup>	2022	11.7	11.7	12.1	12.1	11.8	11.3	12.0	11.6	11.8
	Average <sup>3</sup>	11.7	11.8	11.6	11.7	11.6	11.6	11.8	11.4	11.6
	STDEV	0.7	0.6	0.7	0.8	1.0	0.7	0.5	0.8	0.7
Stearic <sup>2</sup>	2022	4.7	4.7	5.0	4.9	4.8	4.5	4.9	4.6	4.9
	Average <sup>3</sup>	4.6	4.5	4.7	4.6	4.8	4.6	4.5	3.8	4.7
	STDEV	0.5	0.4	0.5	0.5	0.6	0.5	0.4	1.3	0.5
Oleic <sup>2</sup>	2022	19.5	19.0	20.1	17.0	19.5	23.1	18.7	21.1	20.9
	Average <sup>3</sup>	19.2	18.8	19.5	18.4	19.2	20.5	19.2	19.8	20.1
	STDEV	2.0	1.9	2.5	2.3	2.5	2.6	1.6	0.8	2.2
Linoleic <sup>2</sup>	2022	52.4	52.6	51.3	54.0	51.9	50.2	53.2	50.3	50.8
	Average <sup>3</sup>	54.8	55.1	54.4	55.4	54.9	53.9	55.1	54.8	54.0
	STDEV	3.1	3.2	3.4	3.2	3.0	3.3	3.0	3.2	3.2
Linolenic <sup>2</sup>	2022	8.7	8.8	8.7	8.9	8.6	8.0	8.2	8.5	8.5
	Average <sup>3</sup>	9.4	9.4	9.4	9.6	9.4	8.9	9.2	8.5	9.0
	STDEV	1.4	1.3	1.3	1.2	1.2	1.4	1.4	2.1	1.4
<sup>1</sup> -13% moi	sture basis,	<sup>2</sup> - Percent	t dry mat	ter basis	<sup>3</sup> -10-yea	r averag	e			

**Table 9.** Soluble sugar of 2022 North Dakota soybeans as well as 10-year average and standard deviation (STDEV) by North Dakota agricultural districts

	District	CENT	EC	NC	NE	NW	SC	SE	SW	WC		
Sucrose <sup>2</sup>	2022	3.7	3.5	3.1	3.3	3.2	4.2	3.0	3.6	3.0		
	Average <sup>3</sup>	6.0	5.9	6.1	6.1	6.1	5.9	5.6	4.8	5.9		
	STDEV	1.3	1.2	1.4	1.3	1.4	1.2	1.3	1.4	1.5		
Raffinose <sup>2</sup>	2022	0.4	0.3	0.2	0.3	0.3	0.6	0.2	0.4	0.2		
	Average <sup>3</sup>	0.5	0.5	0.5	0.5	0.5	0.6	0.5	0.5	0.5		
	STDEV	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1		
Stachyose <sup>2</sup>	2022	4.4	4.2	4.0	4.1	4.0	4.7	4.0	4.3	3.9		
	Average <sup>3</sup>	4.2	4.2	4.3	4.2	4.0	4.3	4.2	4.1	4.2		
	STDEV	1.1	1.1	1.0	1.0	0.9	1.1	1.0	0.5	1.0		
<sup>1</sup> -13% moisture	<sup>1</sup> -13% moisture basis, <sup>2</sup> - Percent dry matter basis <sup>3</sup> -10-year average											

**Table 10.** Amino acid of 2022 North Dakota soybean as well as 10-year average and standard deviation (STDEV) by North Dakota agricultural districts

	District	CENT	EC	NC	NE	NW	SC	SE	sw	WC
Aspartic acid <sup>2</sup>	2022	4.3	4.3	4.3	4.3	4.4	4.2	4.4	4.4	4.3
	Average <sup>3</sup>	4.3	4.3	4.2	4.2	4.3	4.3	4.3	4.2	4.3
	STDEV	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.2	0.2
Threonine <sup>2</sup>	2022	1.5	1.5	1.5	1.5	1.5	1.4	1.5	1.5	1.5
	Average <sup>3</sup>	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.4	1.5
	STDEV	0.0	0.1	0.0	0.1	0.1	0.1	0.0	0.0	0.1
Serine <sup>2</sup>	2022	1.8	1.8	1.8	1.8	1.8	1.7	1.8	1.8	1.8
	Average <sup>3</sup>	1.9	1.9	1.9	1.9	1.9	1.9	2.0	1.9	1.9
	STDEV	1.6	1.6	1.6	1.6	1.6	1.6	1.7	1.6	1.6
Glutamic acid <sup>2</sup>	2022	6.8	6.7	6.7	6.8	6.9	6.6	6.9	6.9	6.8
	Average <sup>3</sup>	2.4	2.4	2.4	2.4	2.4	2.3	2.4	2.4	2.4
	STDEV	2.0	2.0	2.0	2.0	2.0	1.9	2.0	2.0	2.0
Proline <sup>2</sup>	2022	2.0	1.9	2.0	2.0	2.0	1.9	2.0	2.0	2.0
	Average <sup>3</sup>	2.1	2.1	2.1	2.2	2.2	2.1	2.2	2.2	2.2
	STDEV	1.7	1.6	1.6	1.7	1.7	1.6	1.7	1.7	1.7
Glycine <sup>2</sup>	2022	1.6	1.6	1.6	1.6	1.7	1.6	1.7	1.6	1.7
	Average <sup>3</sup>	1.6	1.7	1.6	1.6	1.6	1.7	1.6	1.6	1.6
	STDEV	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Alanine	2022	1.6	1.6	1.6	1.6	1.7	1.6	1.7	1.7	1.7
	Average	1.6	1.7	1.6	1.6	1.6	1.6	1.6	1.6	1.6
Questa in a <sup>2</sup>	SIDEV	0.0	0.1	0.1	0.1	0.1	0.0	0.0	0.0	0.1
Cysteine	2022	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6
	Average	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6
Valino <sup>2</sup>	31DEV	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
vanne	2022 Avorago <sup>3</sup>	1.9	1.9	1.9	1.9	1.9	1.9	1.9	1.9	1.9
	STDEV	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Methionine <sup>2</sup>	2022	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
meenonne	Average <sup>3</sup>	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
	STDEV	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Isoleucine <sup>2</sup>	2022	1.8	1.8	1.8	1.8	1.8	1.8	1.9	1.8	1.8
	Average <sup>3</sup>	1.8	1.8	1.8	1.8	1.8	1.8	1.8	1.8	1.8
	STDEV	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Leucine <sup>2</sup>	2022	2.9	2.9	2.9	2.9	3.0	2.9	3.0	3.0	3.0
	Average <sup>3</sup>	2.9	2.9	2.9	2.9	2.9	2.9	3.0	2.8	2.9
	STDEV	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Tyrosine <sup>2</sup>	2022	1.3	1.3	1.3	1.3	1.3	1.3	1.4	1.3	1.3
	Average <sup>3</sup>	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.3	1.4
	STDEV	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.1
Phenylalanine <sup>2</sup>	2022	1.9	1.9	1.9	1.9	2.0	1.9	2.0	2.0	2.0
	Average <sup>3</sup>	2.0	2.0	1.9	1.9	1.9	1.9	2.0	1.9	2.0
	STDEV	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Lysine <sup>2</sup>	2022	2.5	2.5	2.5	2.5	2.5	2.5	2.6	2.5	2.5
	Average <sup>3</sup>	2.6	2.5	2.5	2.5	2.6	2.5	2.6	2.5	2.5
-	STDEV	0.1	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.1
Histidine <sup>2</sup>	2022	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
	Average <sup>3</sup>	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
	SIDEV	0.1	0.1	0.1	0.0	0.1	0.1	0.1	0.1	0.1
Arginine <sup>2</sup>	2022	2.8	2.8	2.8	2.8	2.9	2.7	2.9	2.8	2.9
	Average <sup>3</sup>	2.7	2.7	2.7	2.7	2.7	2.7	2.7	2.7	2.7
Transford?	STDEV	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.2	0.2
Typtopnan*	2022	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.5
	STDEV	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4
1.400/	STDEV	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
-13% moisture	pasis, Pe	rcent dry n	nanter ba	sis °-10-	yearave	erage				

## **ACKNOWLEDGEMENTS**

The Northern Crops Institute would like to thank the North Dakota Soybean Council for providing funding for the project, and would like to acknowledge the support from Darin Jantzi and Kara Hagemeister at the USDA-NASS.

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#### 2022 NORTH DAKOTA SOYBEAN QUALITY SURVEY

Northern Crops Institute





**FUNDING PROVIDED BY** North Dakota Soybean Council