Quality of the United States Soybean Crop: 2020

Seth Naeve and Jill Miller-Garvin
University of Minnesota

Soybean Outlook Conferences
November 17-19, 2020

Outline

- 2020 Weather highlights
- Historical protein and oil variation
- 2020 Soybean Survey results
  - Protein and Oil
  - Physical Characteristics
  - Amino Acids
  - Sucrose

CRITICAL WEATHER EVENTS

Environmental impacts on soybean Protein and oil

- Location-specific environmental impacts (latitude, climate, and soil type) affect long-term quality trends
- However, annual variation in weather patterns affects year-over-year variation in soybean quality
- Rainfall patterns appear to have the greatest impact on soybean quality
- Excessive rainfall early in the season appears to reduce protein deposition in the seed
- Drought conditions during the seed-filling stages exacerbate this condition

2020 Soybean Production

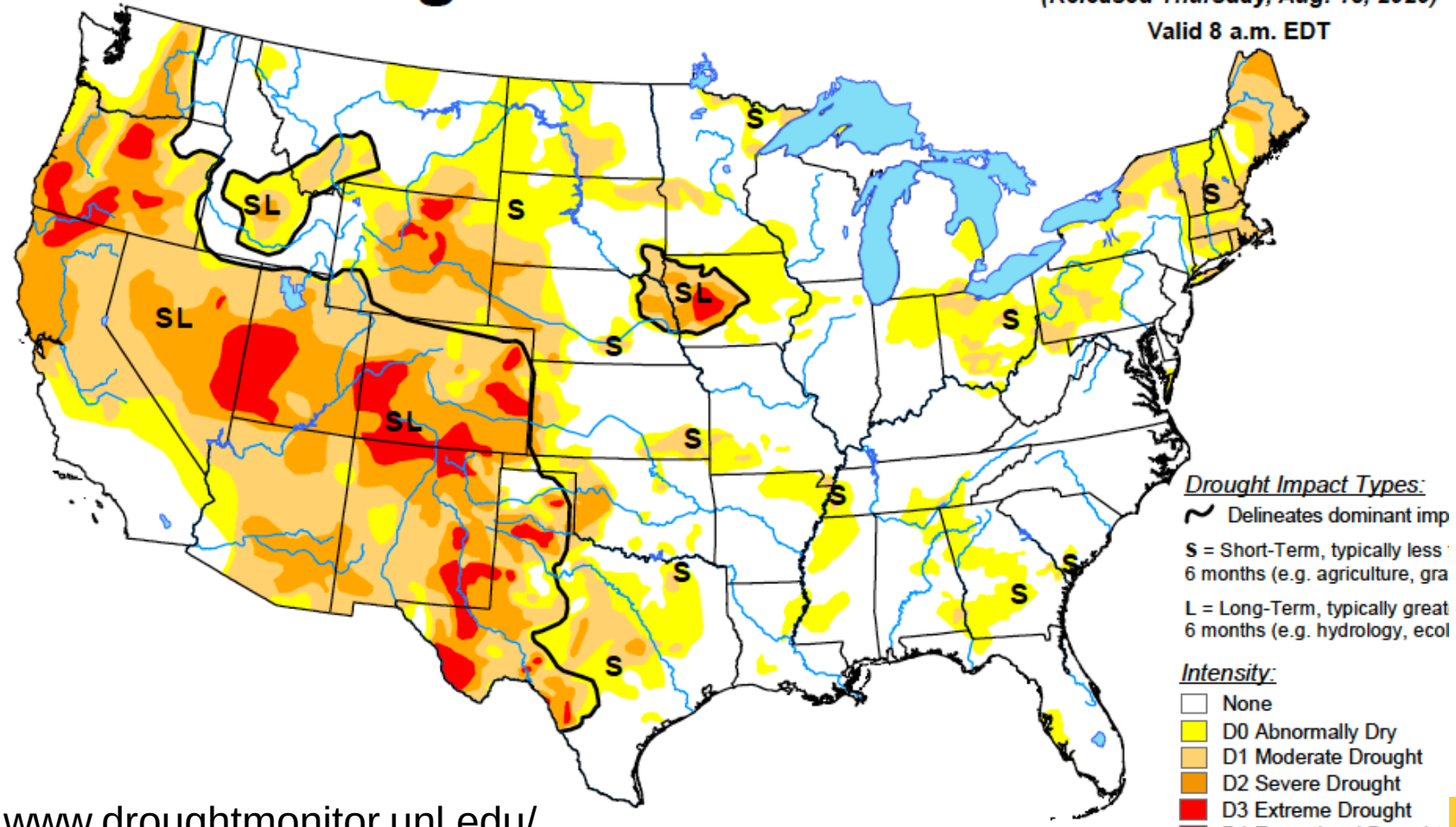
- Record early planting in Iowa and Minnesota
  - Early in Illinois, Indiana, Nebraska, and Wisconsin
- Severe drought centered on western Iowa, but extended across much of the central Corn Belt
- Extreme winds (derecho) passed through this area on August 10, 2020
  - 110-140 mph winds

U.S. Drought Monitor

August 11, 2020

(Released Thursday, Aug. 13, 2020)

Valid 8 a.m. EDT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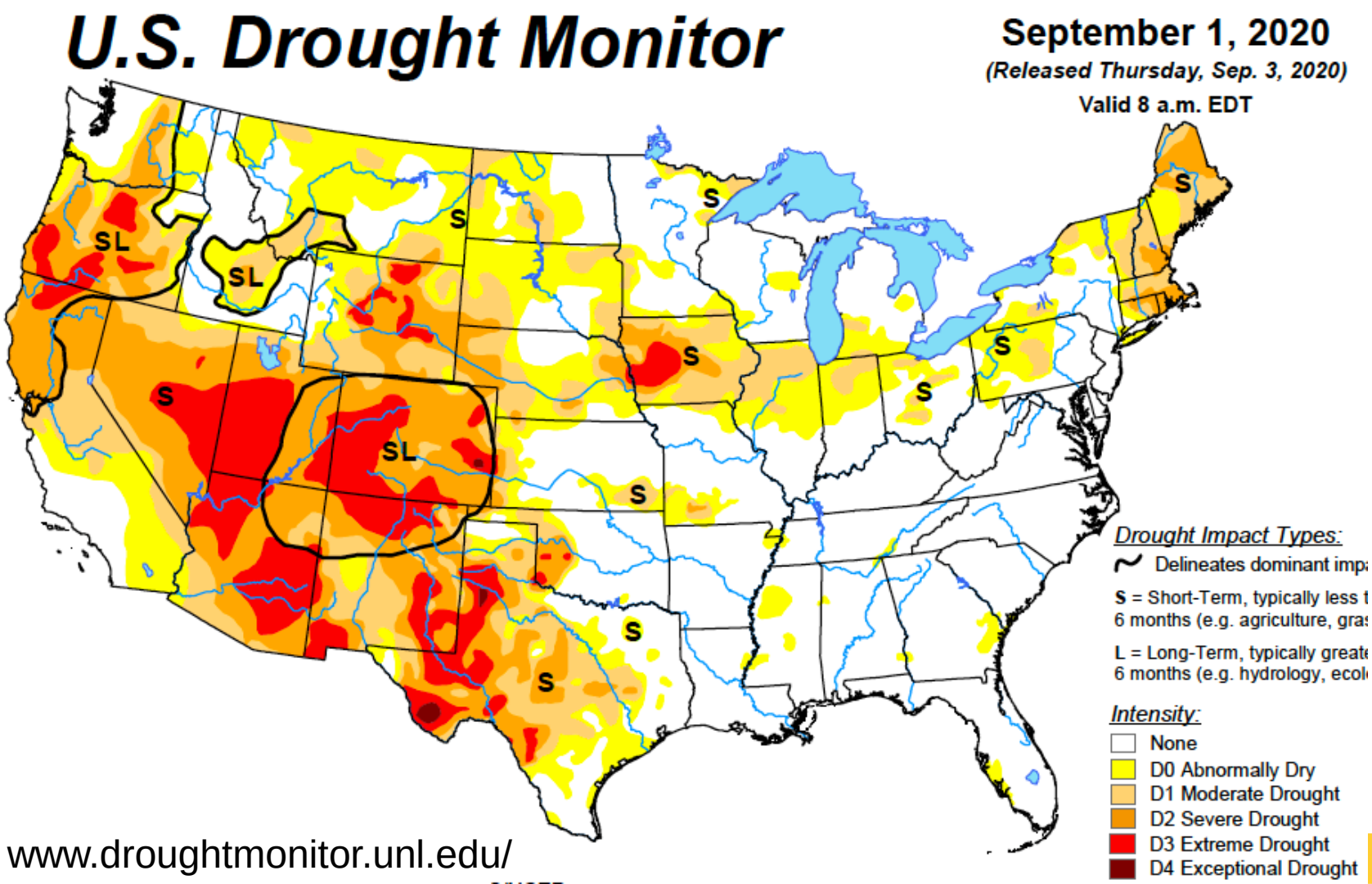
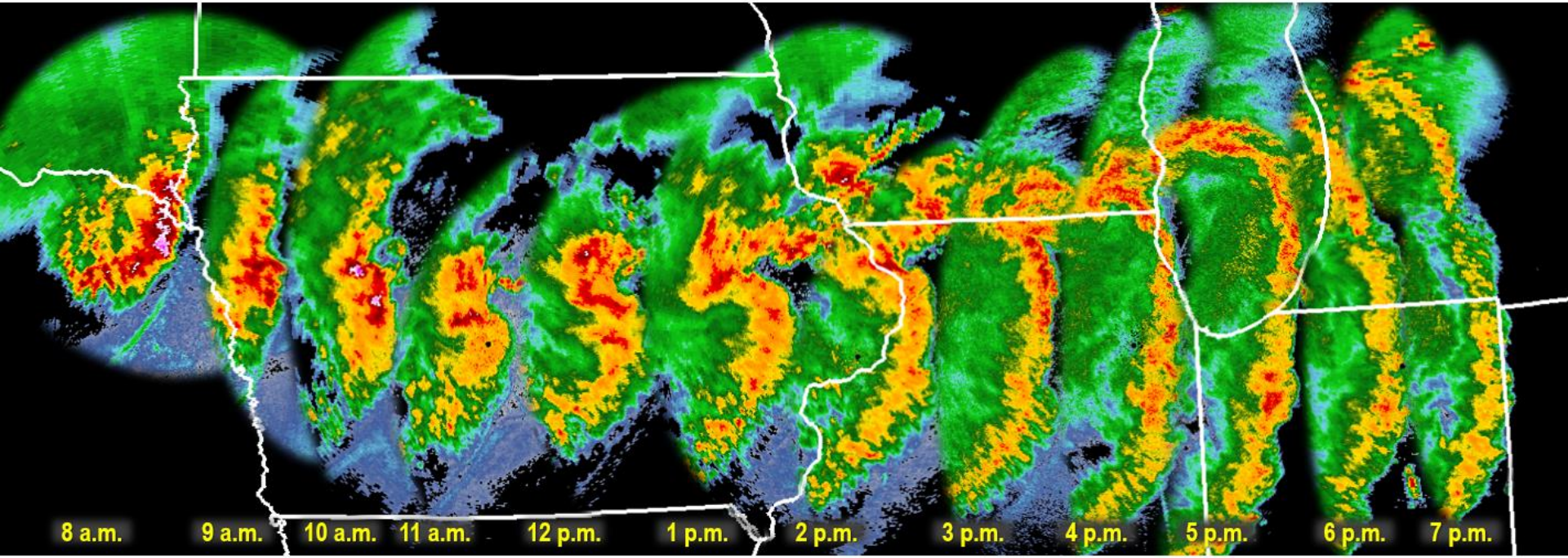


www.droughtmonitor.unl.edu/

August 10, 2020 Derecho: Lowest Angle NWS Radar Reflectivity at One-Hour Time Steps

All times in CDT



This long-lasting, severe wind thunderstorm complex (known as a derecho) produced hundreds of reports of damage along with likely a few tornadoes.

NWS Chicago | weather.gov

Aug 11, 2020

QUALITY OF THE UNITED STATES SOYBEAN CROP: 2020

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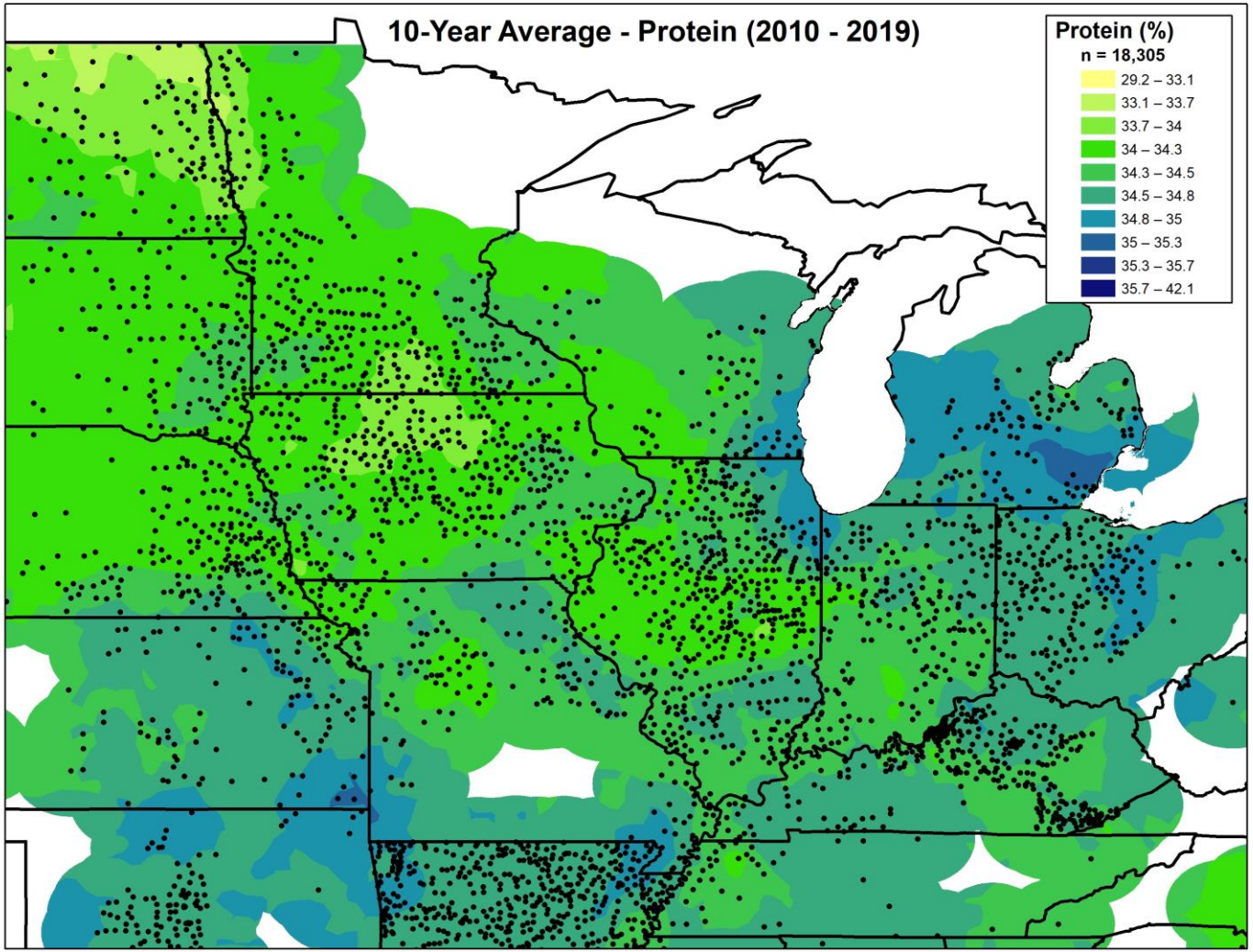
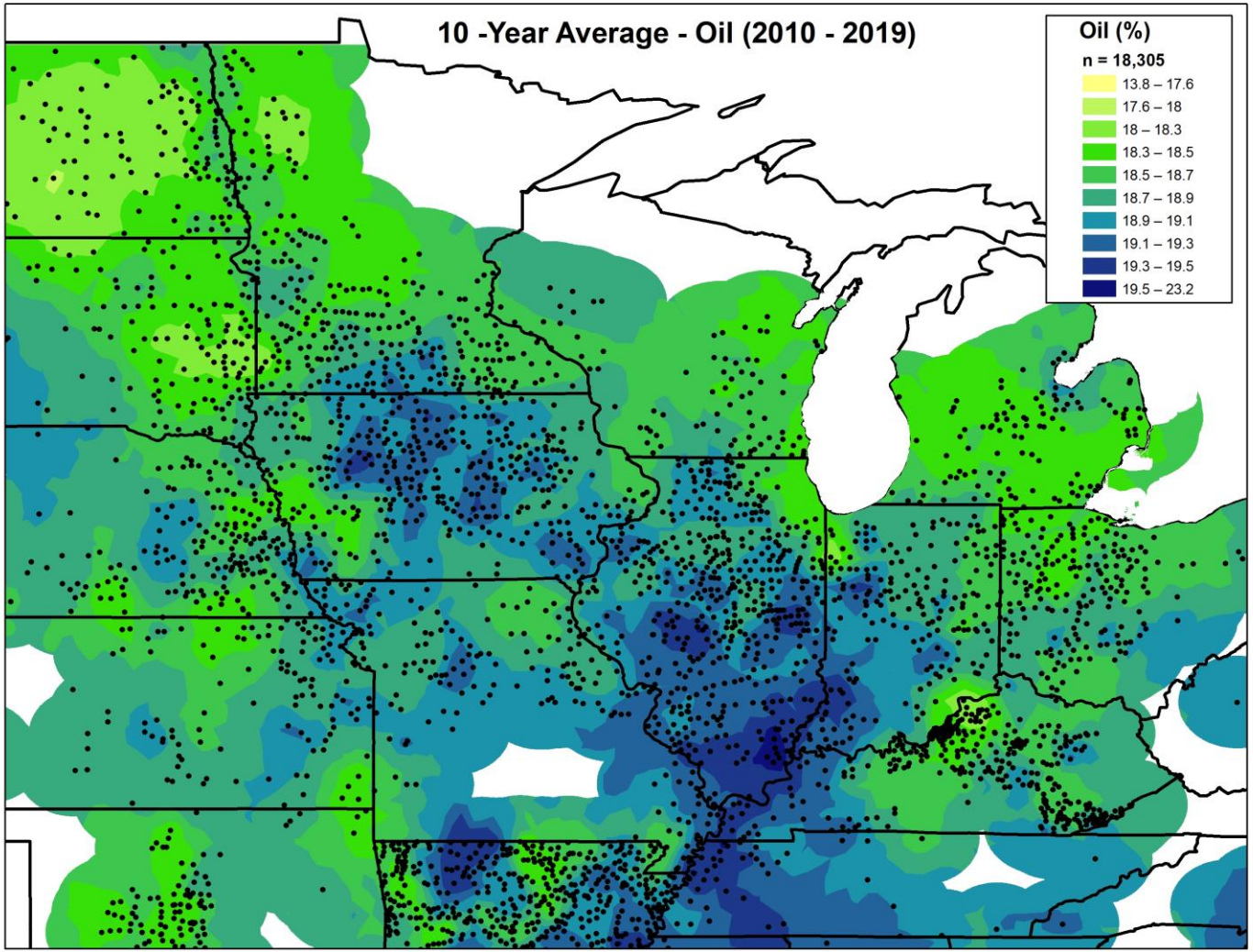
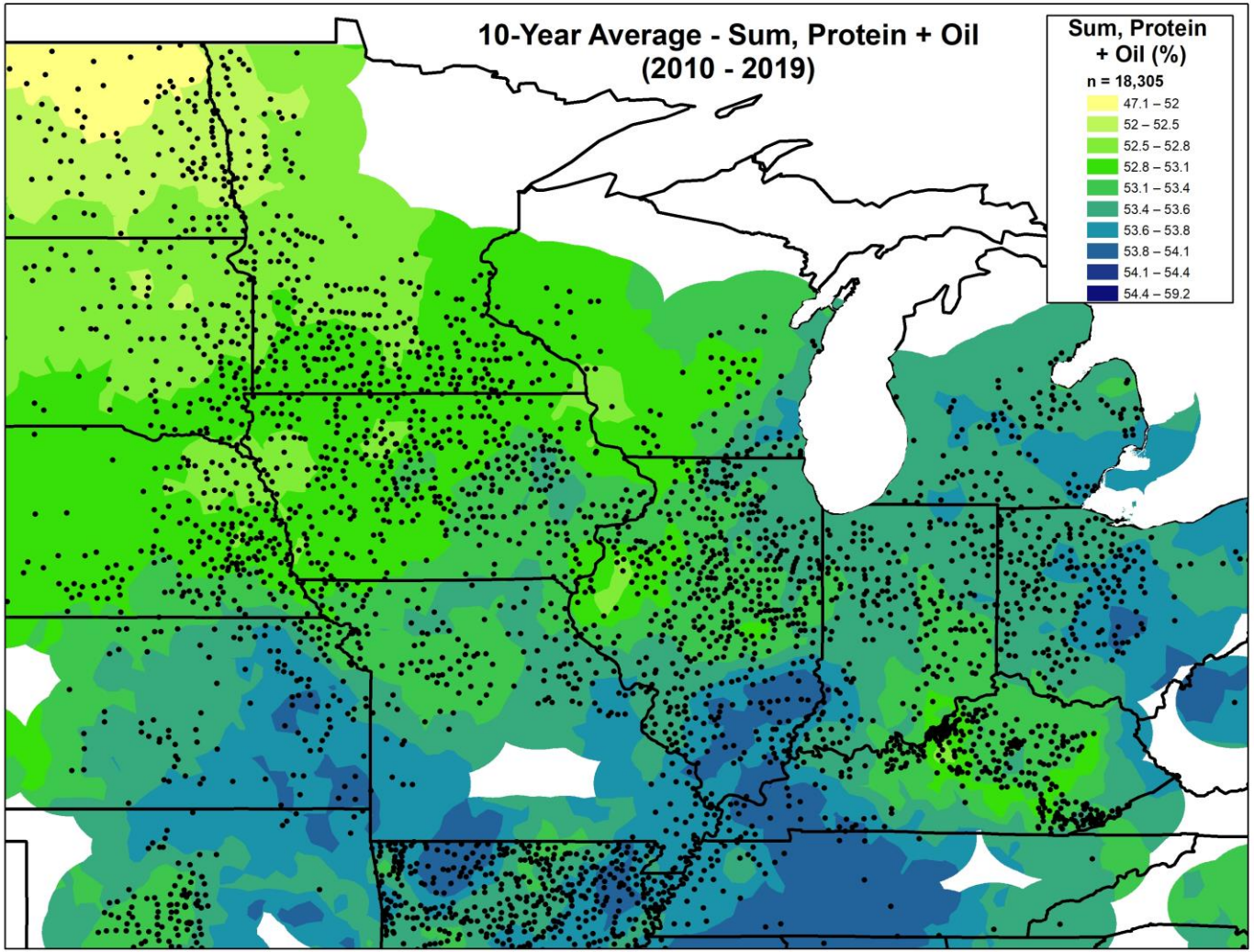
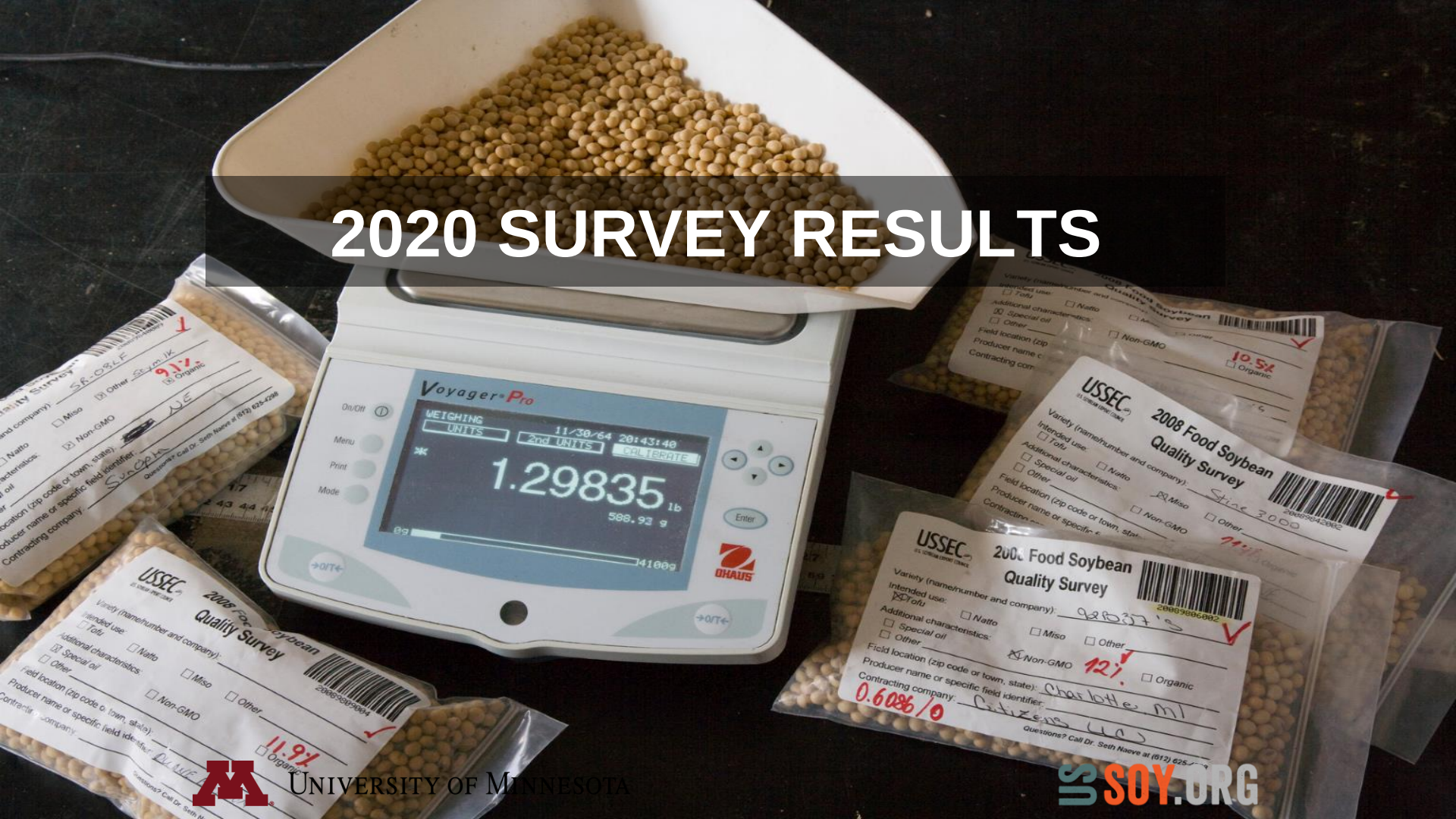
HISTORICAL PROTEIN AND OIL VARIATION


10-Year Average - Protein (2010 - 2019)
Protein (%)
n = 18,305
29.2 – 33.1
33.1 – 33.7
33.7 – 34
34 – 34.3
34.3 – 34.5
34.5 – 34.8
34.8 – 35
35 – 35.3
35.3 – 35.7
35.7 – 42.1


10 -Year Average - Oil (2010 - 2019)
Oil (%)
n = 18,305
13.8 – 17.6
17.6 – 18
18 – 18.3
18.3 – 18.5
18.5 – 18.7
18.7 – 18.9
18.9 – 19.1
19.1 – 19.3
19.3 – 19.5
19.5 – 23.2


10-Year Average - Sum, Protein + Oil
(2010 - 2019)
Sum, Protein + Oil (%)
n = 18,305
47.1 – 52
52 – 52.5
52.5 – 52.8
52.8 – 53.1
53.1 – 53.4
53.4 – 53.6
53.6 – 53.8
53.8 – 54.1
54.1 – 54.4
54.4 – 59.2

2020 SURVEY RESULTS



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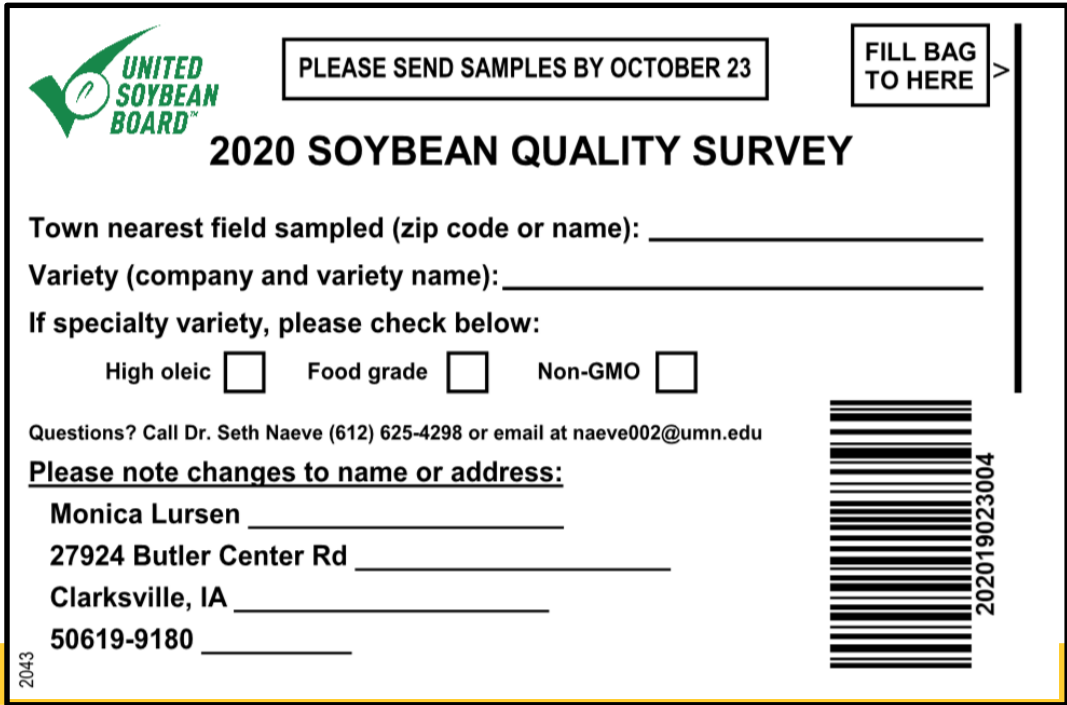
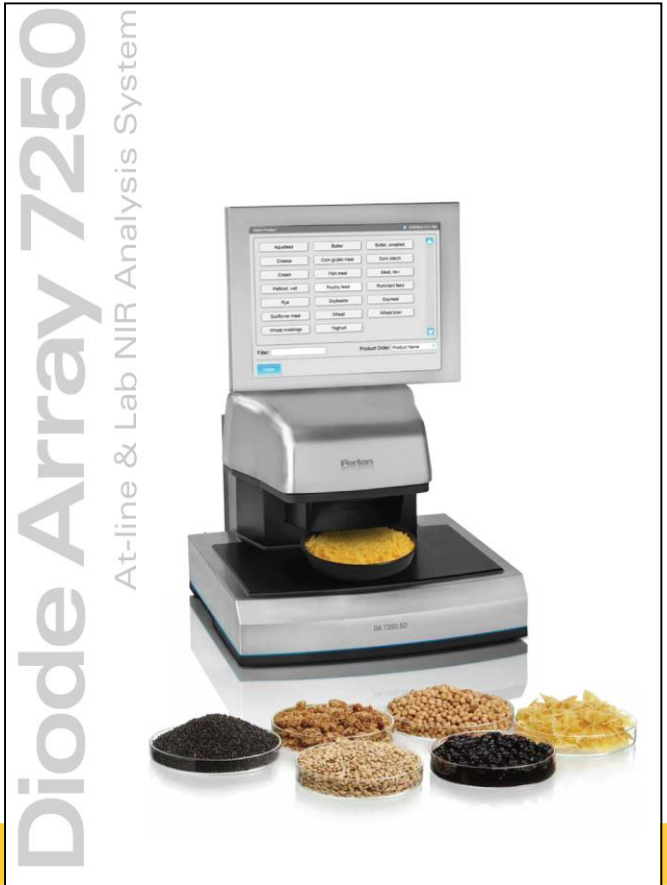
USSOY.ORG

2020 Survey Methods

- In August, sample kits were mailed to 5,800 soybean producers based on soybean production by state
- By October 28, 2020, 1,285 samples were returned for analysis



2020 Survey Methods - Protein and Oil



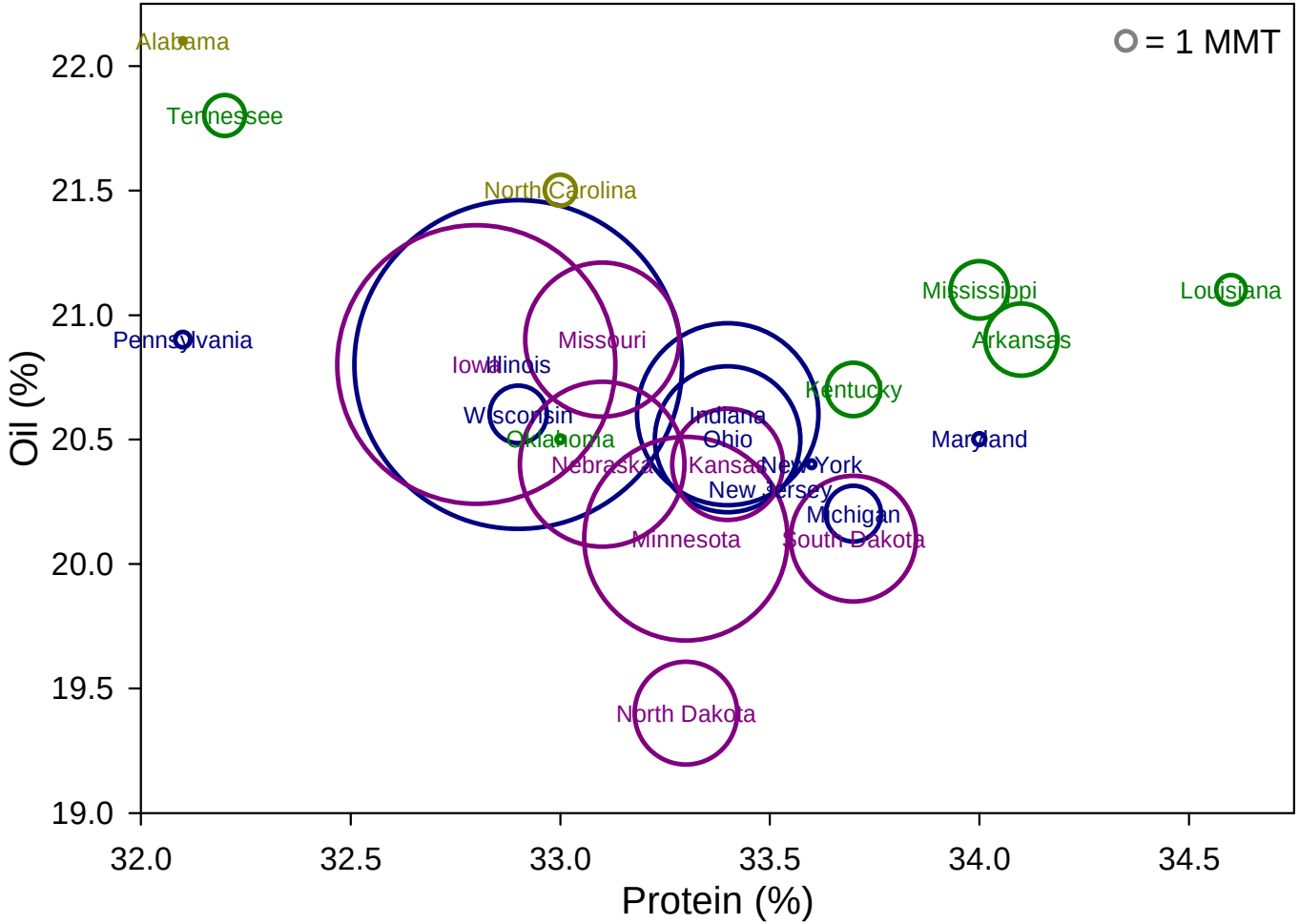
- Samples were analyzed for protein and oil concentration by Near Infrared Spectroscopy (NIRS) using a Perten® diode array instrument
- Average protein and oil values were determined by state
- Regional and US average values were determined by weighting averages based on estimated 2020 production

PROTEIN AND OIL

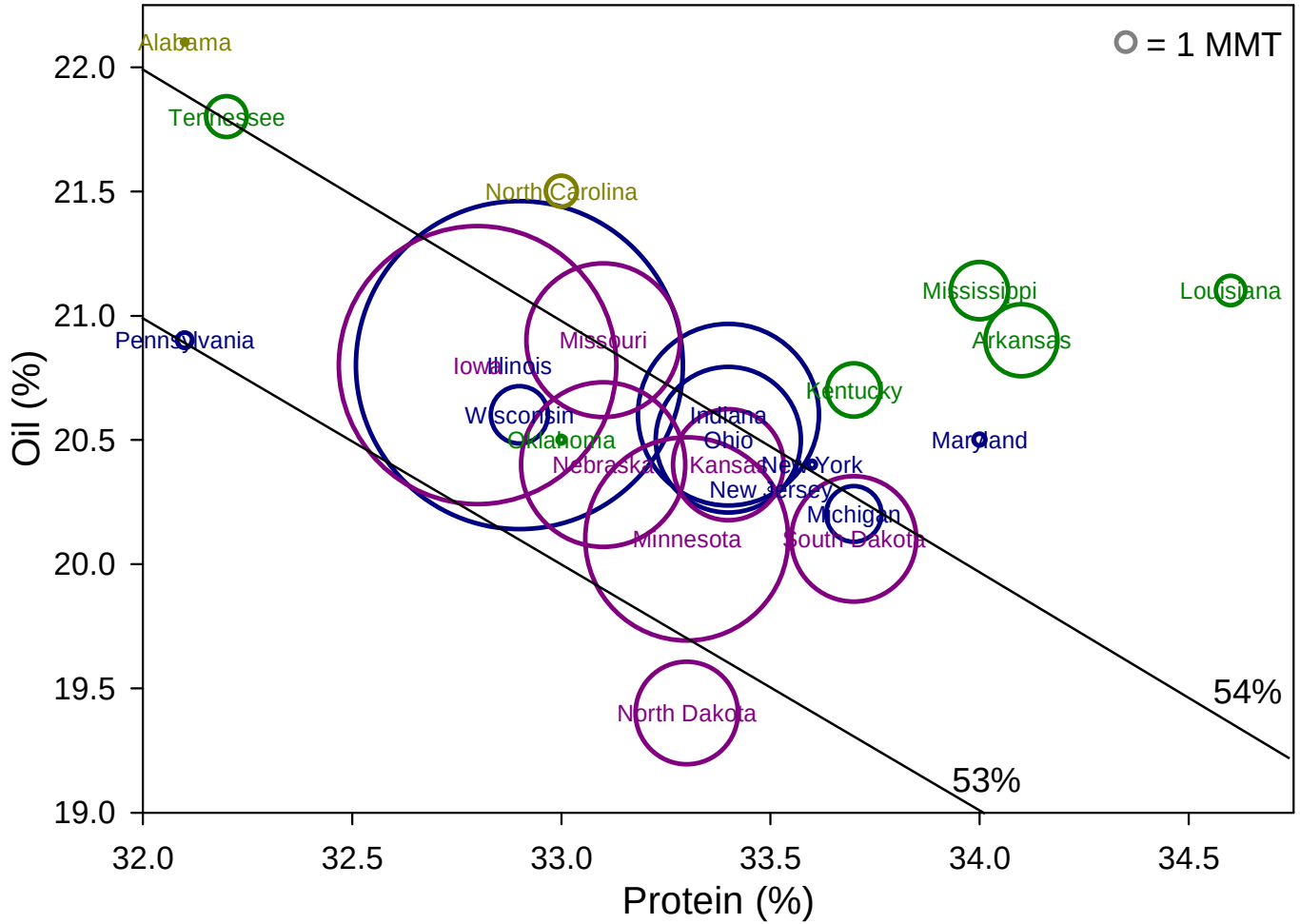
Region	Number of Samples	Protein (13%)	Change from 2019	Oil (13%)	Change from 2019	Seed Weight (g/100 seeds)
US Average	1,285	33.2		20.4		16.1
Average of 2020 Crop†		33.2	-0.9	20.5	+1.5	15.8
US 2010-2019 Average†		34.4		18.9		

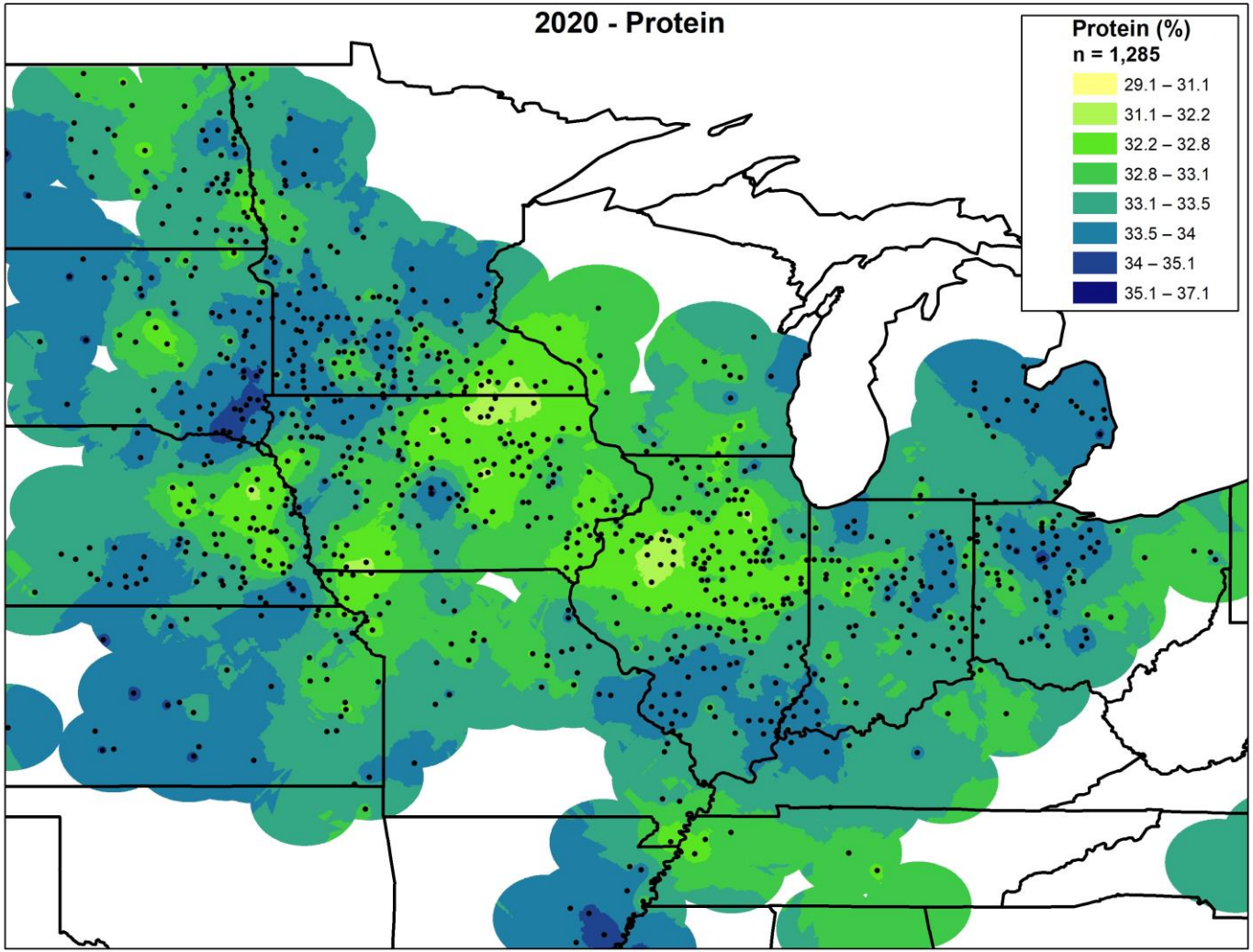
†US average values weighted based on estimated production by state, as estimated by USDA, NASS Crop Production Report (October, 2020)

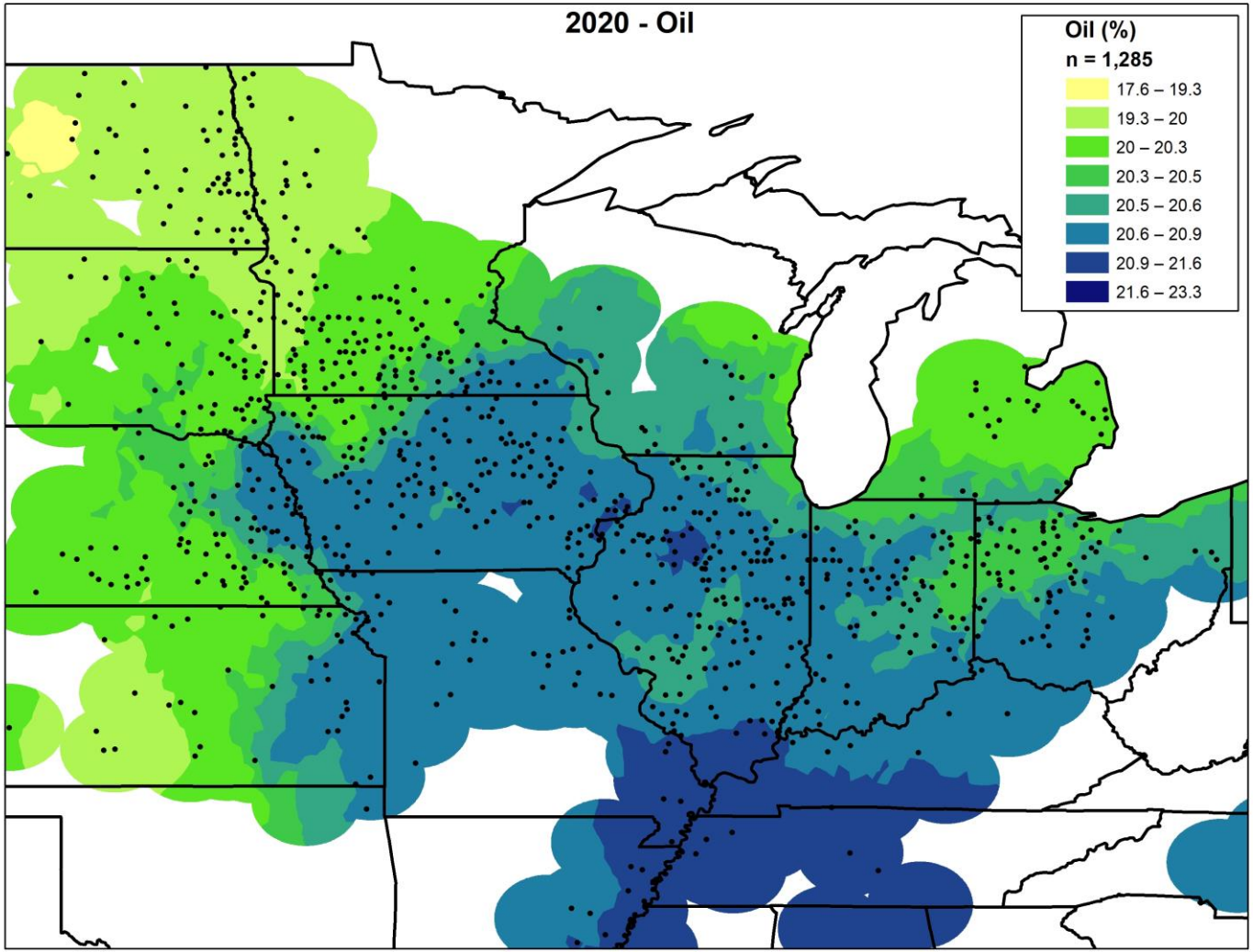
State Protein and Oil: Relative to Total Production

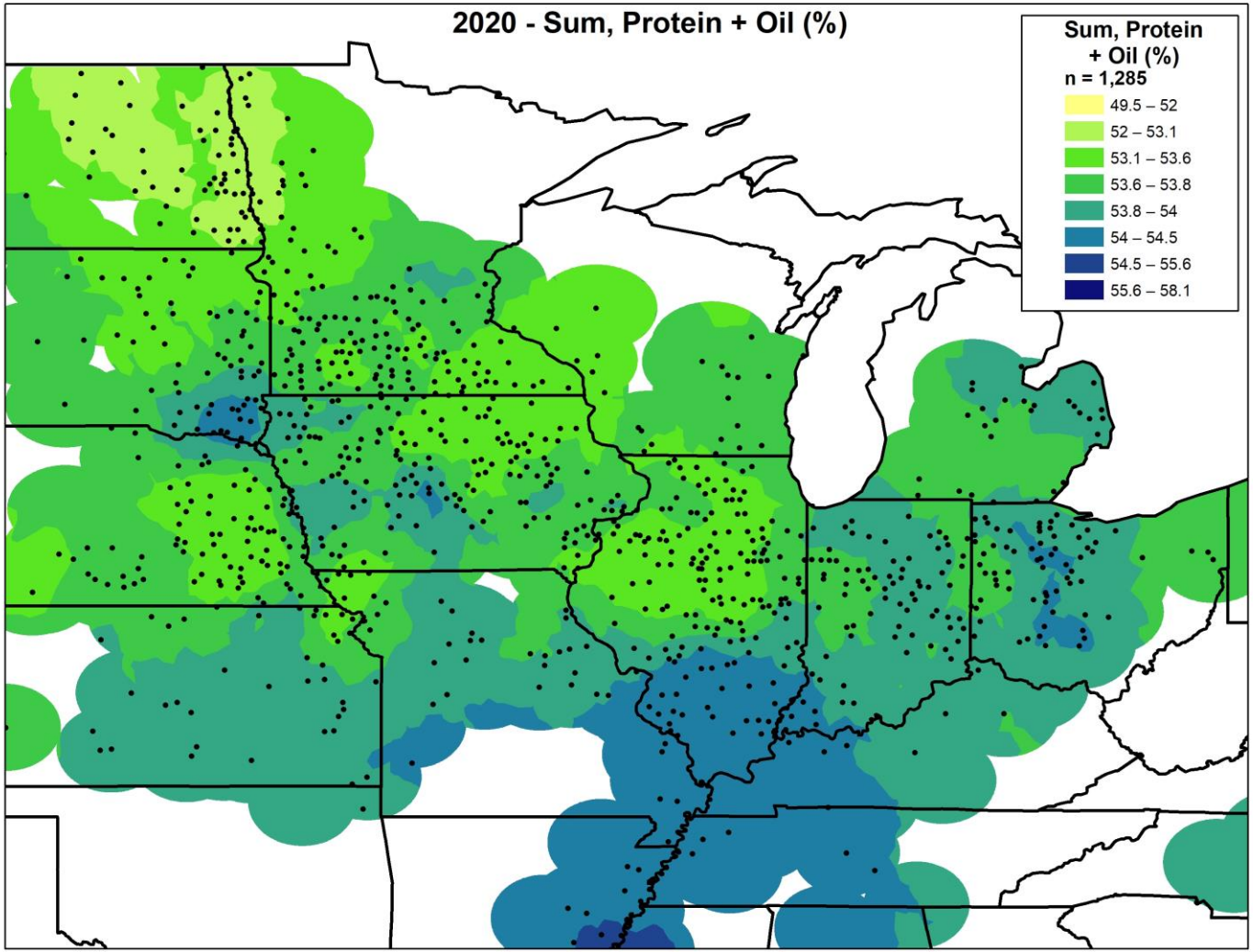


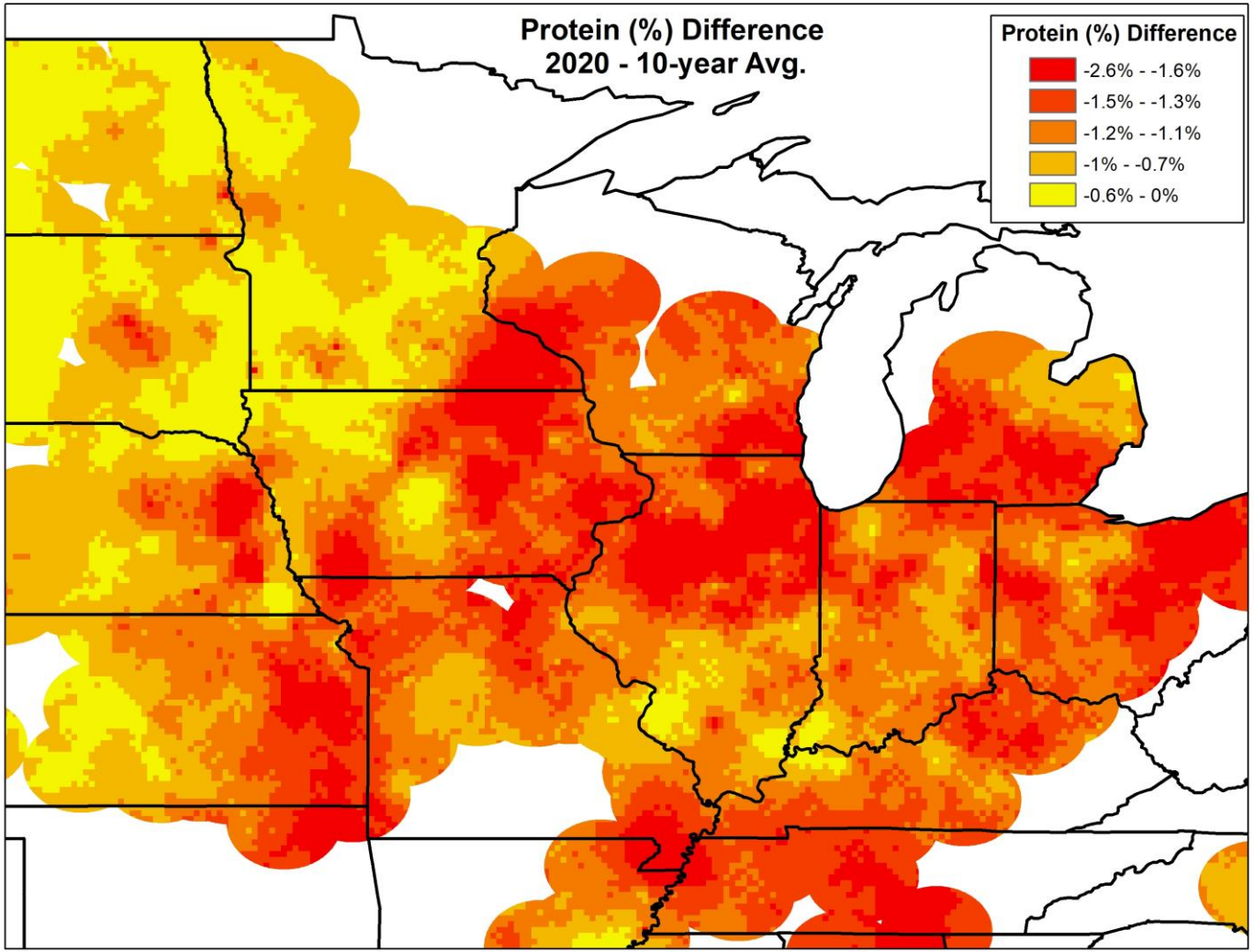
State Protein and Oil: Relative to Total Production

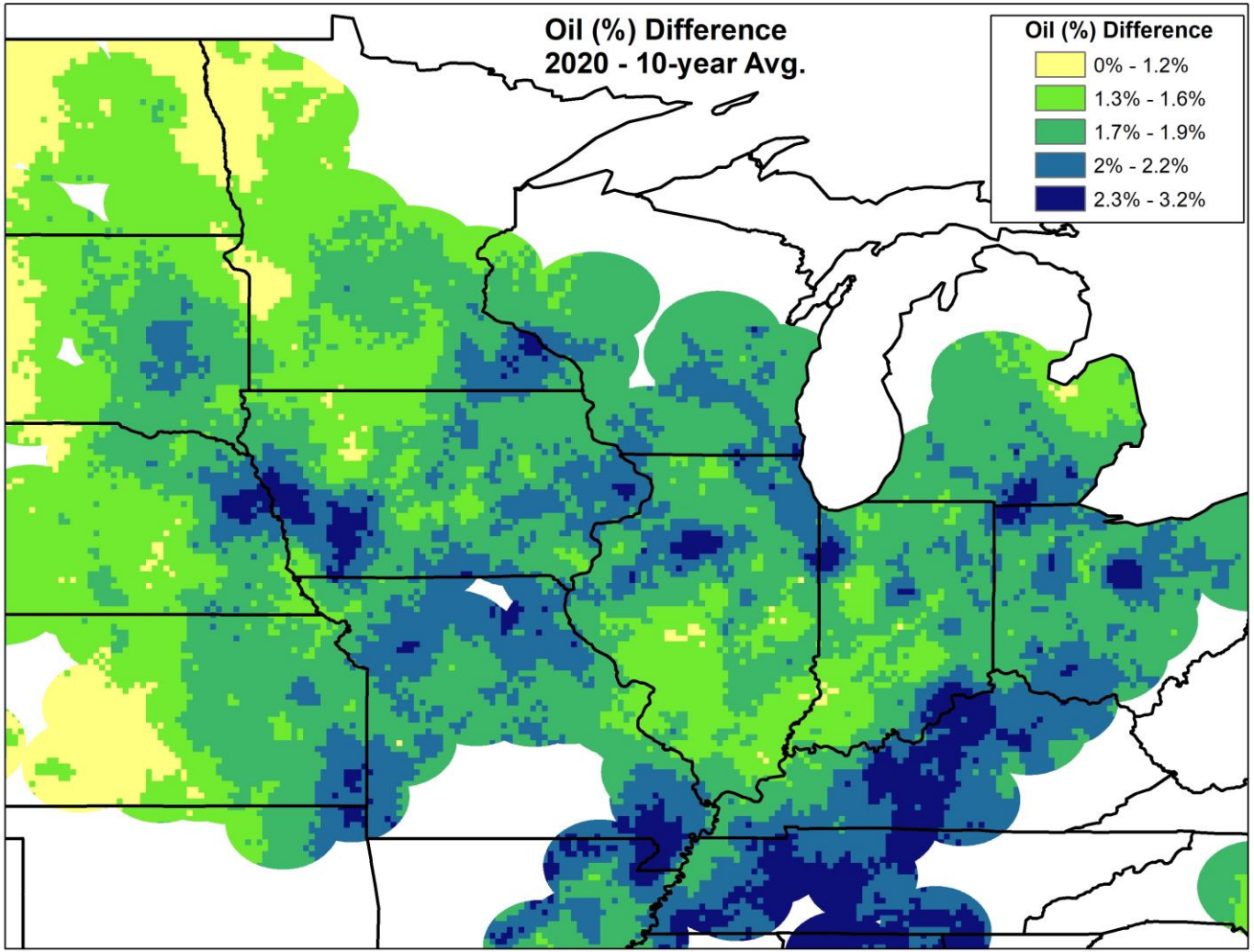


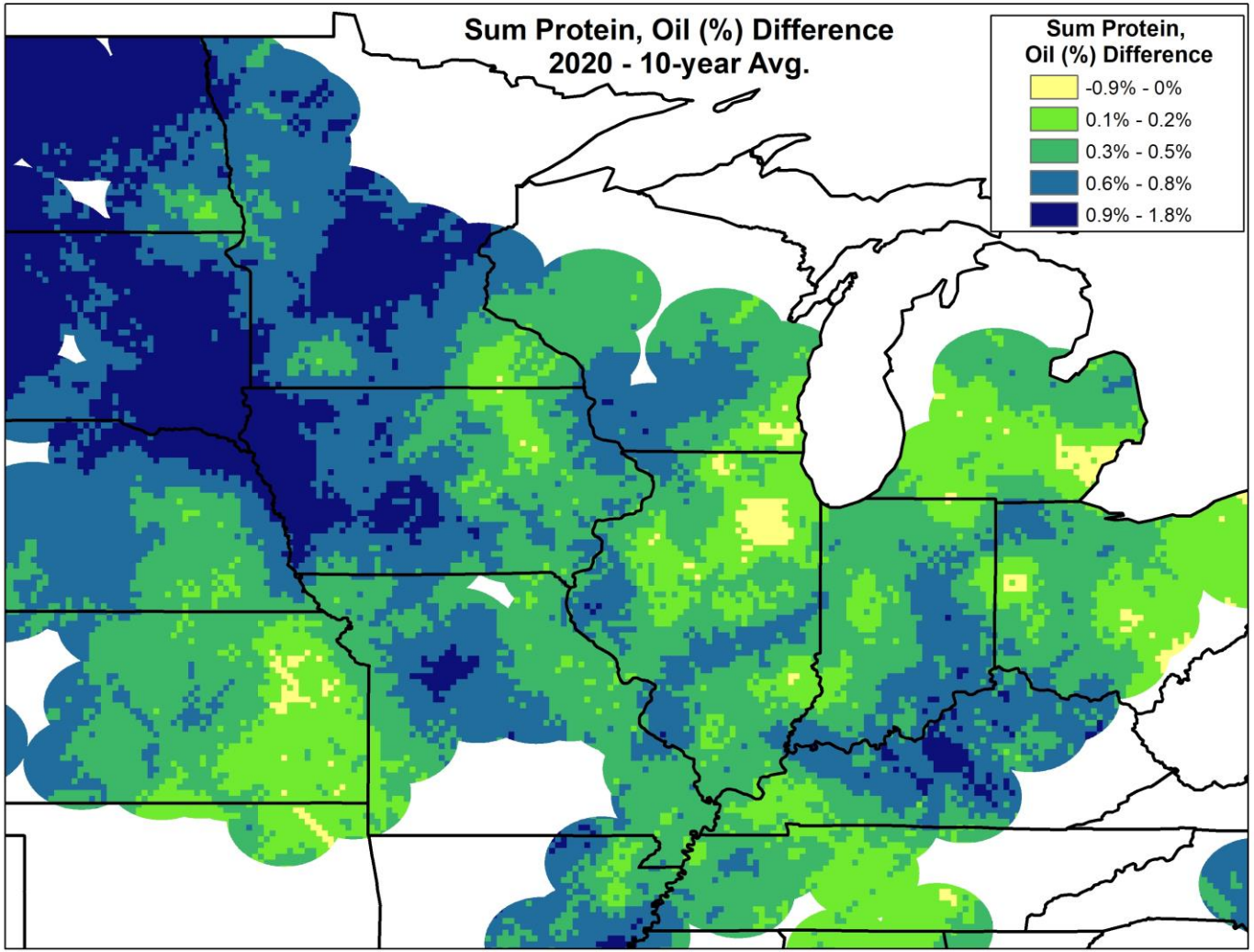

2020 - Protein
Protein (%)
n = 1,285
29.1 – 31.1
31.1 – 32.2
32.2 – 32.8
32.8 – 33.1
33.1 – 33.5
33.5 – 34
34 – 35.1
35.1 – 37.1


2020 - Oil
Oil (%)
n = 1,285
17.6 – 19.3
19.3 – 20
20 – 20.3
20.3 – 20.5
20.5 – 20.6
20.6 – 20.9
20.9 – 21.6
21.6 – 23.3

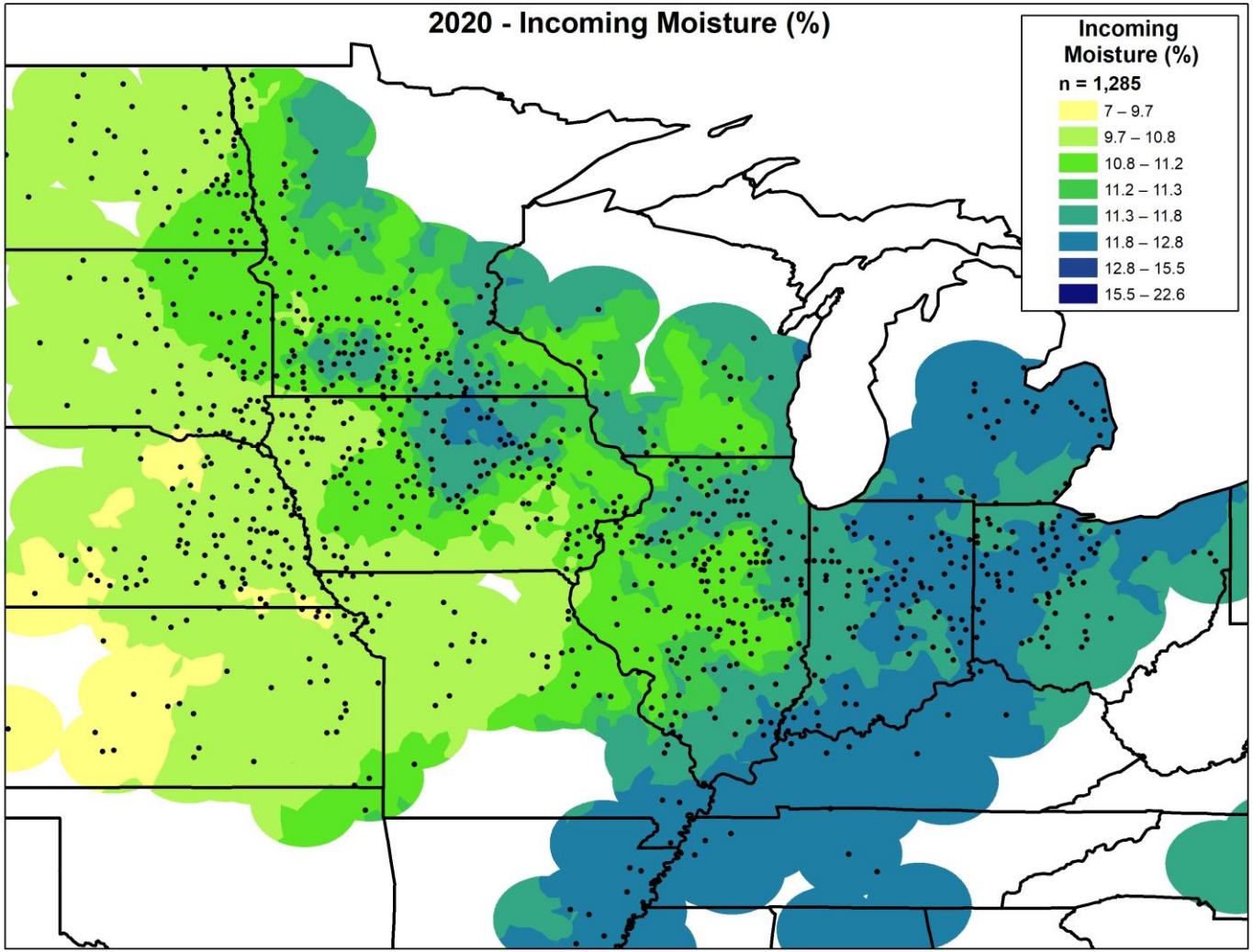

2020 - Sum, Protein + Oil (%)
Sum, Protein + Oil (%)
n = 1,285
49.5 – 52
52 – 53.1
53.1 – 53.6
53.6 – 53.8
53.8 – 54
54 – 54.5
54.5 – 55.6
55.6 – 58.1

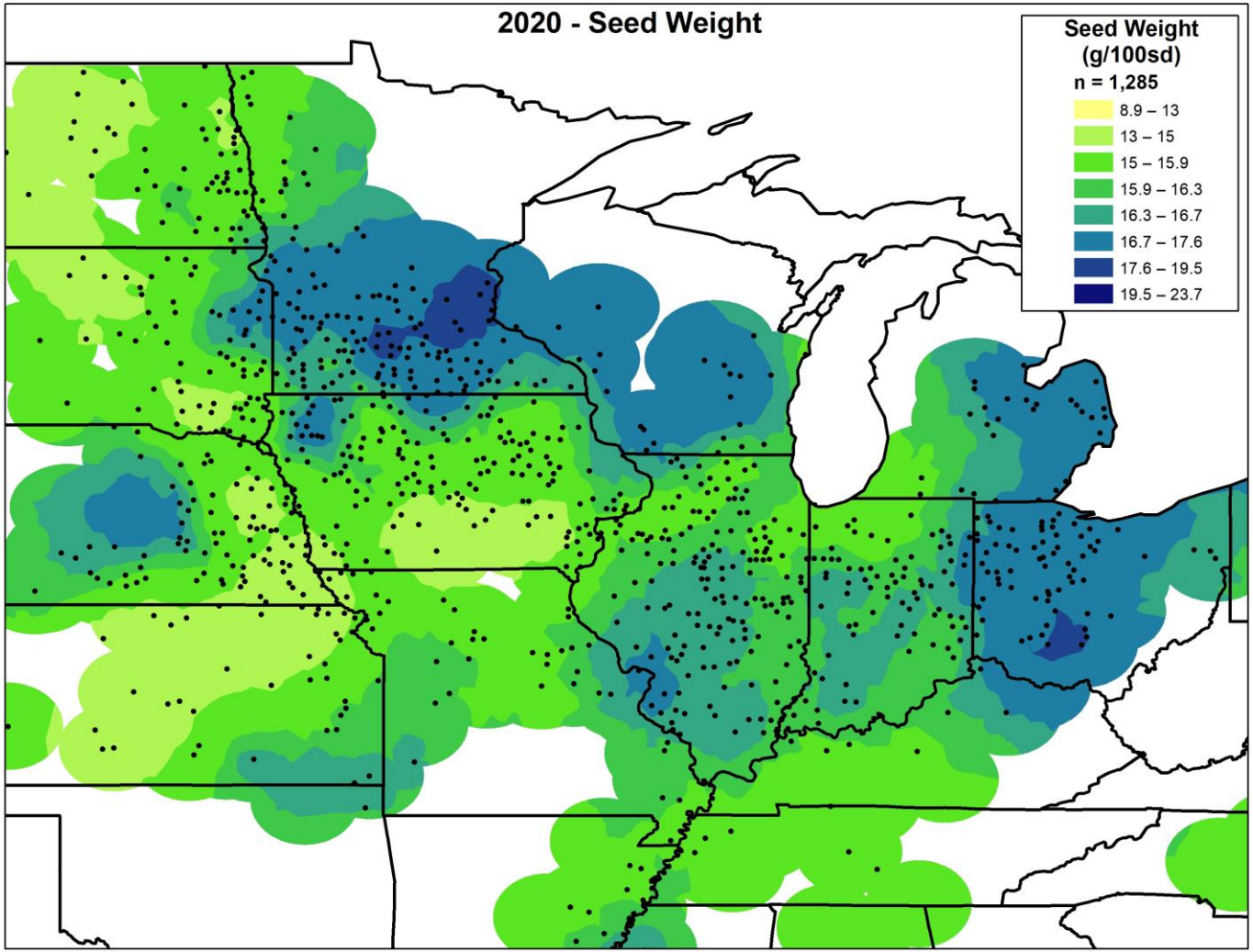

Protein (%) Difference
2020 - 10-year Avg.
Protein (%) Difference
-2.6% - -1.6%
-1.5% - -1.3%
-1.2% - -1.1%
-1% - -0.7%
-0.6% - 0%

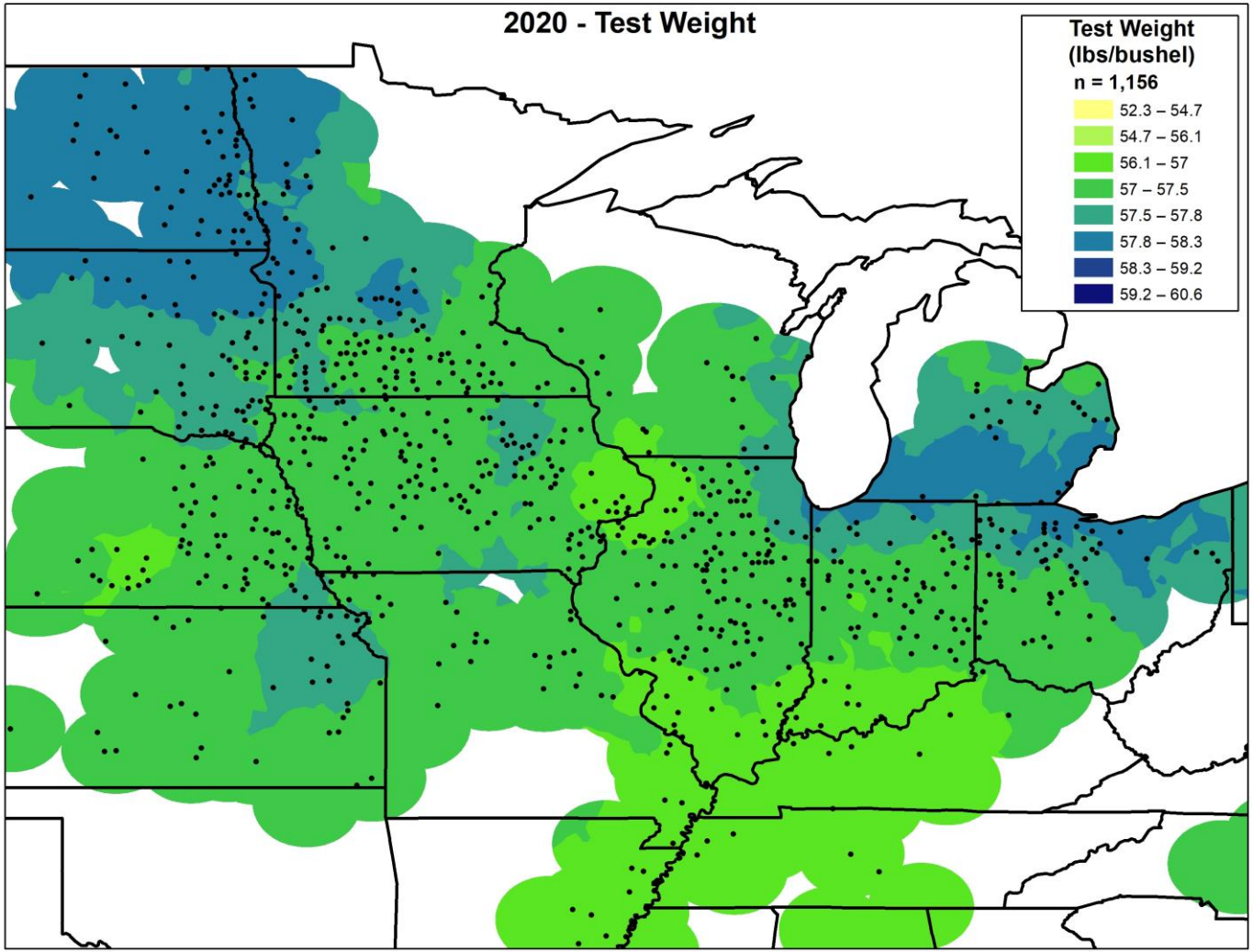

Oil (%) Difference
2020 - 10-year Avg.
Oil (%) Difference
0% - 1.2%
1.3% - 1.6%
1.7% - 1.9%
2% - 2.2%
2.3% - 3.2%

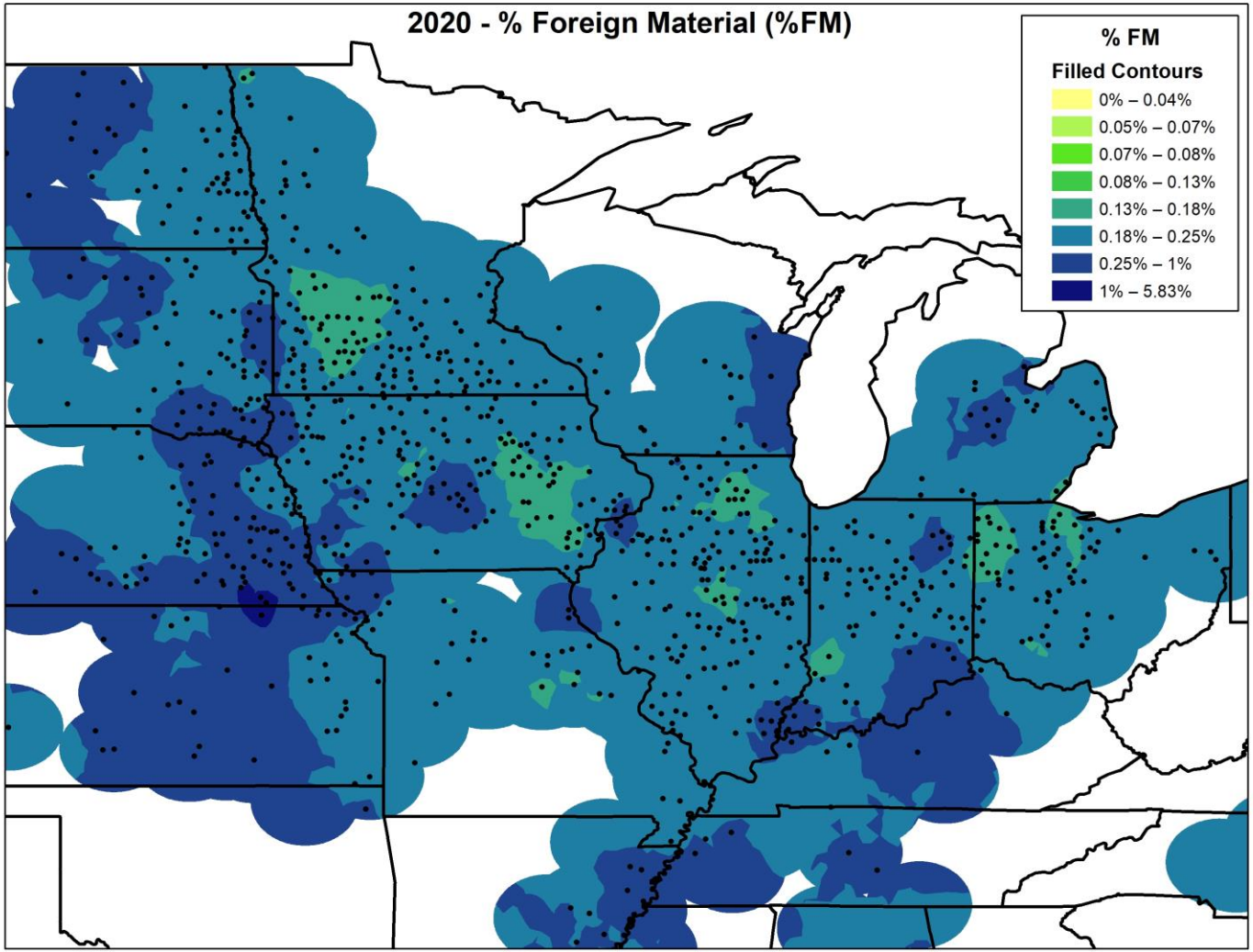

Sum Protein, Oil (%) Difference
2020 - 10-year Avg.
Sum Protein,
Oil (%) Difference
-0.9% - 0%
0.1% - 0.2%
0.3% - 0.5%
0.6% - 0.8%
0.9% - 1.8%

PHYSICAL CHARACTERISTICS


2020 - Incoming Moisture (%)
Incoming Moisture (%)
n = 1,285
7 – 9.7
9.7 – 10.8
10.8 – 11.2
11.2 – 11.3
11.3 – 11.8
11.8 – 12.8
12.8 – 15.5
15.5 – 22.6


2020 - Seed Weight
Seed Weight (g/100sd)
n = 1,285
8.9 – 13
13 – 15
15 – 15.9
15.9 – 16.3
16.3 – 16.7
16.7 – 17.6
17.6 – 19.5
19.5 – 23.7


2020 - Test Weight
Test Weight (lbs/bushel)
n = 1,156
52.3 – 54.7
54.7 – 56.1
56.1 – 57
57 – 57.5
57.5 – 57.8
57.8 – 58.3
58.3 – 59.2
59.2 – 60.6


2020 - % Foreign Material (%FM)
% FM
Filled Contours
0% – 0.04%
0.05% – 0.07%
0.07% – 0.08%
0.08% – 0.13%
0.13% – 0.18%
0.18% – 0.25%
0.25% – 1%
1% – 5.83%

Better Measures of the Value of Soybeans

- Soybeans & soybean meal have been valued primarily on an indirect measure of protein – ‘crude protein’
- Crude protein is probably not the best measure of a soybean (or a soybean meal’s) value
  - Overestimates total amino acids (true protein) at higher protein levels
  - No information on protein QUALITY (relative balance of amino acids)
- Both formal and informal feeding trials in destination countries have repeatedly shown that meal from US soybeans performs better than expected based on protein levels

BETTER MEASURES OF QUALITY: AMINO ACIDS

AMINO ACIDS ARE THE BUILDING BLOCKS OF PROTEINS IN LIVING ORGANISMS. THERE ARE OVER 500 AMINO ACIDS FOUND IN NATURE - HOWEVER, THE HUMAN GENETIC CODE ONLY DIRECTLY ENCODES 20. 'ESSENTIAL' AMINO ACIDS MUST BE EATEN FROM THE DIET. NON-ESSENTIAL AMINO ACIDS CAN BE SYNTHESISED IN THE BODY.

Chart Key: ALIPHATIC · AROMATIC · AMIDIC · NON-ESSENTIAL · ESSENTIAL

Chemical Structure — *single letter code*

NAME (A) — *three letter code* — DNA codons

ALANINE (A) — *Ala* — GCT, GCC, GCA, GCG

GLYCINE (G) — *Gly* — GGT, GGC, GGA, GGG

ISOLEUCINE (I) — *Ile* — ATT, ATC, ATA

LEUCINE (L) — *Leu* — CTT, CTC, CTA, CTG, TTA, TTG

PROLINE (P) — *Pro* — CCT, CCC, CCA, CCG

VALINE (V) — *Val* — GTT, GTC, GTA, GTG

PHENYLALANINE (F) — *Phe* — TTT, TTC

TRYPTOPHAN (W) — *Trp* — TGG

TYROSINE (Y) — *Tyr* — TAT, TAC

ASPARTIC ACID (D) — *Asp* — GAT, GAC

GLUTAMIC ACID (E) — *Glu* — GAA, GAG

ARGININE (R) — *Arg* — CGT, CGC, CGA, CGG, AGA, AGG

HISTIDINE (H) — *His* — CAT, CAC

LYSINE (K) — *Lys* — AAA, AAG

SERINE (S) — *Ser* — TCT, TCC, TCA, TCG, AGT, AGC

THREONINE (T) — *Thr* — ACT, ACC, ACA, ACG

CYSTEINE (C) — *Cys* — TGT, TGC

METHIONINE (M) — *Met* — ATG

ASPARAGINE (N) — *Asn* — AAT, AAC

GLUTAMINE (Q) — *Gln* — CAA, CAG

Note: This chart only shows those amino acids for which the human genetic code directly codes for. Selenocysteine is often referred to as the 21st amino acid, but is encoded in a special manner. In some cases, distinguishing between asparagine/aspartic acid and glutamine/glutamic acid is difficult. In these cases, the codes asx (B) and glx (Z) are respectively used.

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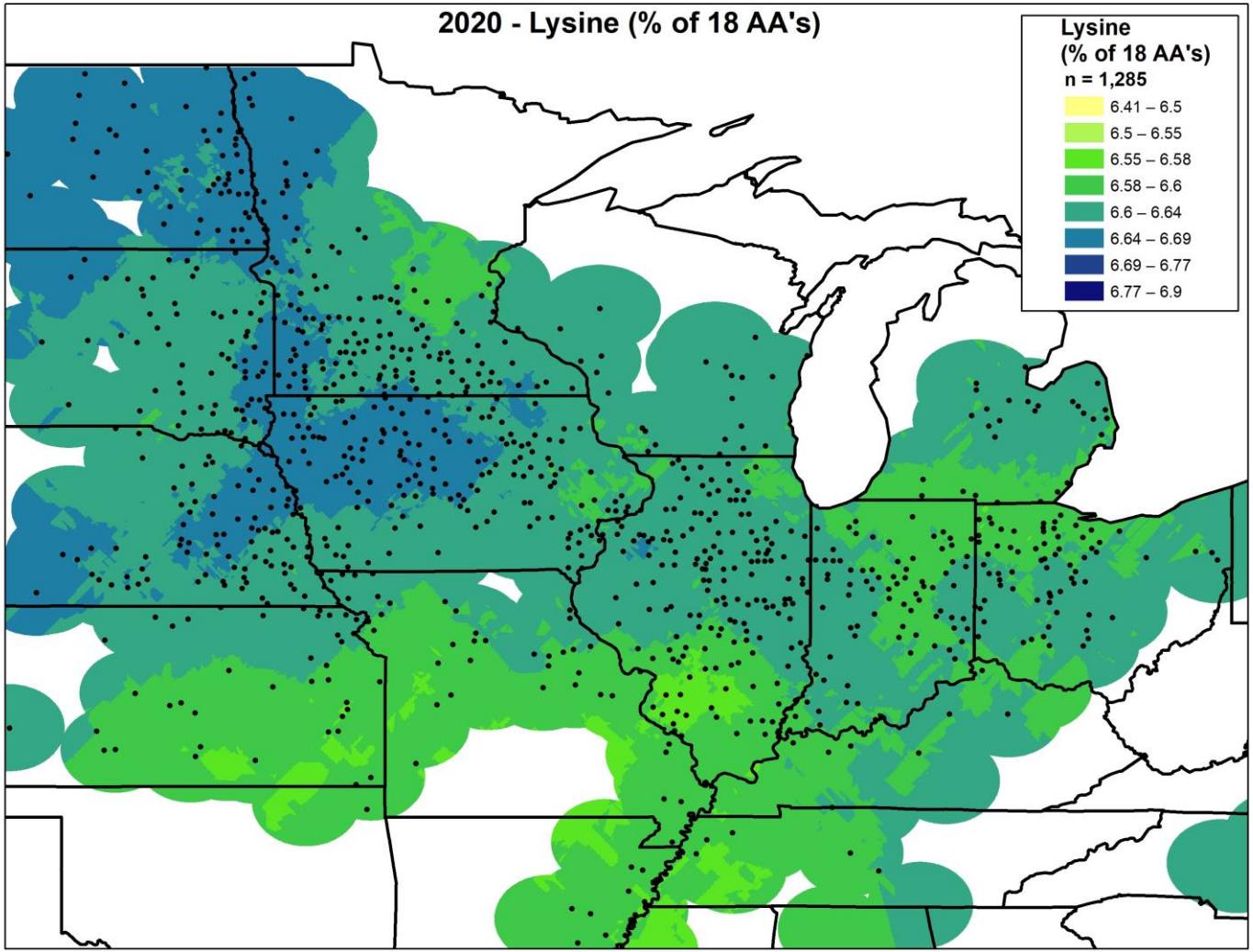
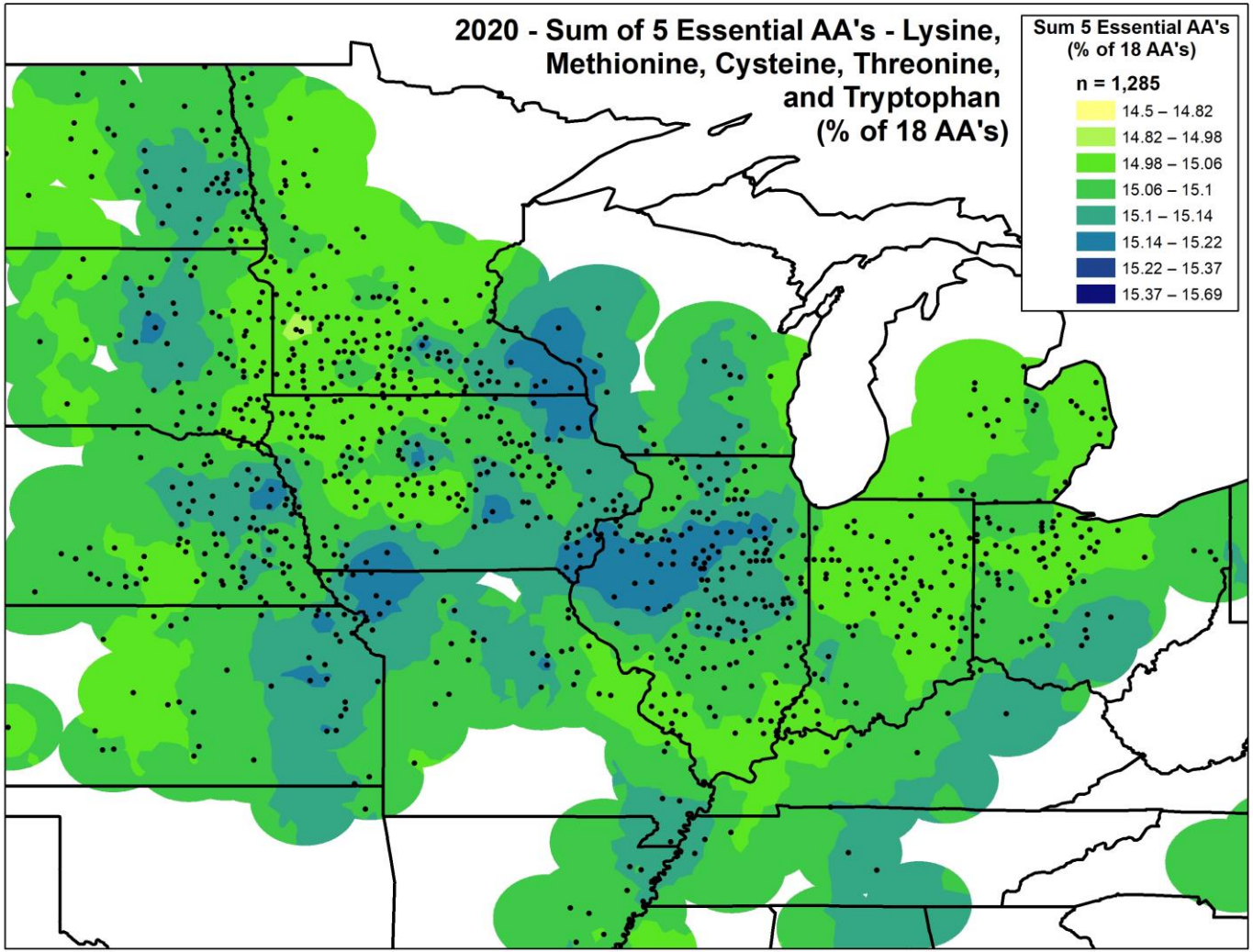
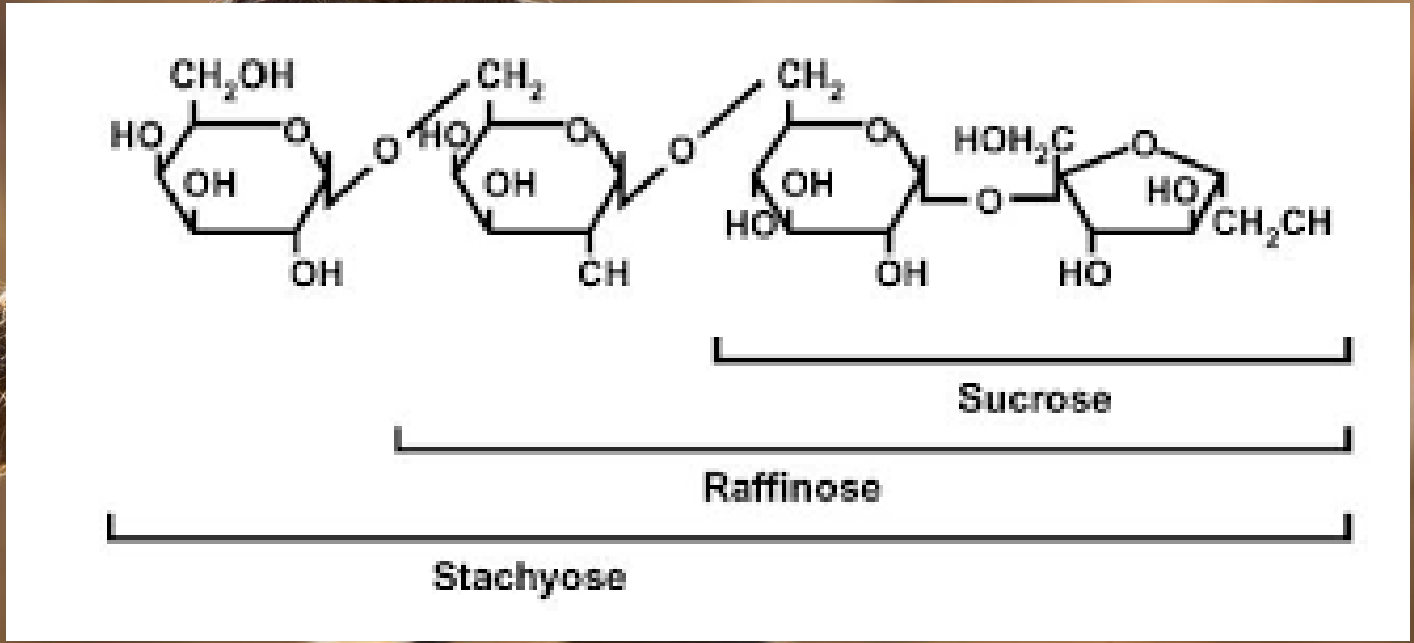
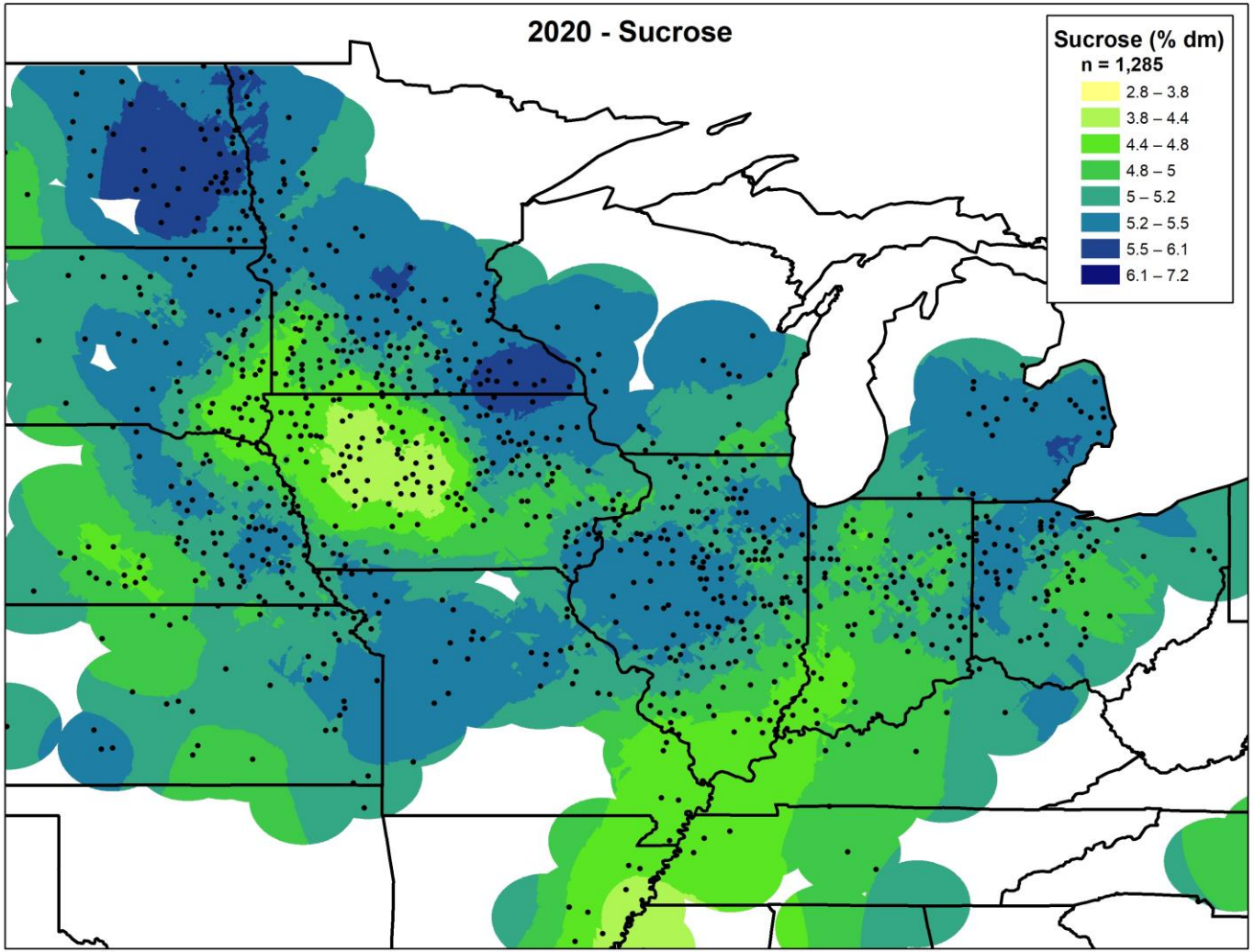

2020 - Lysine (% of 18 AA's)
Lysine
(% of 18 AA's)
n = 1,285
6.41 – 6.5
6.5 – 6.55
6.55 – 6.58
6.58 – 6.6
6.6 – 6.64
6.64 – 6.69
6.69 – 6.77
6.77 – 6.9


2020 - Sum of 5 Essential AA's - Lysine, Methionine, Cysteine, Threonine, and Tryptophan (% of 18 AA's)
Sum 5 Essential AA's (% of 18 AA's)
n = 1,285
14.5 – 14.82
14.82 – 14.98
14.98 – 15.06
15.06 – 15.1
15.1 – 15.14
15.14 – 15.22
15.22 – 15.37
15.37 – 15.69

BETTER MEASURES OF QUALITY: SOLUBLE SUGARS




2020 - Sucrose
Sucrose (% dm)
n = 1,285
2.8 – 3.8
3.8 – 4.4
4.4 – 4.8
4.8 – 5
5 – 5.2
5.2 – 5.5
5.5 – 6.1
6.1 – 7.2

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