# U.S. Grains Council 2020/2021 Corn Harvest Quality Report

November 27, 2020

U.S. GRAINS COUNCIL

# Quality, Reliability, Transparency

U.S. GRAINS COUNCIL

U.S. GRAINS COUNCIL

*Building partnerships based on trust*

*Bridge to world's largest, most reliable grain supply*

## 2020/2021 Corn Harvest Quality Report

*Reliable and Comparable Data*

*Transparent and Consistent Methodology*

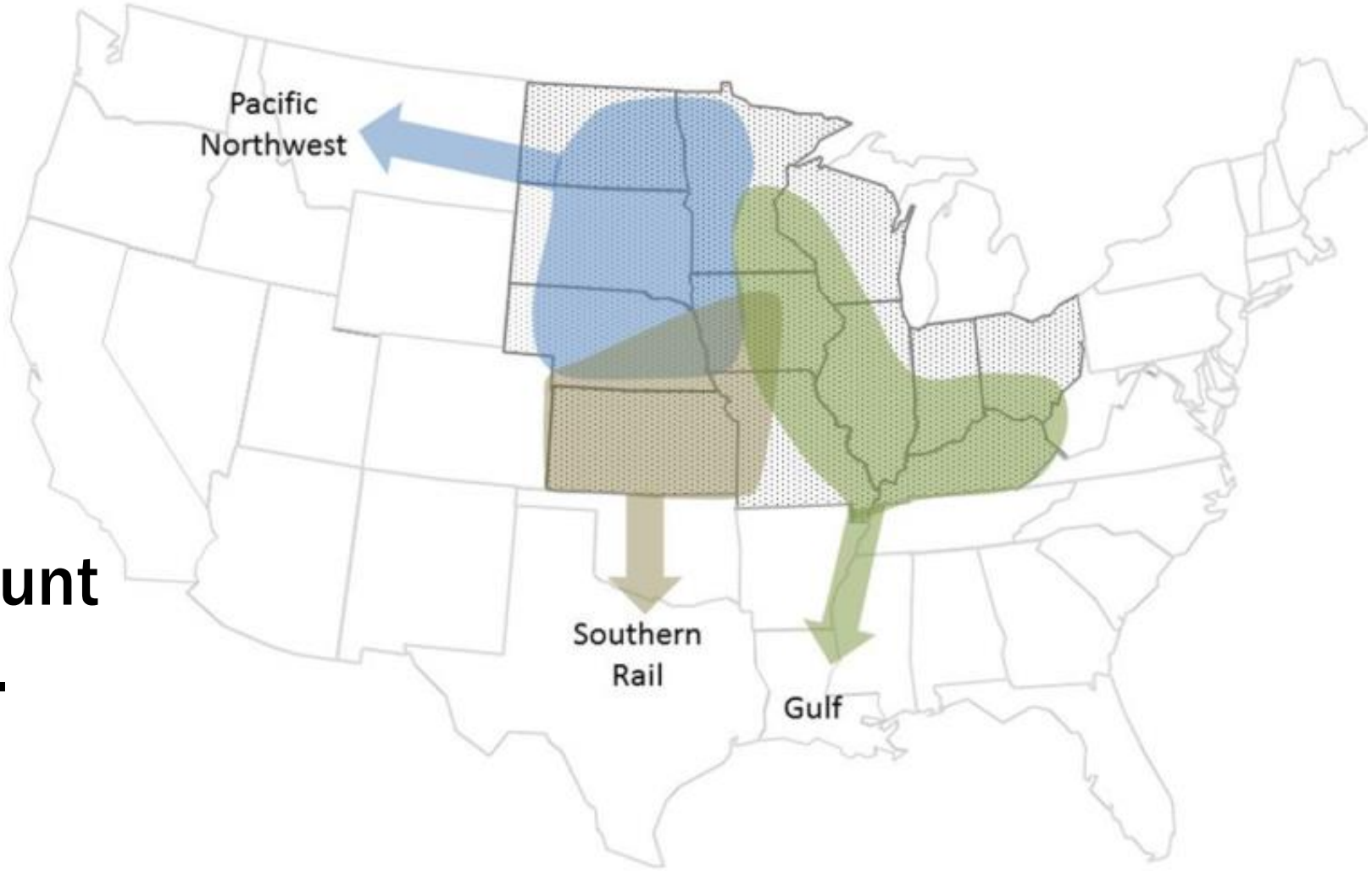
*Early Look at General Harvest Quality*


# Tools for Better Decision Making

U.S. GRAINS COUNCIL

- ✓ Evaluating trends and factors that impact corn quality
- ✓ Annual Series:
  *Enhancing knowledge over time*
- ✓ Quality at export affected by many factors in the U.S. grain marketing system
- ✓ Corn Export Cargo Quality Report in March 2021 will report U.S. corn quality from samples at export points

# Export Catchment Areas (ECAs)




601 samples from 12 states that account for over 90% of U.S. corn exports

# Quality Factors Tested

U.S. GRAINS COUNCIL

## Grading Factors

- Test weight
- Broken corn
- Foreign material
- Total damage
- Heat damage

## Moisture

## Chemical Composition

- Protein
- Starch
- Oil

## Physical Factors

- Stress cracks
- 100-kernel weight
- Kernel volume
- True density
- Whole kernels
- Horneous (hard) endosperm

## Mycotoxins

- Aflatoxin
- DON (Vomitoxin)
- Fumonisin
- Ochratoxin A
- T-2
- Zearalenone

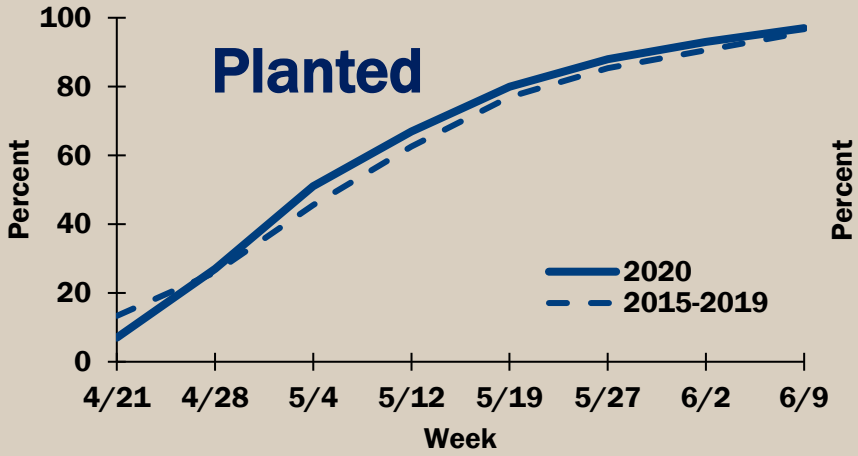
# 2020 Growing Conditions and Impact on Crop Development

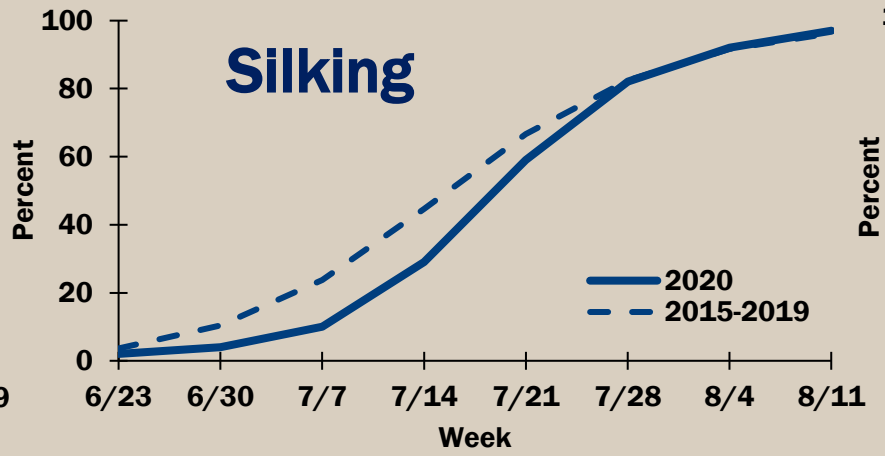
U.S. GRAINS COUNCIL

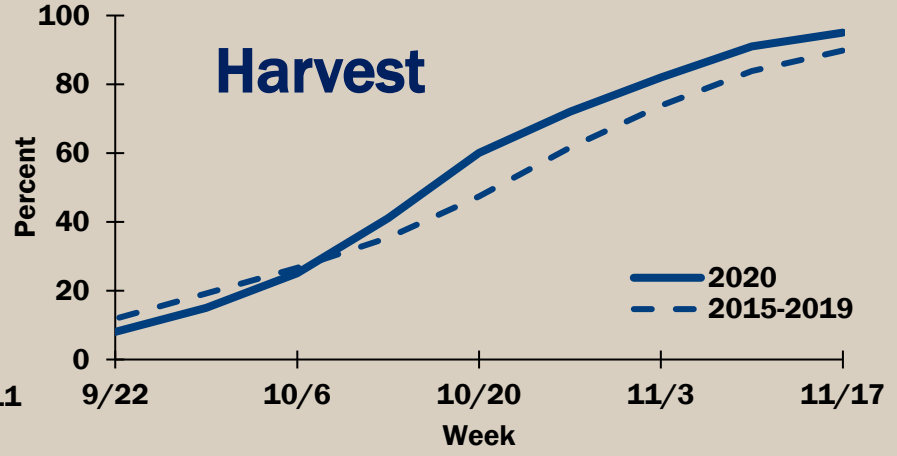
Favorable April and May conditions led to timely planting

Wide-ranging temperatures and precipitation

Late grain-fill was dry and warm, promoting a timely harvest




Favorable weather conditions for crop development

Favorable pollination and crop development

Crop harvested with lower moisture content

# 2020/2021 Corn Harvest Quality Highlights

U.S. GRAINS COUNCIL

## Overall Crop

**67**% of crop rated good or excellent condition & **record high yields**

Harvest about **91**% complete as of November 8, higher than the 5YA† (85%) and 2019 (62%)

## Grade Factors/ Moisture vs. 5YA

Test Weight
**Higher**

BCFM
**Same**

Total Damage
**Lower**

Moisture
**Lower**

## Chemical Composition vs. 5YA

Protein
**Higher**

Starch
**Lower**

Oil
**Lower**

## Physical Factors vs. 5YA

Stress Cracks
**Slightly Higher**

100-Kernel Weight
**Slightly Lower**

True Density
**Similar**

Whole Kernels
**Similar**

## Mycotoxins

**99.4**% of samples ≤ FDA action level for Aflatoxin‡

**100.0%** of samples below FDA advisory level for DON of 5.0 ppm ‡

**98.9**% of samples ≤ FDA Fumonisin guidance level of 5 ppm‡

†5YA = 2015-2019 crop years

‡Action, advisory and guidance levels for corn intended for feed use

# Grade Factors and Moisture

U.S. GRAINS COUNCIL

# Grades and Grade Requirements

U.S. GRAINS COUNCIL

| Grade | Minimum Test Weight | | Maximum Limits of Damaged Kernels | | |
|---|---|---|---|---|---|
| | Pounds per Bushel | Kilogram per Hectoliter | Heat Damage (%) | Total (%) | BCFM (%) |
| U.S. No. 1 | 56.0 | 72.1 | 0.1 | 3.0 | 2.0 |
| U.S. No. 2 | 54.0 | 69.5 | 0.2 | 5.0 | 3.0 |
| U.S. No. 3 | 52.0 | 66.9 | 0.5 | 7.0 | 4.0 |
| U.S. No. 4 | 49.0 | 63.1 | 1.0 | 10.0 | 5.0 |
| U.S. No. 5 | 46.0 | 59.2 | 3.0 | 15.0 | 7.0 |

# USDA Corn Quality Grades

U.S. GRAINS COUNCIL

## The U.S. has a reliable and transparent quality grading system.


**Minimum test weight per bushel:**
56 pounds (25.4 kg)
**Maximum limits:**
0.1% heat damaged
3% total damaged
2% BCFM


**Minimum test weight per bushel:**
54 pounds (24.5 kg)
**Maximum limits:**
0.2% heat damaged
5% total damaged
3% BCFM


**Minimum test weight per bushel:**
52 pounds (23.6 kg)
**Maximum limits:**
0.5% heat damaged
7% total damaged
4% BCFM


**Minimum test weight per bushel:**
49 pounds (22.2 kg)
**Maximum limits:**
1% heat damaged
10% total damaged
5% BCFM


**Minimum test weight per bushel:**
46 pounds (20.9 kg)
**Maximum limits:**
3% heat damaged
15% total damaged
7% BCFM

- **Buyers should contract** quality requirements and non-grade factors.
- **Final corn quality** is also impacted by movement through export marketing channels.

U.S. GRAINS COUNCIL
www.grains.org

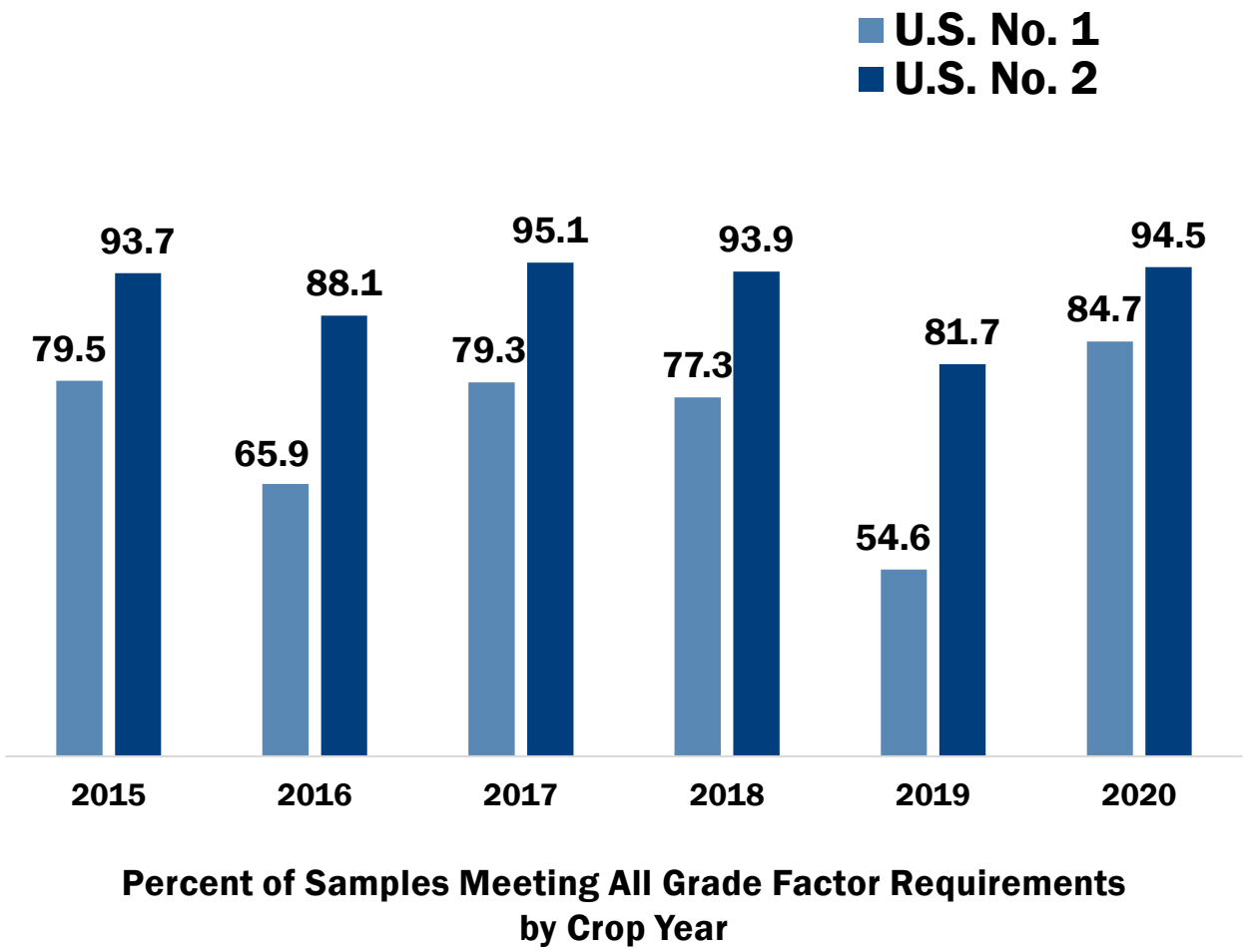
# Grade Factors and Moisture

U.S. GRAINS COUNCIL

| | Number of Samples | Average | Standard Deviation | Minimum | Maximum |
|---|---|---|---|---|---|
| Test Weight (lb/bu) | 601 | 58.7 | 1.22 | 52.6 | 62.5 |
| Test Weight (kg/hl) | 601 | 75.5 | 1.57 | 67.7 | 80.4 |
| BCFM (%) | 601 | 0.8 | 0.49 | 0.1 | 8.8 |
| Broken Corn (%) | 601 | 0.6 | 0.34 | 0.0 | 2.8 |
| Foreign Material (%) | 601 | 0.2 | 0.22 | 0.0 | 8.3 |
| Total Damage (%) | 601 | 1.1 | 1.06 | 0.0 | 18.3 |
| Heat Damage (%) | 601 | 0.0 | 0.00 | 0.0 | 0.1 |
| Moisture (%) | 585 | 15.8 | 1.97 | 9.2 | 29.0 |

# Grade Factors Summary

- **84.7%** of samples No. 1 grade (54.6% in 2019)
- **94.5%** of samples No. 2 grade (81.7% in 2019)
- Average aggregate quality of the 601 samples tested was better than all grade factor requirements for U.S. No. 1 grade

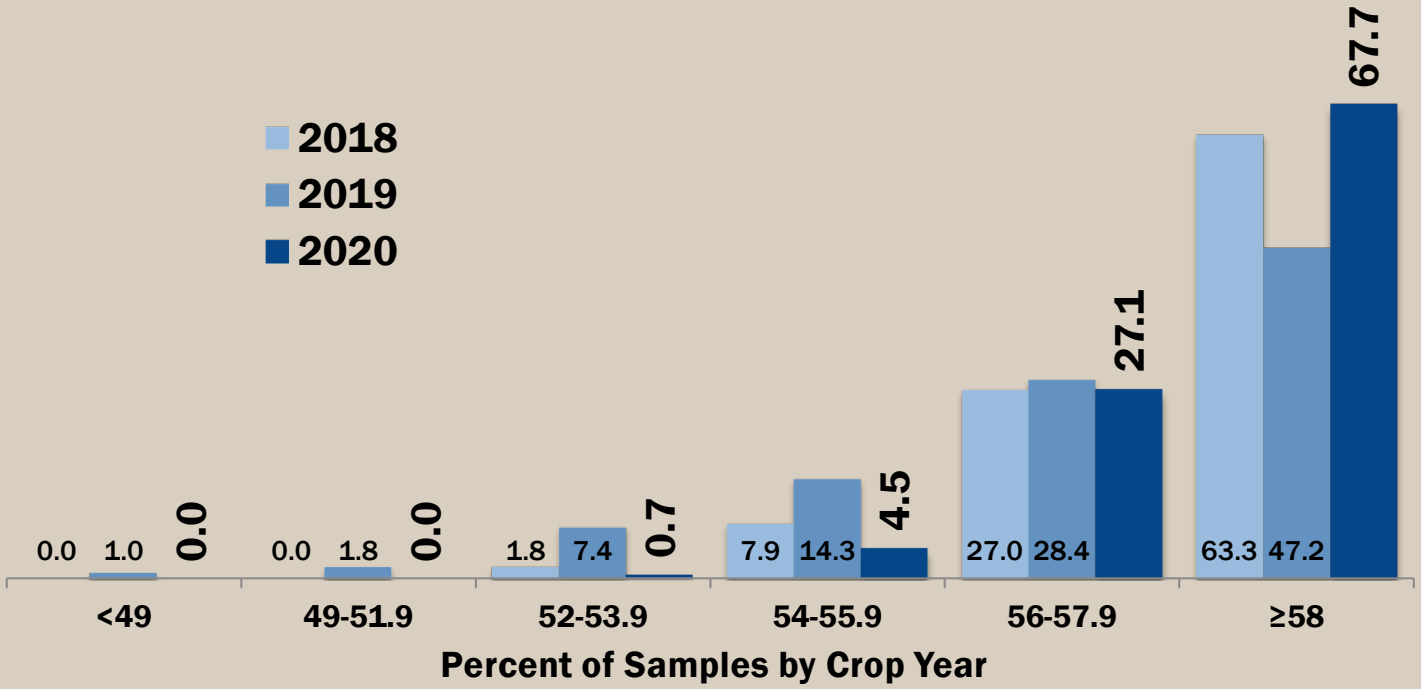


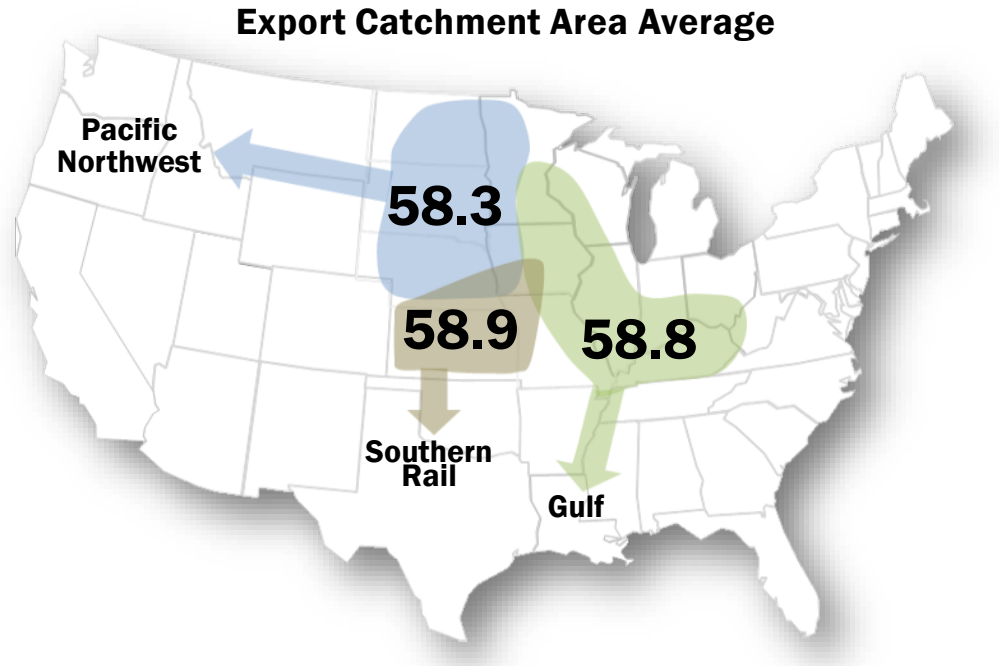

Percent of Samples Meeting All Grade Factor Requirements by Crop Year

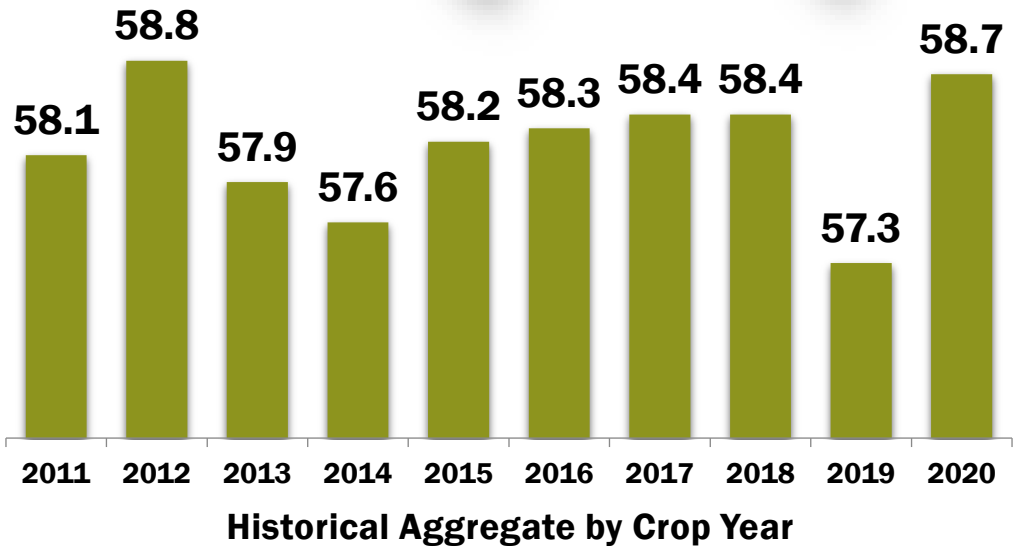
# Test Weight — U.S. Units

## U.S. Aggregate: 58.7 lb/bu

- Average **higher** than the 5YA (58.1 lb/bu)
- **94.8%** No. 1 grade (75.6% in 2019)



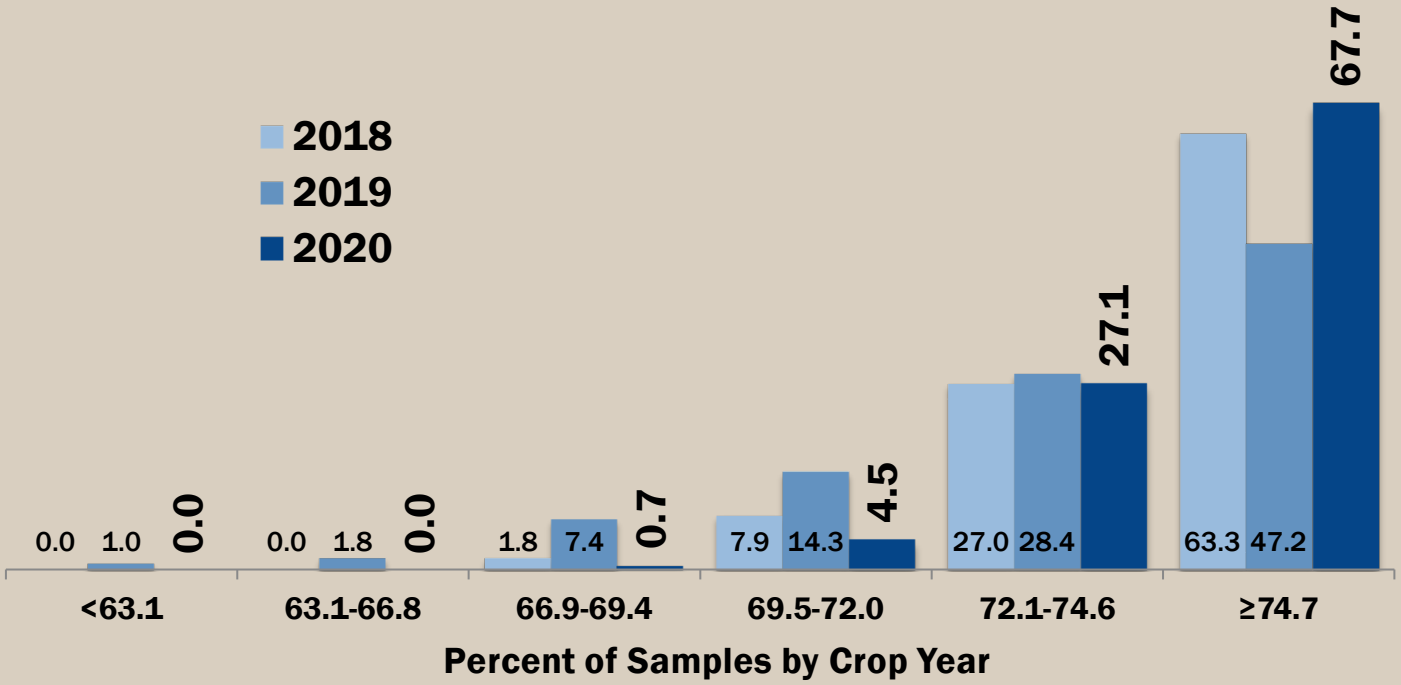



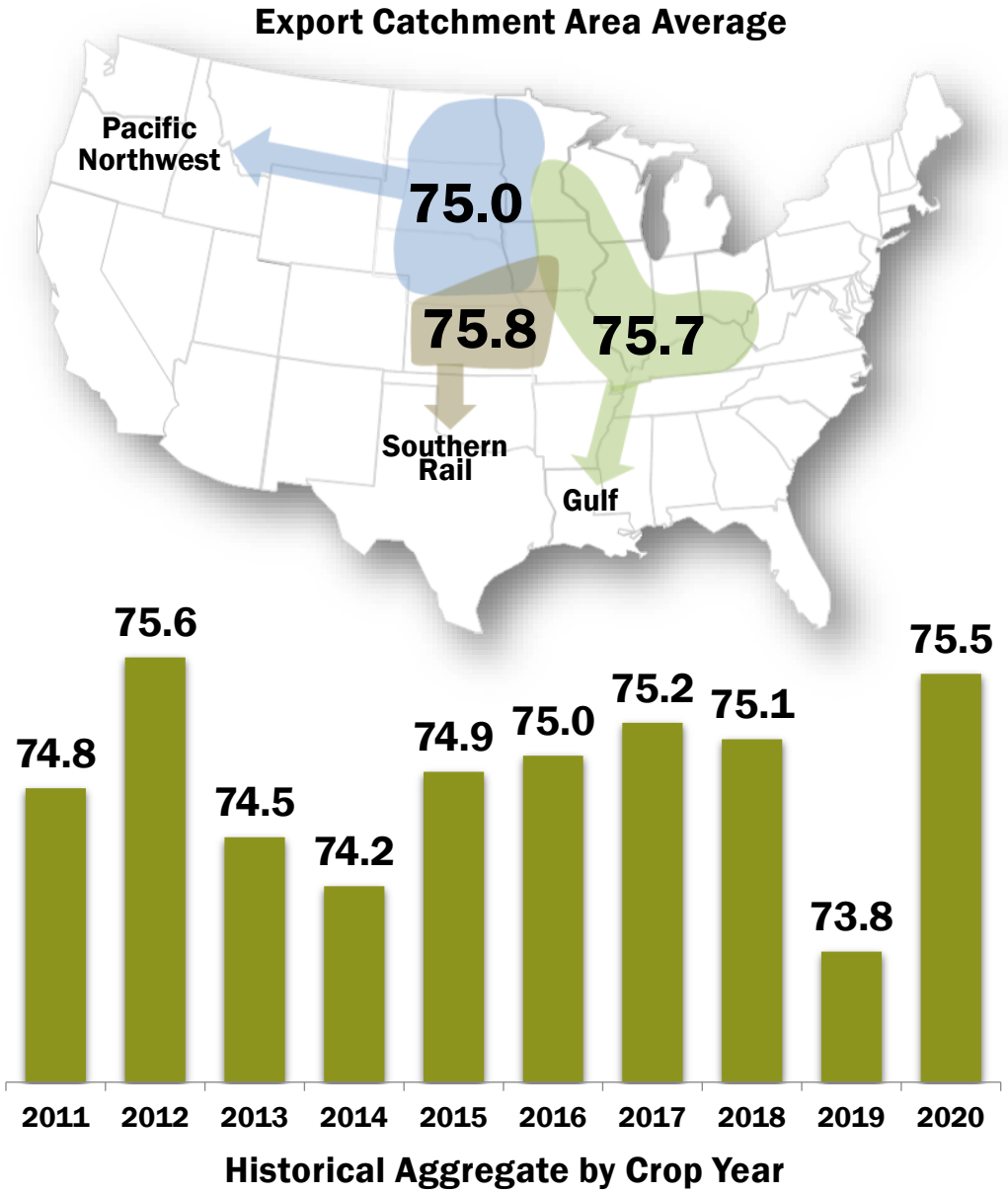



# Test Weight — Metric

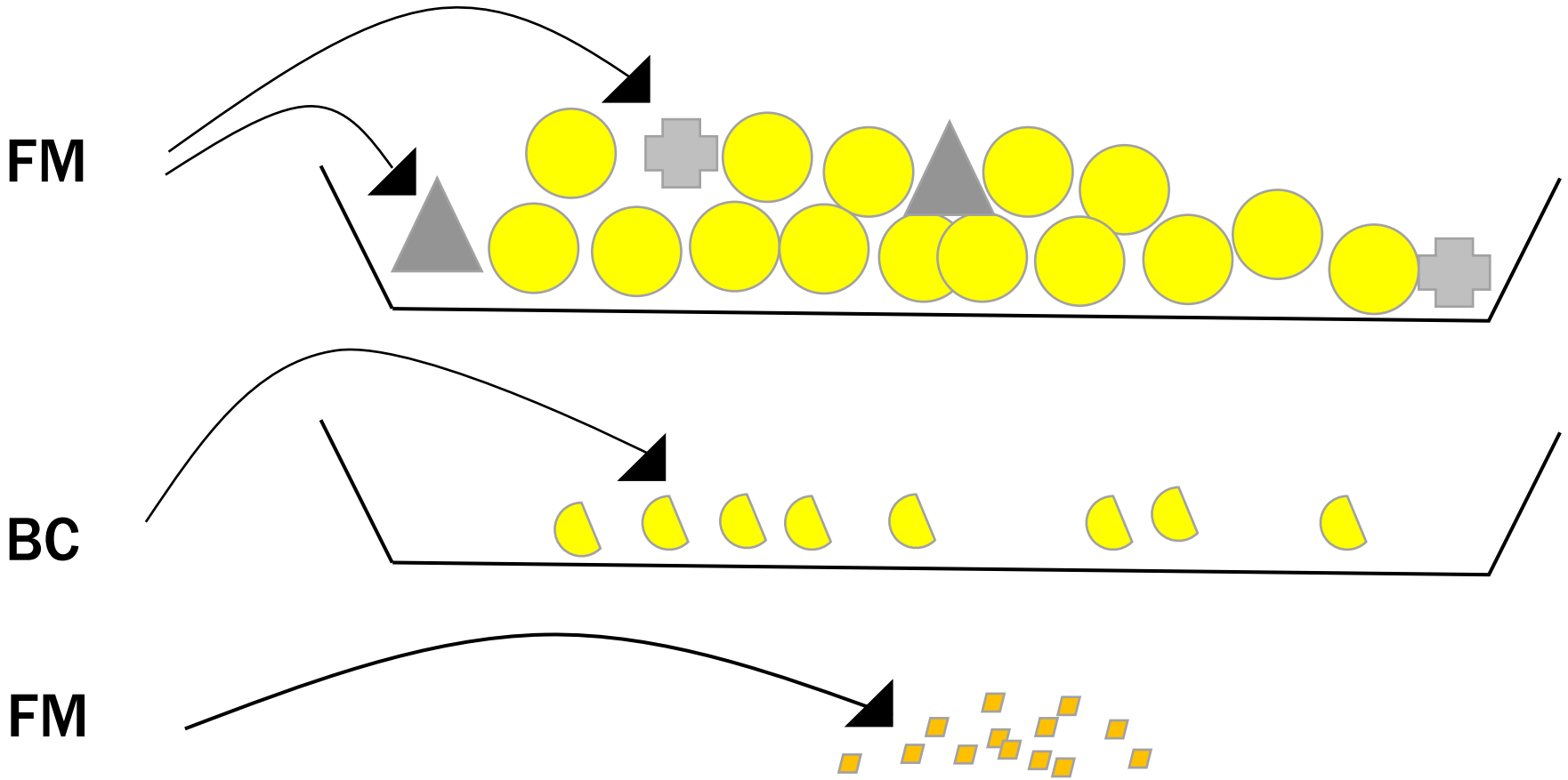
## U.S. Aggregate: 75.5 kg/hl

- Average higher than the 5YA (74.8 kg/hl)
- 94.8% No. 1 grade (75.6% in 2019)



# Broken Corn and Foreign Material*




**Sieve Size**
12/64 inches
(0.476 cm)

**Sieve Size**
6/64 inches
(0.238 cm)

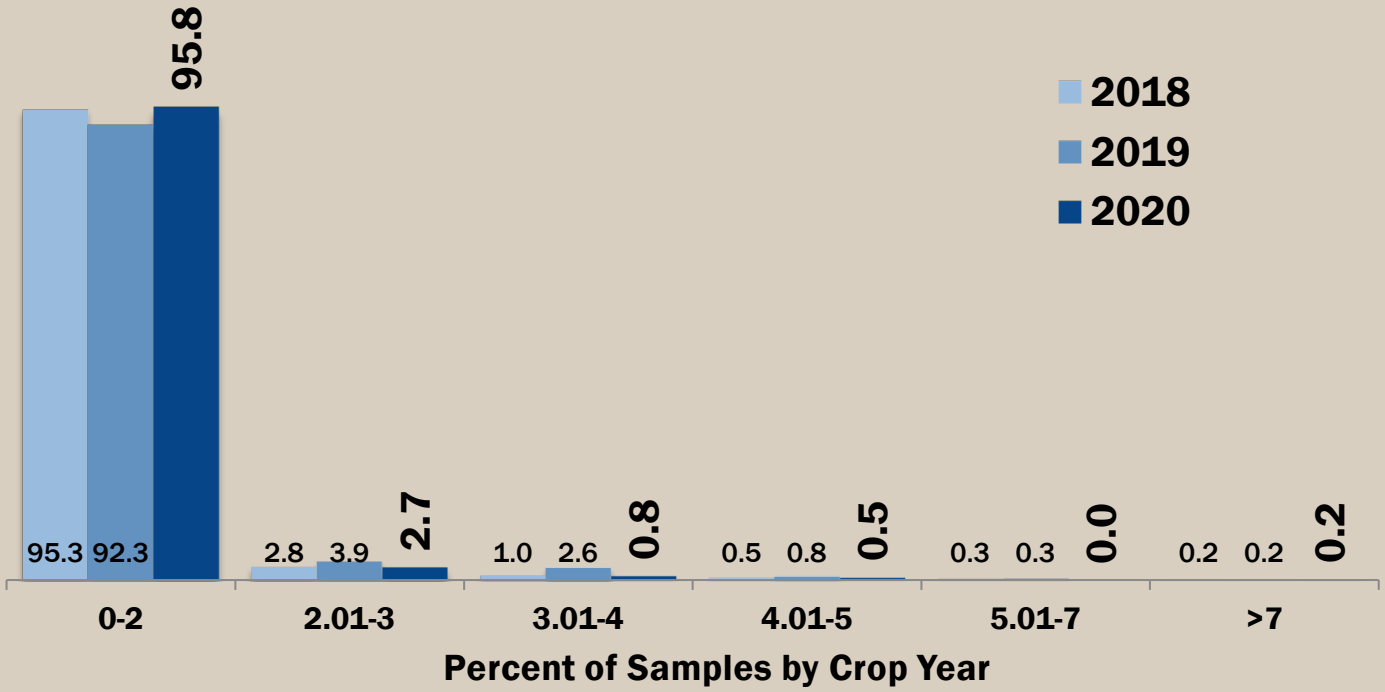
* Measured as percent of weight

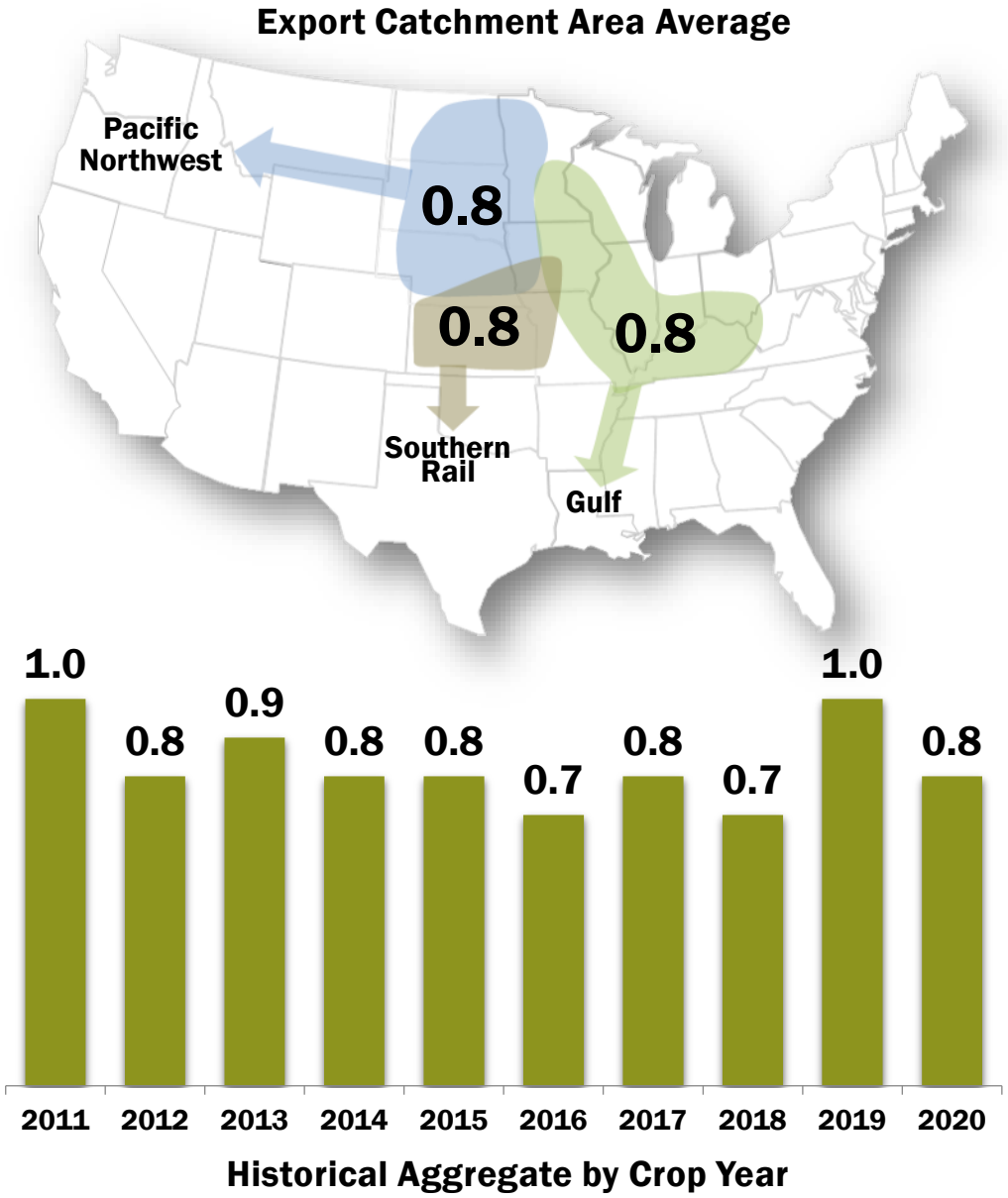
# Broken Corn and Foreign Material (%)

U.S. GRAINS COUNCIL

## U.S. Aggregate: 0.8%

- 95.8% No. 1 grade
- Average same as the 5YA (0.8%)

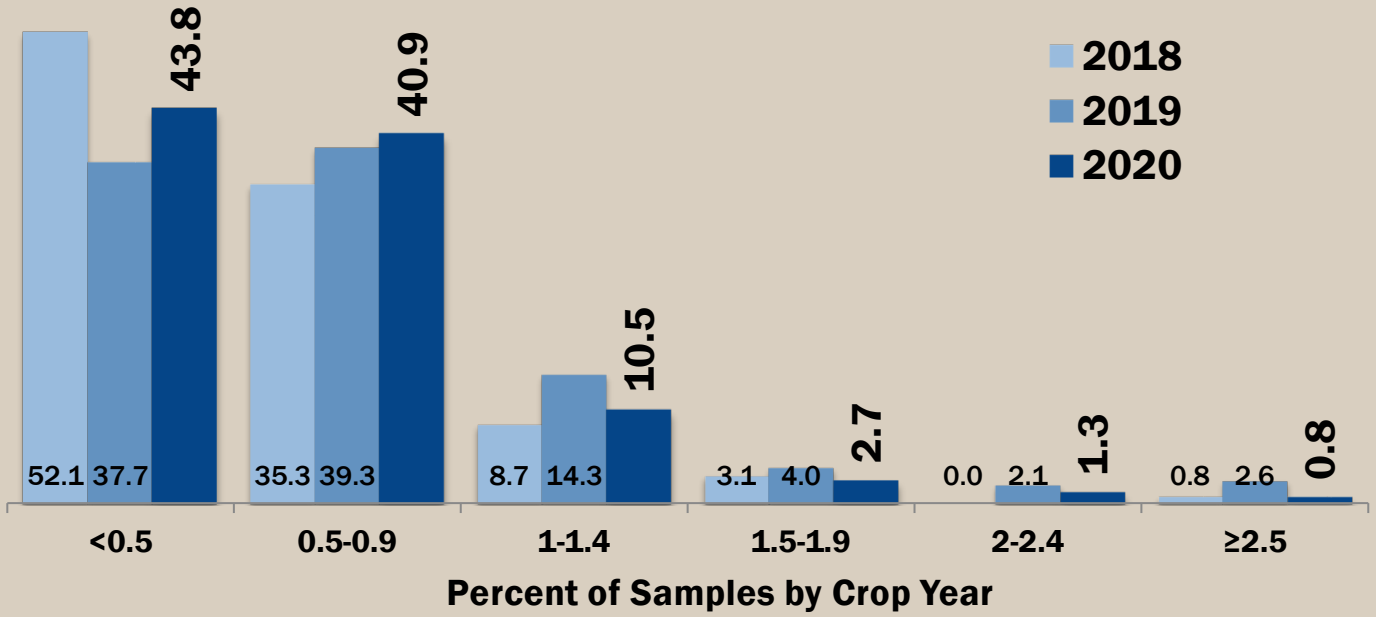


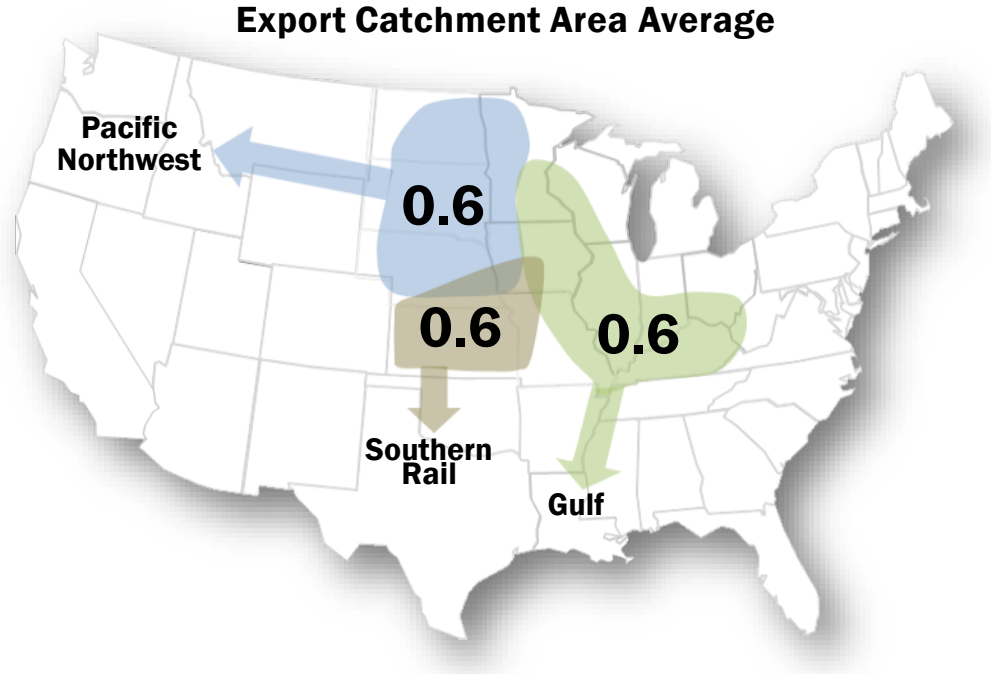



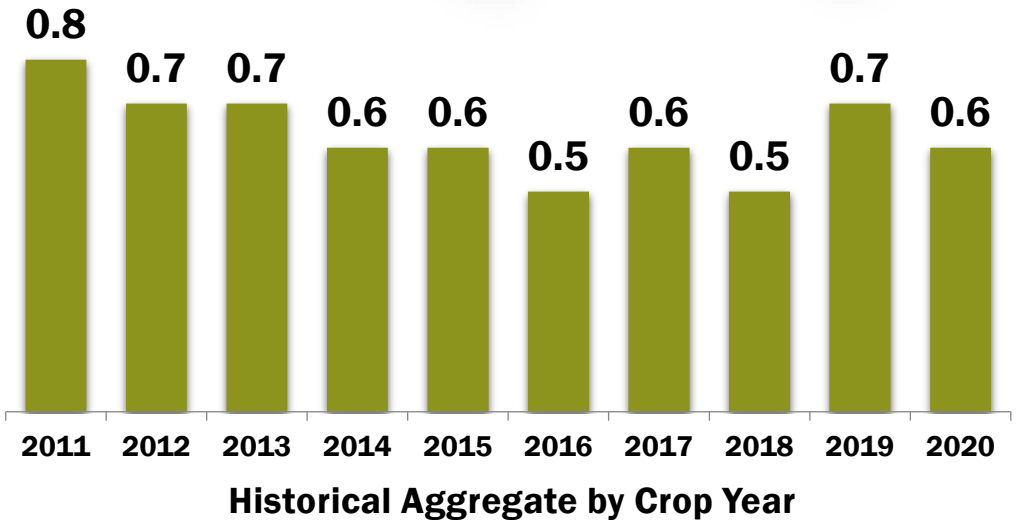
# Broken Corn (%)

## U.S. Aggregate: 0.6%

- Average **same** as the 5YA (0.6%)



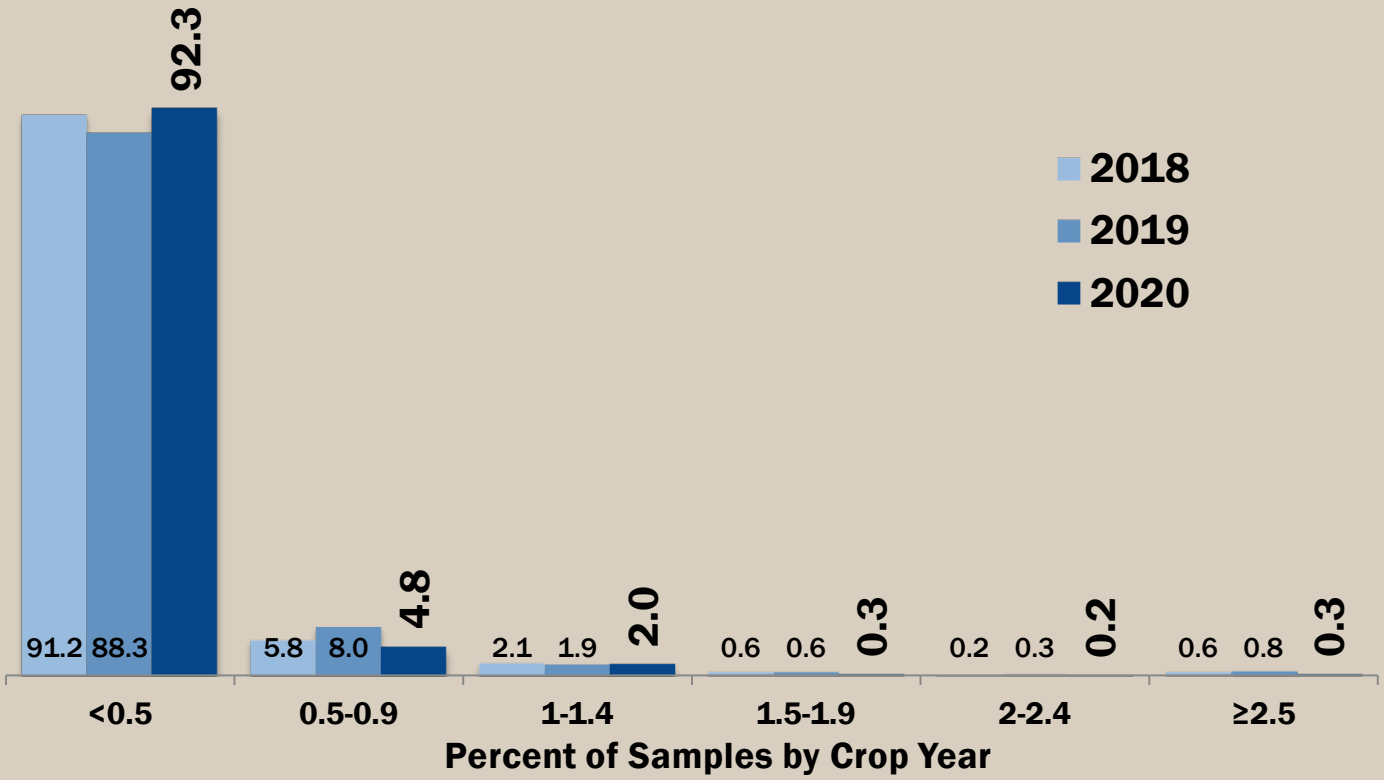



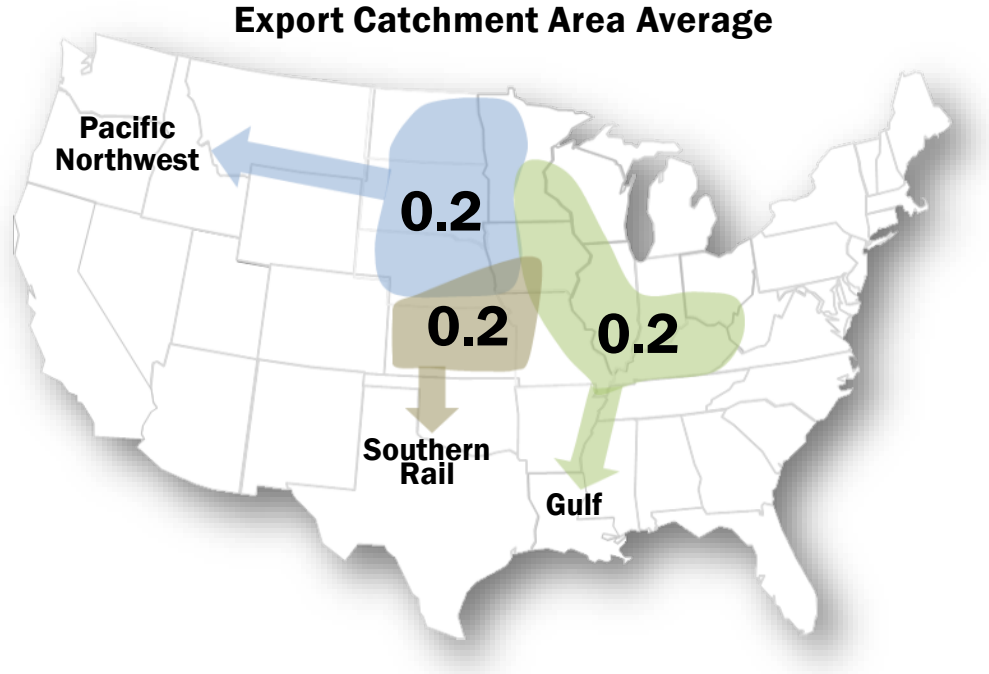



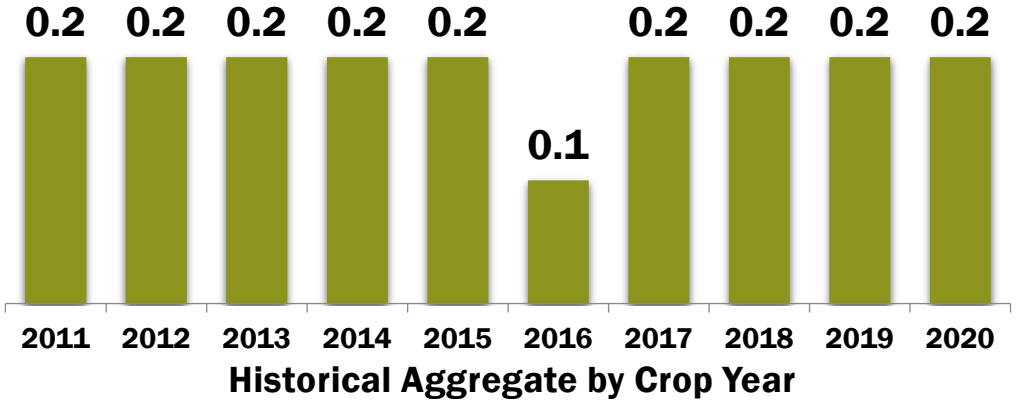
# Foreign Material (%)

## U.S. Aggregate: 0.2%

- Average **same** as the 5YA (0.2%)
- **92.3%** contained less than 0.5% FM

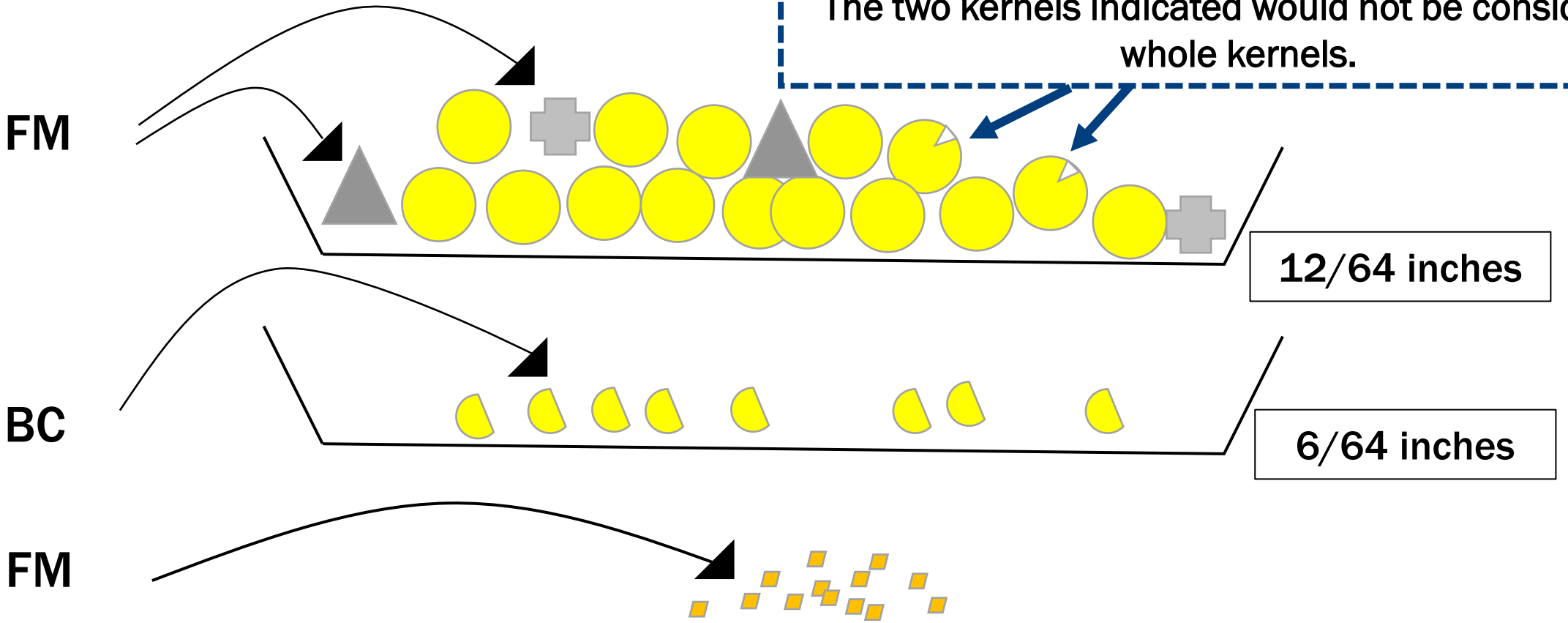


# Whole Kernels (%)

Whole kernels measures the percentage of BCFM-free kernels that are free of chips and pericarp damage. The two kernels indicated would not be considered whole kernels.

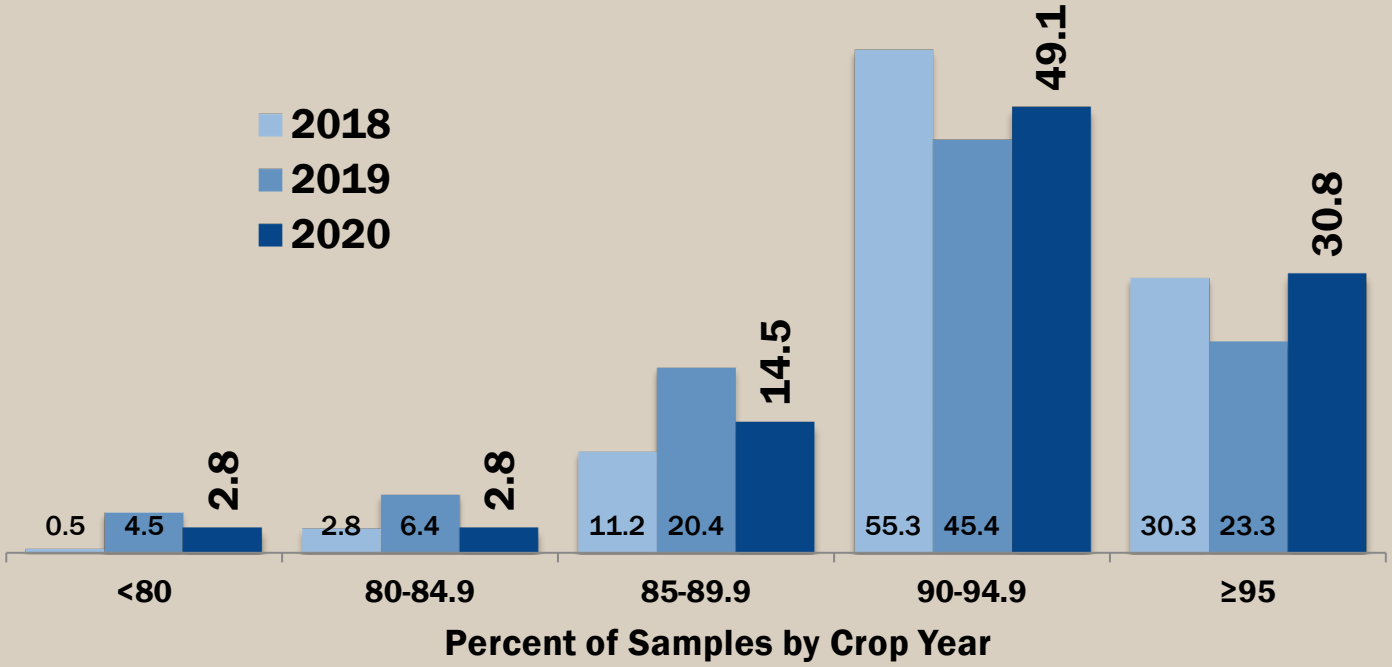


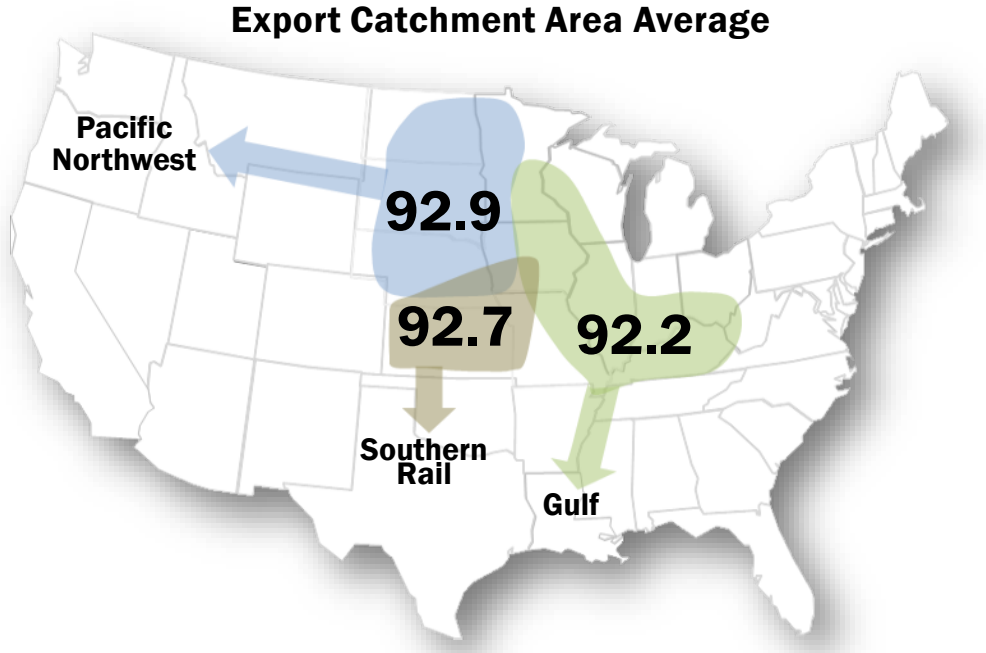
# Whole Kernels (%)

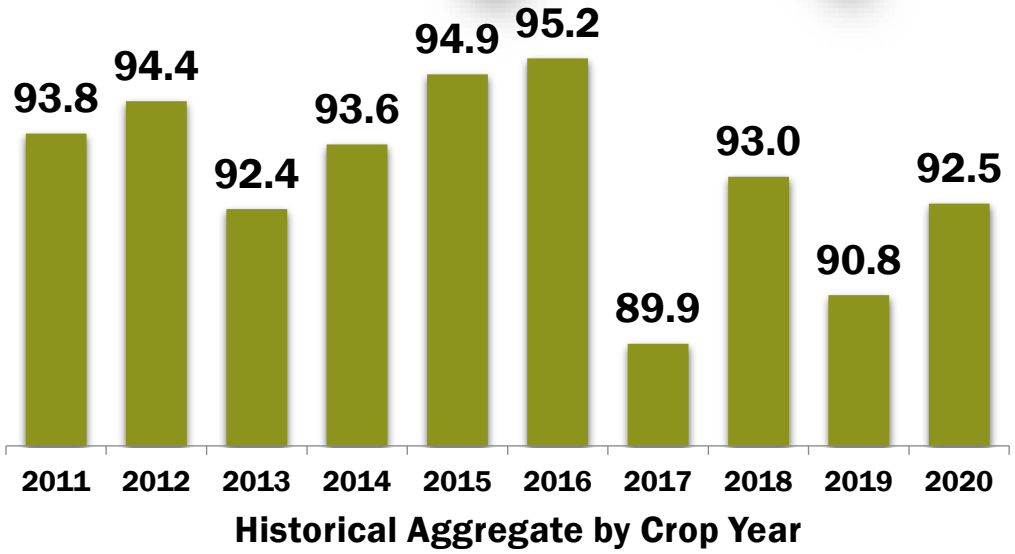
U.S. GRAINS COUNCIL

## U.S. Aggregate: 92.5%

- Not a grade factor
- Average **similar** to the 5YA (92.8%)



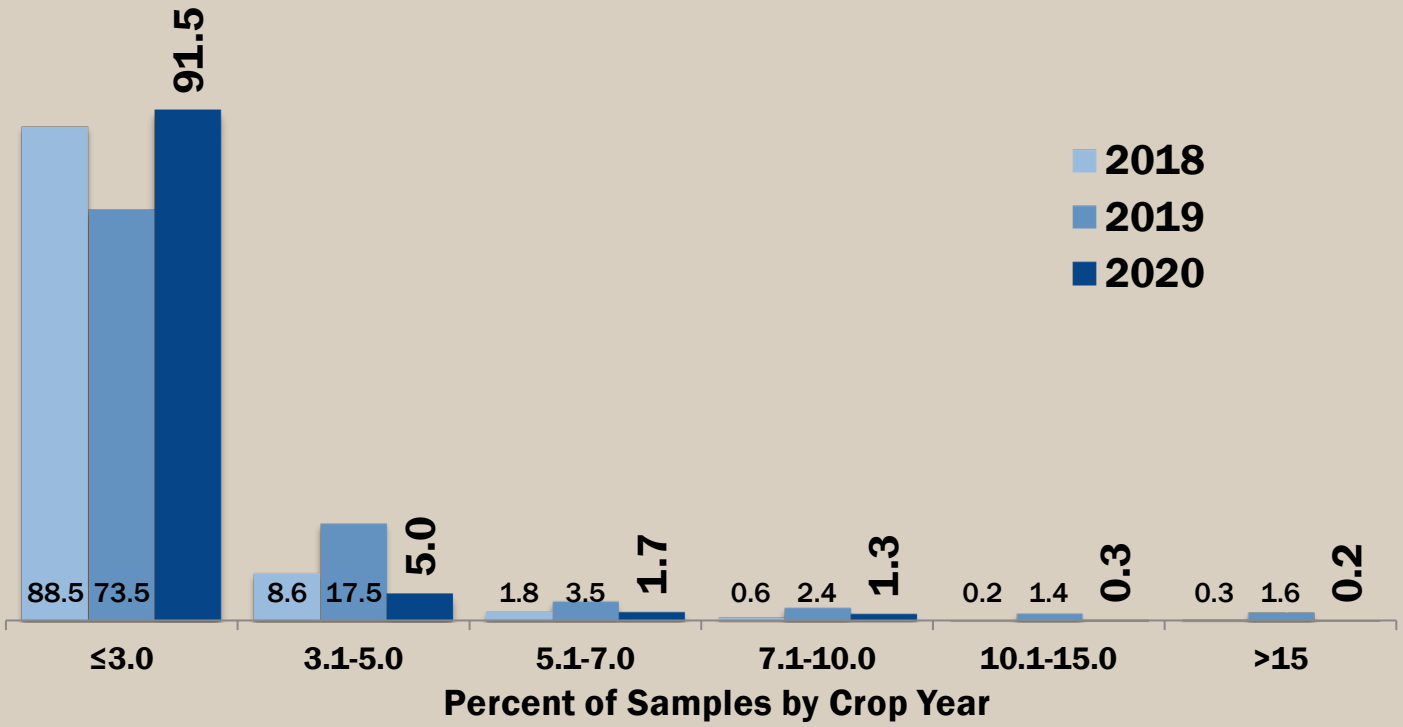



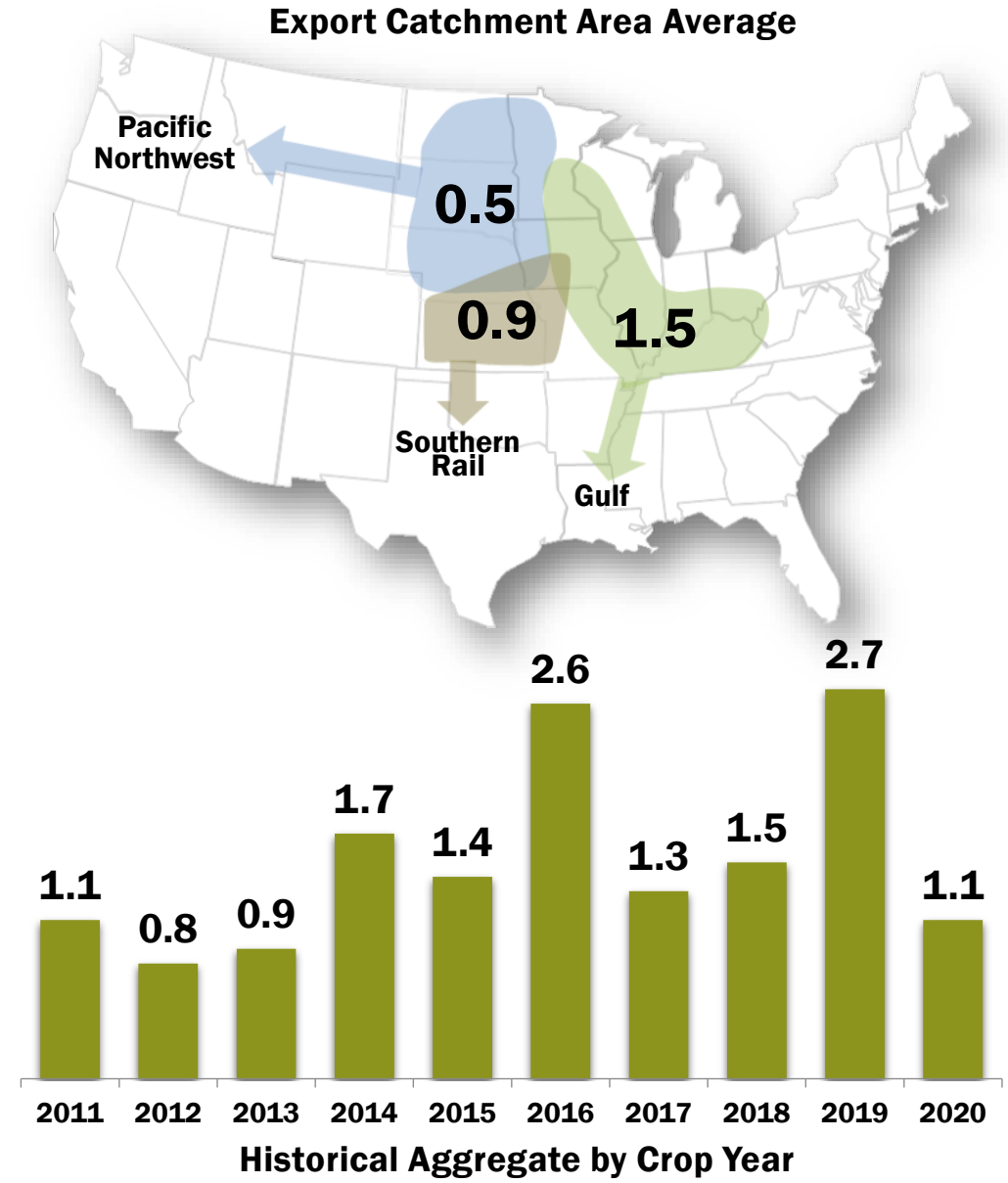
# Total Damage and Heat Damage (%)

U.S. GRAINS COUNCIL

## U.S. Aggregate: 1.1%

- Average **lower** than the 5YA (1.9%)
- **91.5%** No. 1 grade (73.5% in 2019)
- Average heat damage of **0.0%**

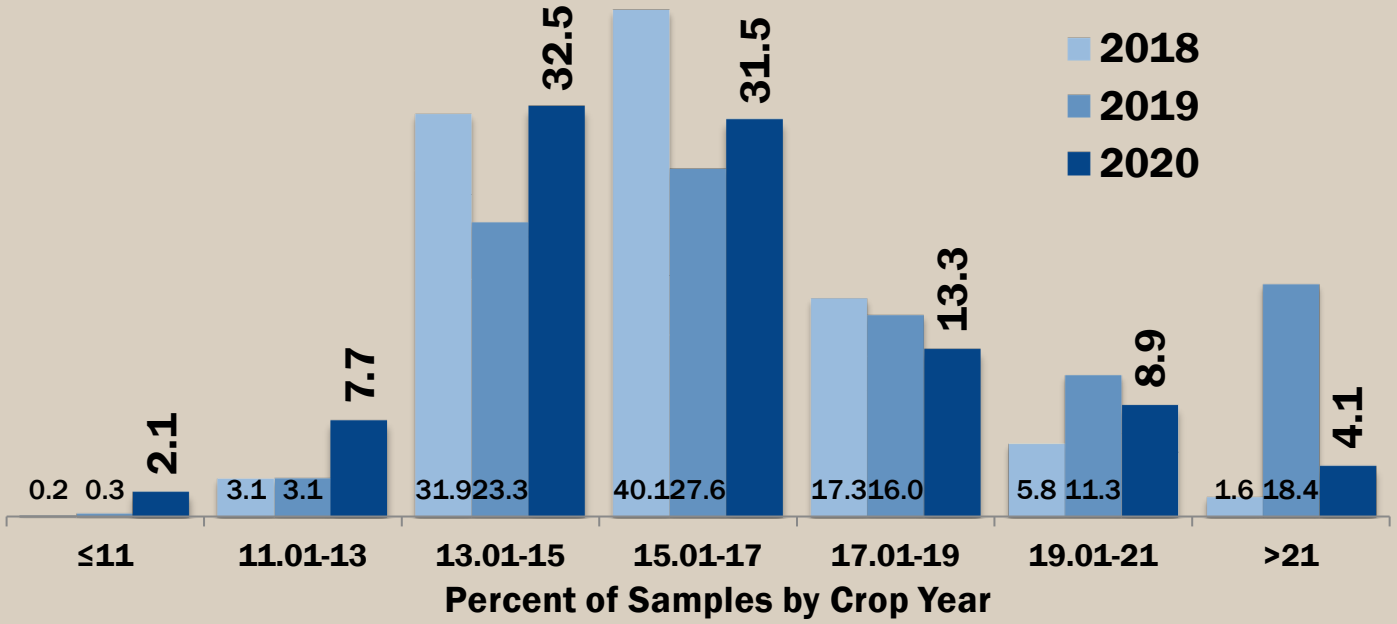


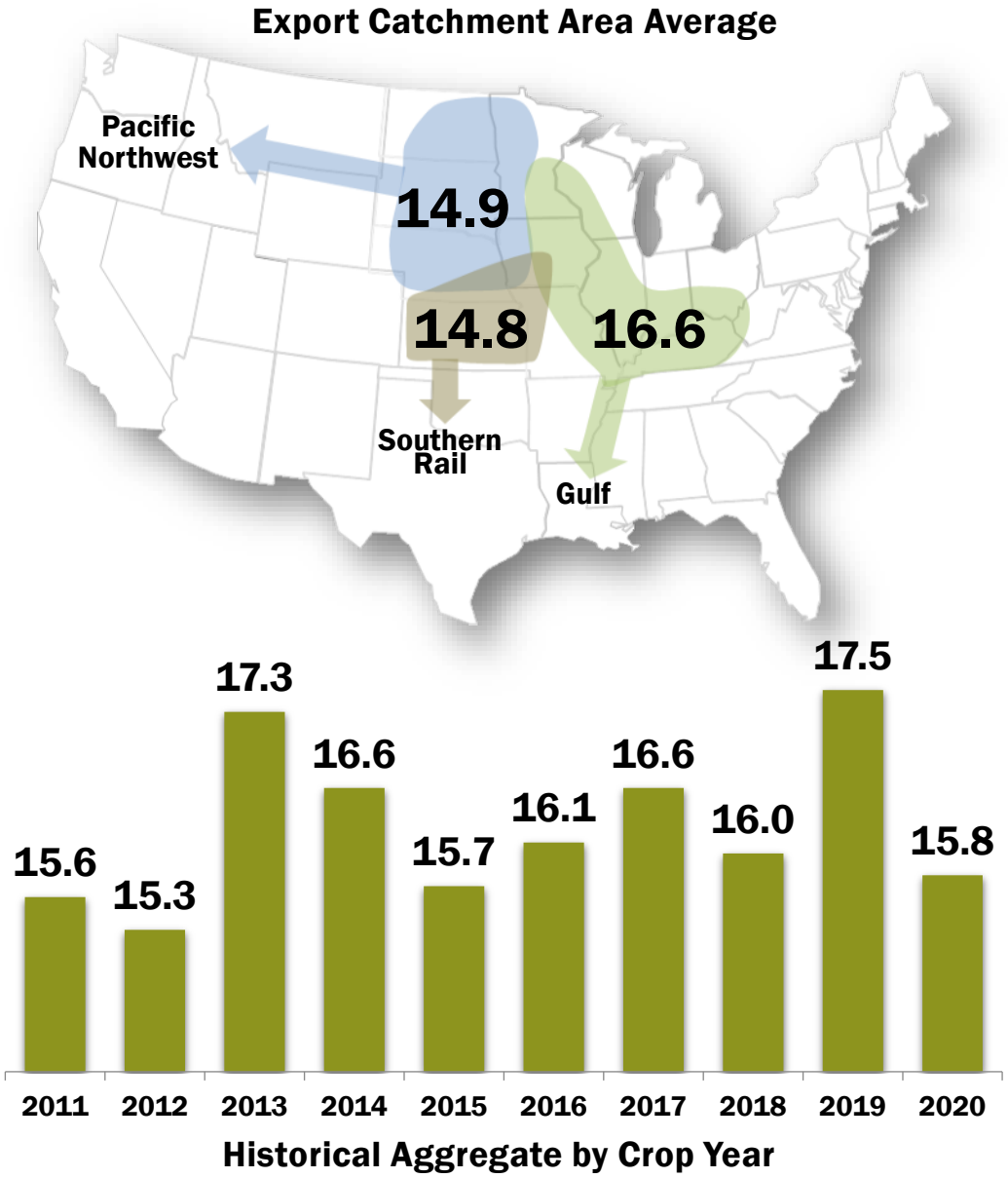



# Moisture (%)

## U.S. Aggregate: 15.8%

- Average lower than the 5YA (16.4%)
- Lower percentage high moisture (>17.0%)



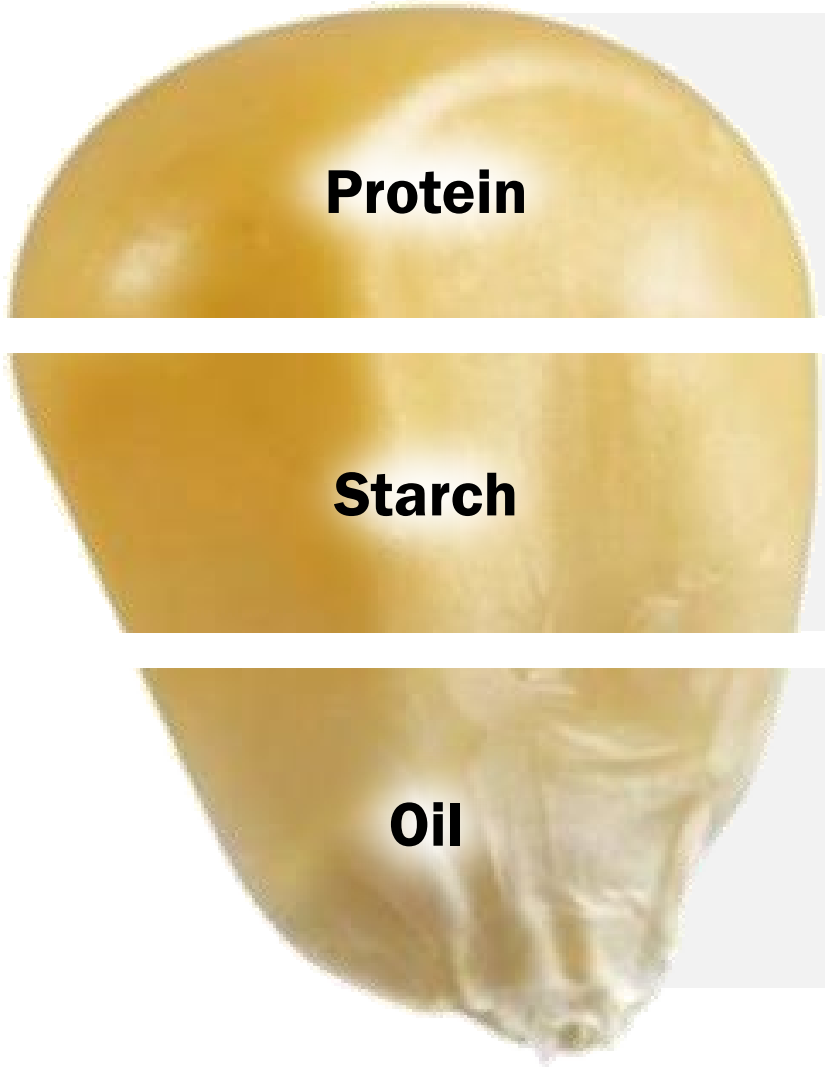



# Chemical Composition

U.S. GRAINS COUNCIL

# Chemical Composition

U.S. GRAINS COUNCIL




| | | | |
|---|---|---|---|
| **Protein** | Important for poultry and livestock feeding<br>Supplies essential amino acids | Influenced by | Genetics, weather, crop yields and available nitrogen during the growing season |
| **Starch** | Important for wet millers and dry-grind ethanol manufacturers | Influenced by | Genetics, weather and crop yields |
| **Oil** | Important by-product of wet and dry milling<br>Essential feed component | | |

# Chemical Composition

U.S. GRAINS COUNCIL

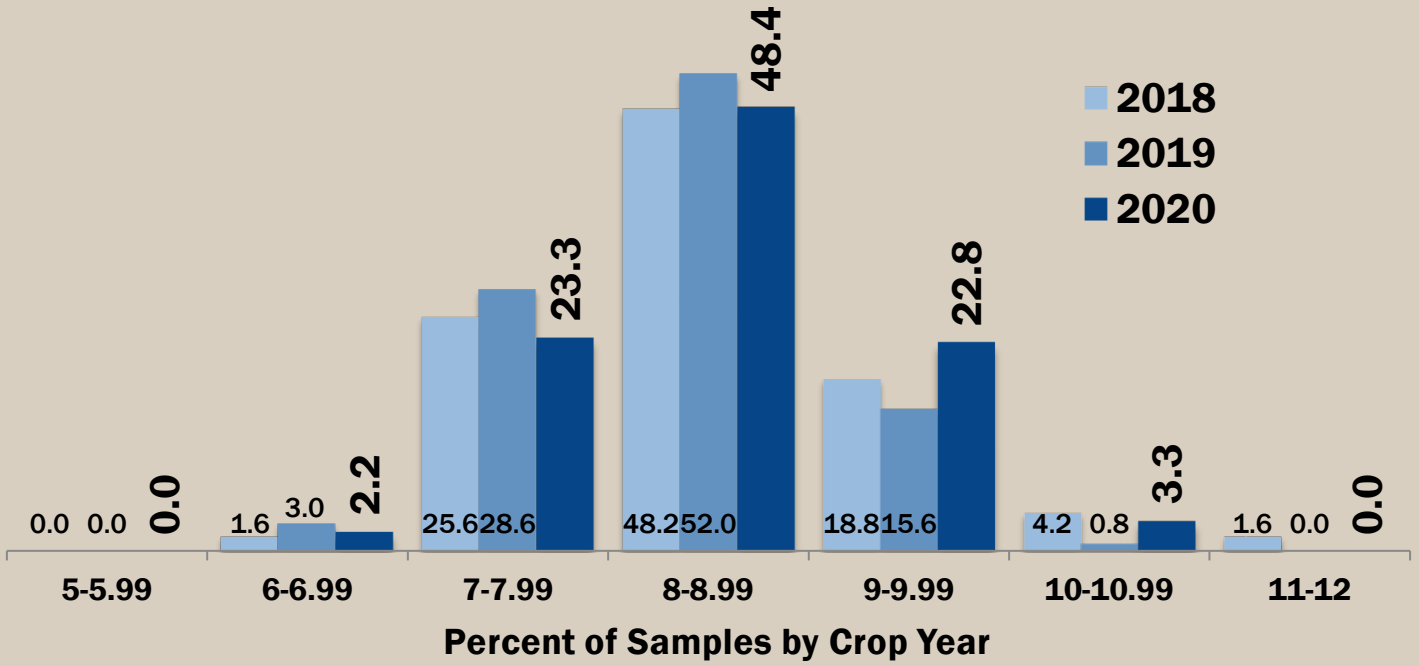
| | Number of Samples | Average | Standard Deviation | Minimum | Maximum |
|---|---|---|---|---|---|
| Protein (Dry Basis %) | 601 | 8.5 | 0.58 | 6.1 | 10.7 |
| Starch (Dry Basis %) | 601 | 72.2 | 0.61 | 69.7 | 74.5 |
| Oil (Dry Basis %) | 601 | 3.9 | 0.22 | 3.2 | 4.8 |

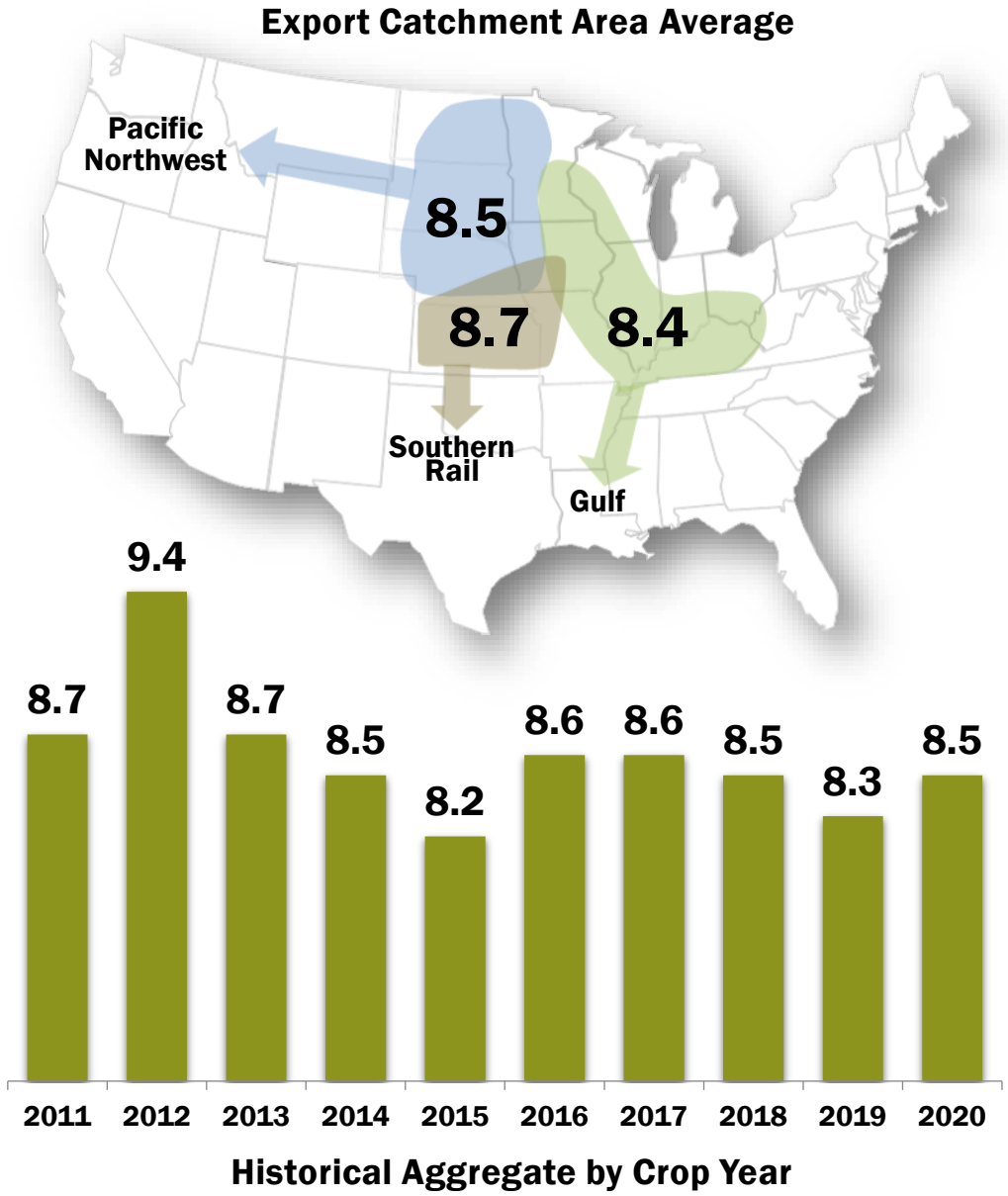
# Protein (Dry Basis %)

U.S. GRAINS COUNCIL

## U.S. Aggregate: 8.5%

- Average **slightly higher** than the 5YA (8.4%)
- **Higher** percentage with ≥9.0% protein

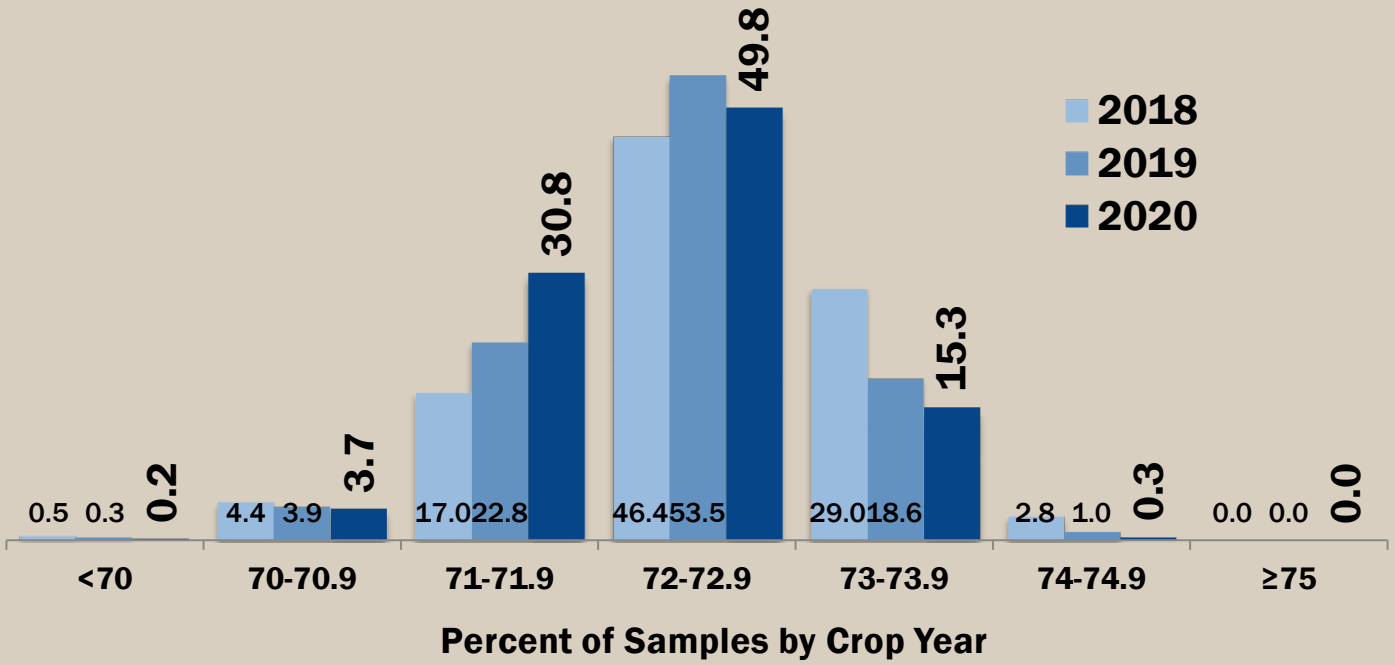


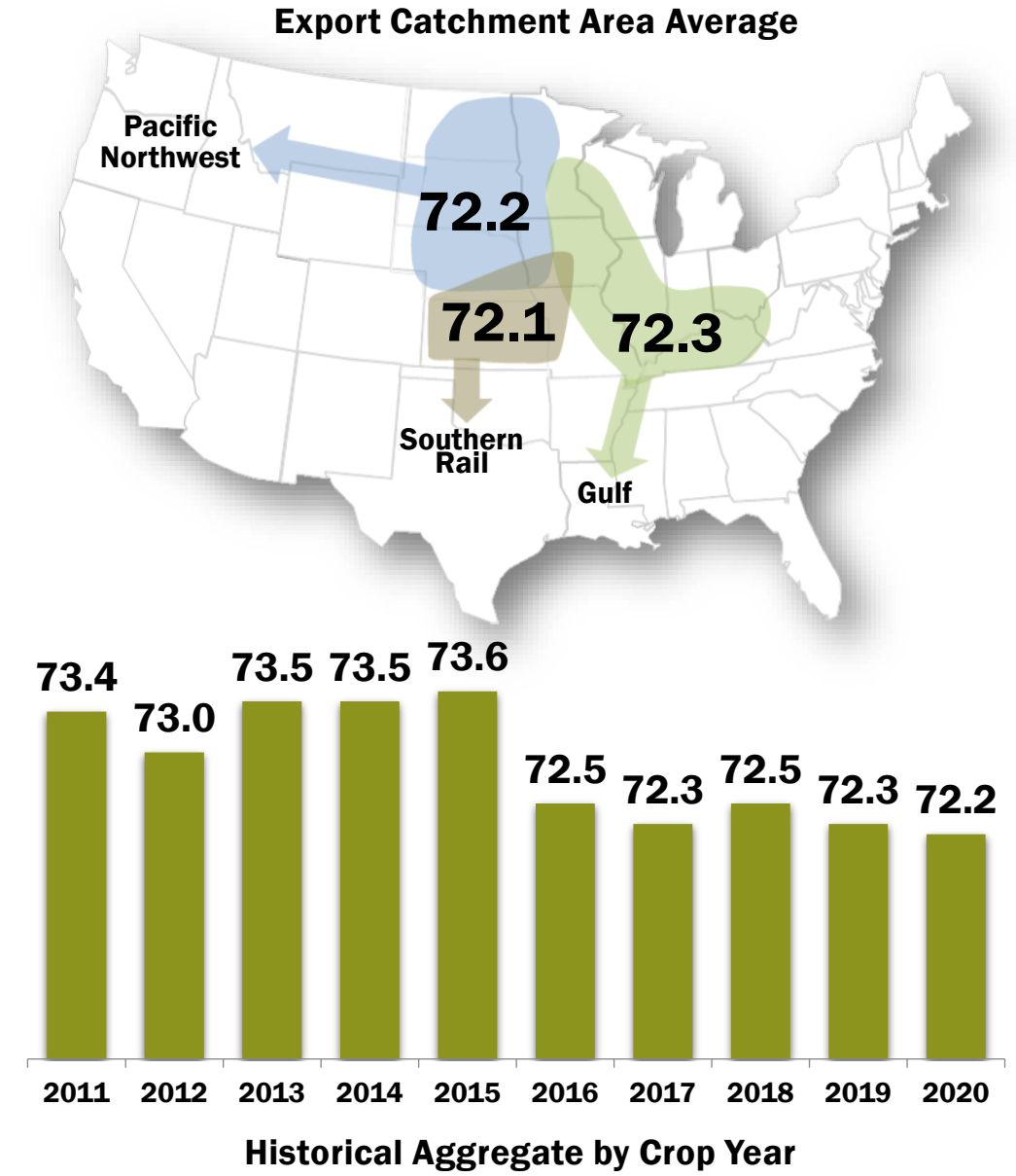



# Starch (Dry Basis %)

## U.S. Aggregate: 72.2%

- Average **slightly lower** than the 5YA (72.6%)
- **Gulf** ECA tends to have the highest average starch

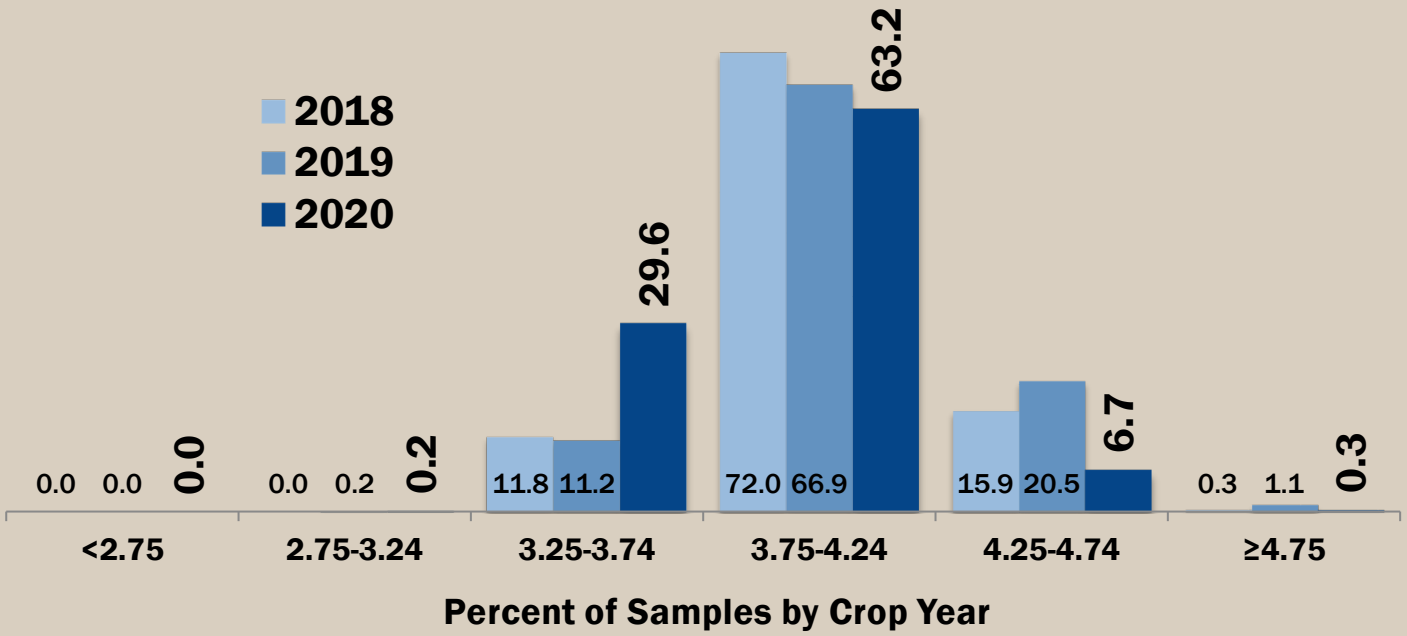


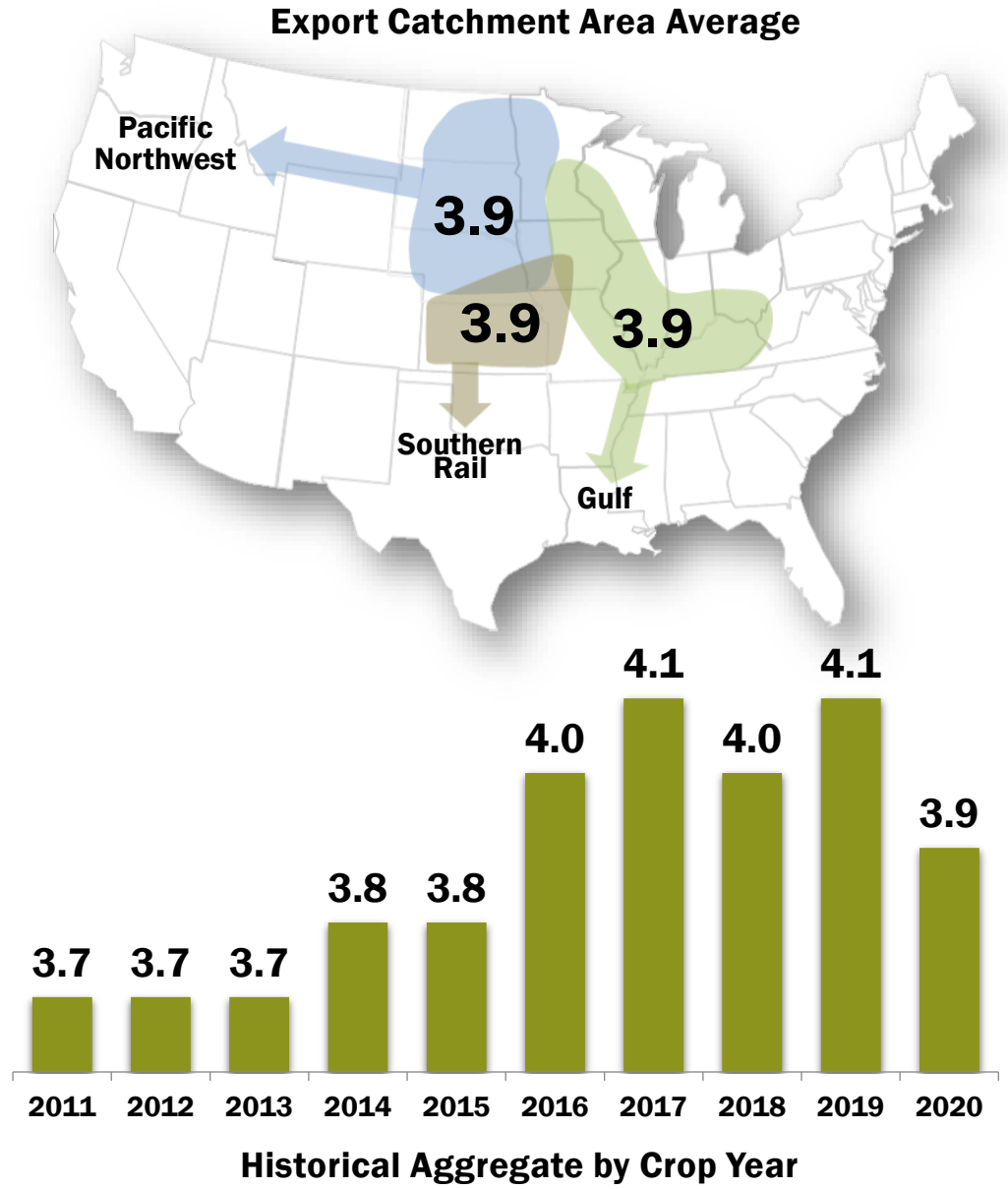



# Oil (Dry Basis %)

## U.S. Aggregate: 3.9%

- Average **slightly lower** than the 5YA (4.0%)
- **Similar** averages across ECAs

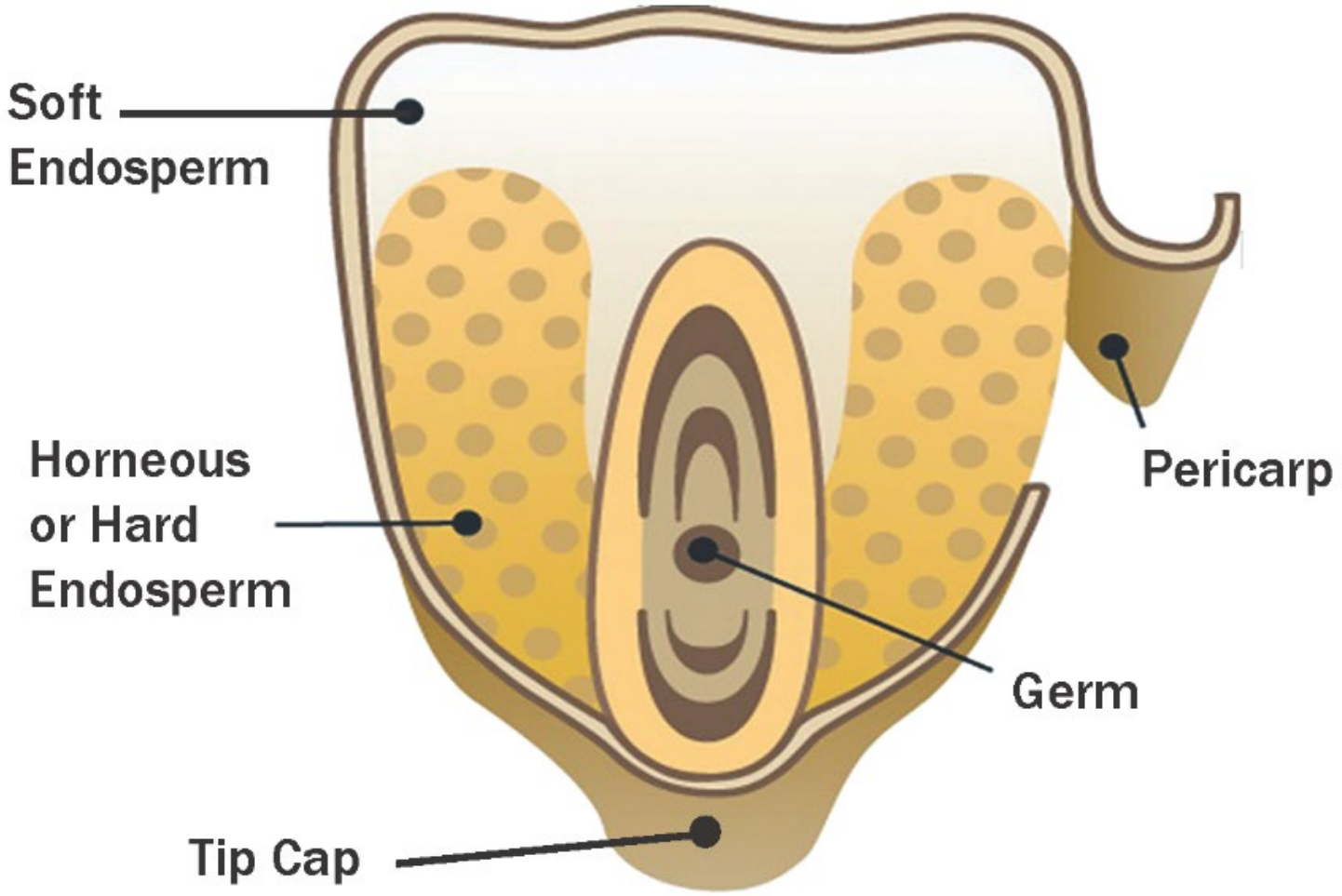


# Physical Factors

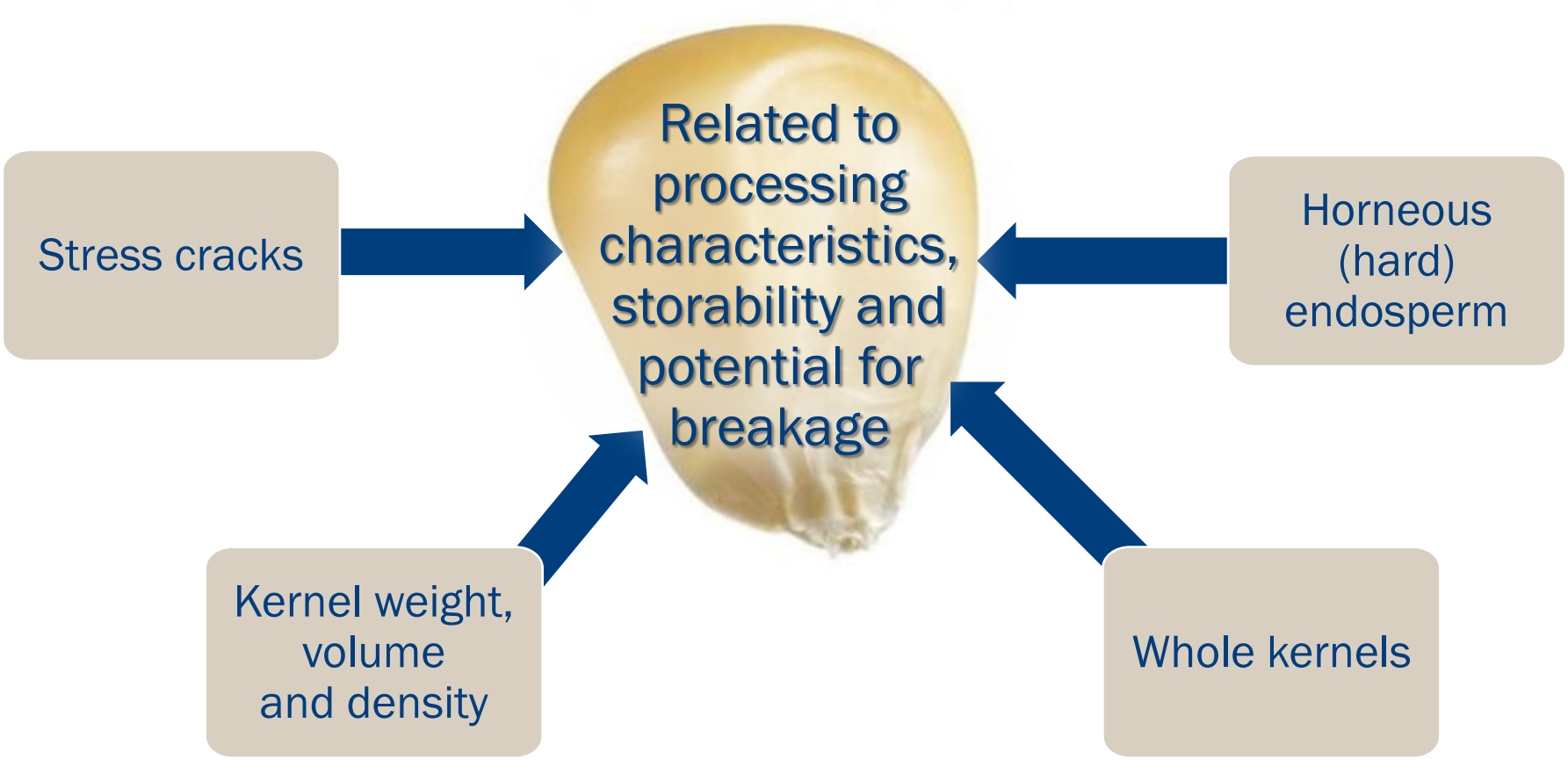
U.S. GRAINS COUNCIL

# Corn Morphology




Source: Adapted from Corn Refiners Association, 2011

# Physical Factors – Overview



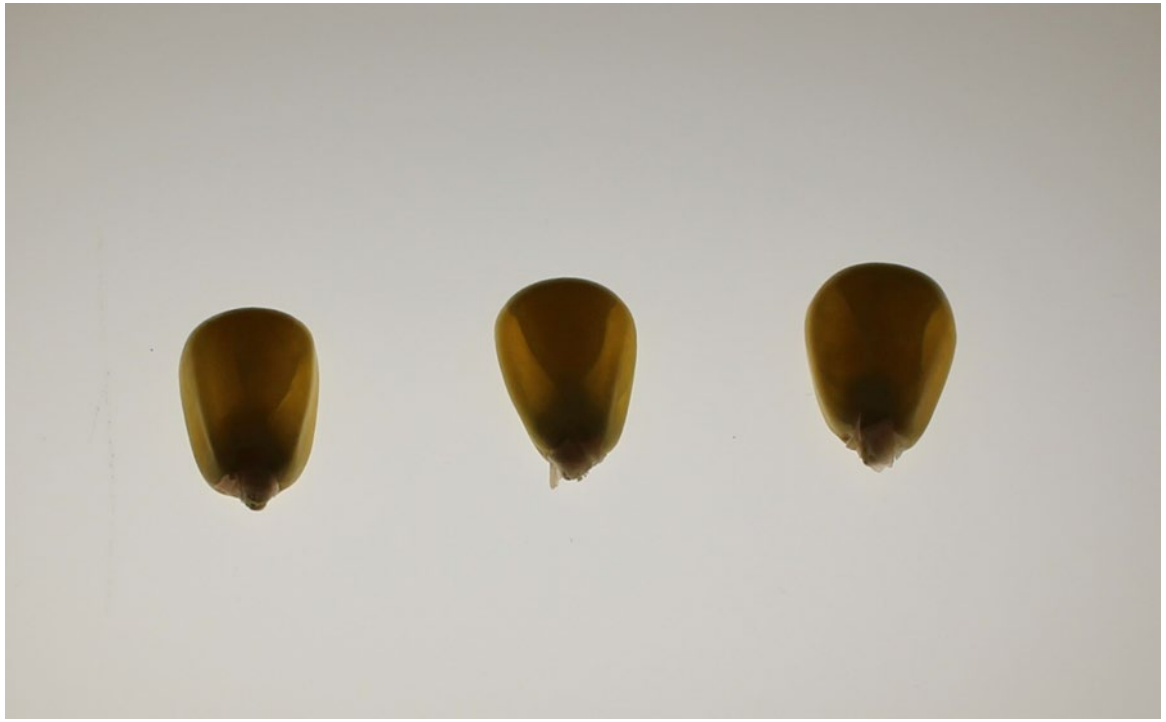
# Physical Factors

U.S. GRAINS COUNCIL

| | Number of Samples | Average | Standard Deviation | Minimum | Maximum |
|---|---|---|---|---|---|
| Stress Cracks (%) | 601 | 6 | 5 | 0 | 80 |
| 100-Kernel Weight (g) | 180 | 34.53 | 3.64 | 22.32 | 43.18 |
| Kernel Volume ($cm^3$) | 180 | 0.27 | 0.03 | 0.19 | 0.33 |
| True Density ($g/cm^3$) | 180 | 1.255 | 0.023 | 1.171 | 1.312 |
| Whole Kernels (%) | 601 | 92.5 | 3.9 | 35.8 | 99.6 |
| Horneous Endosperm (%) | 180 | 81 | 4 | 72 | 92 |

# Stress Cracks

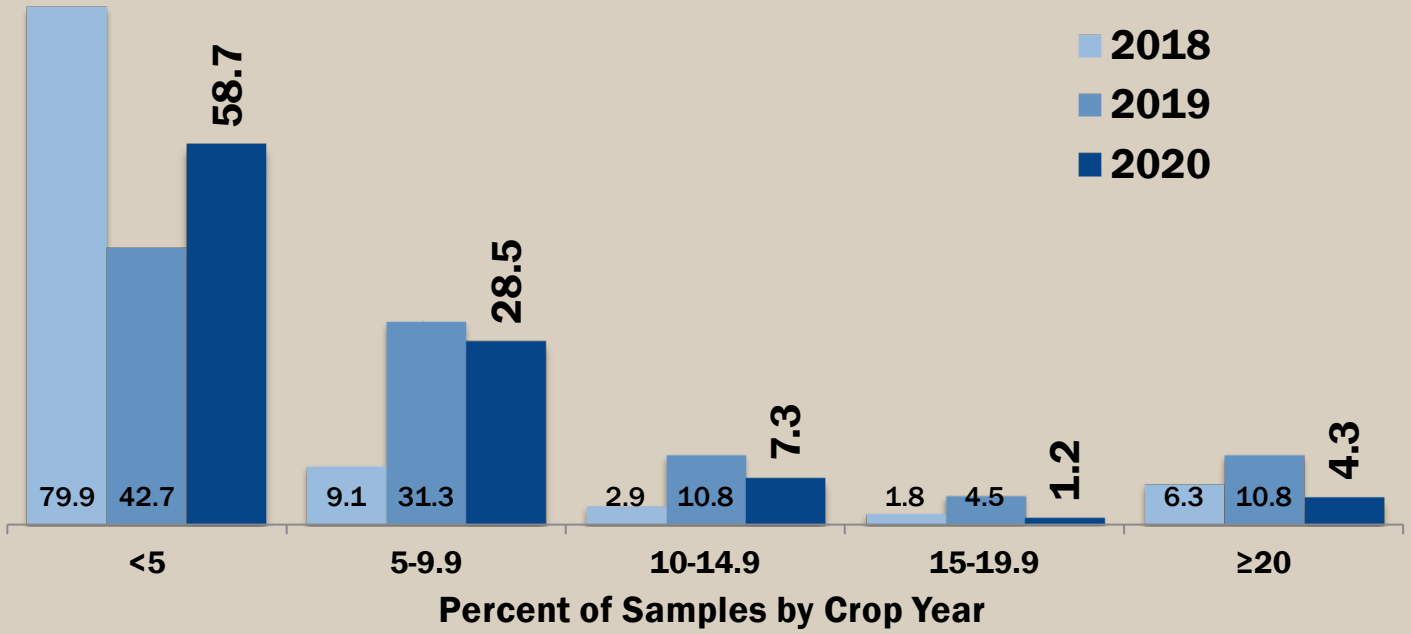
- Internal cracks in the horneous (hard) endosperm
- Most common cause is artificial drying
- Impacts breakage susceptibility, milling and alkaline cooking

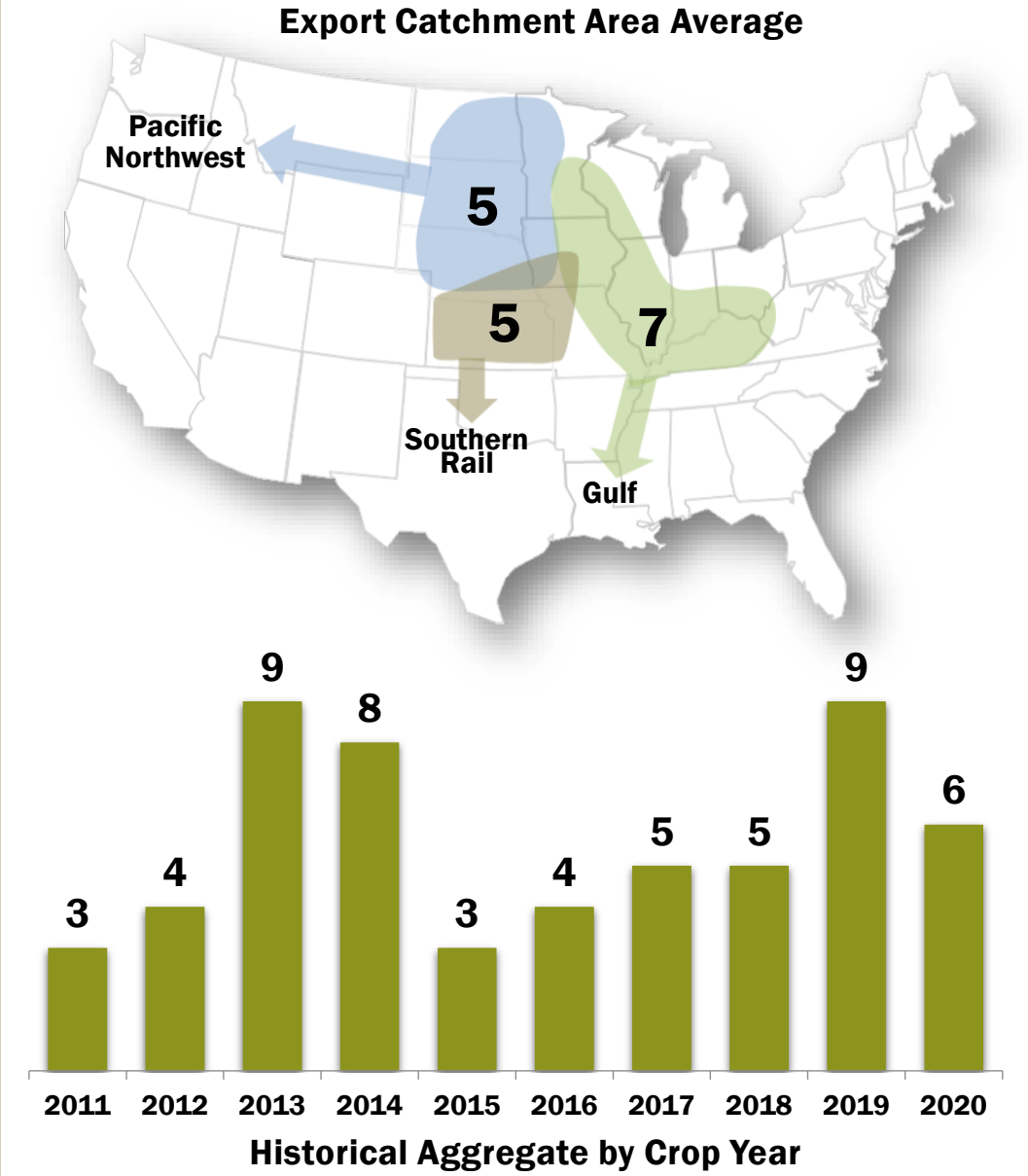


# Stress Cracks (%)

## U.S. Aggregate: 6%

- Slightly higher than the 5YA (5%), but lower than 2019 (9%)



# Stress Crack Index

U.S. GRAINS COUNCIL

% kernels with 1 stress crack

× 1

+

% kernels with 2 stress cracks

× 3

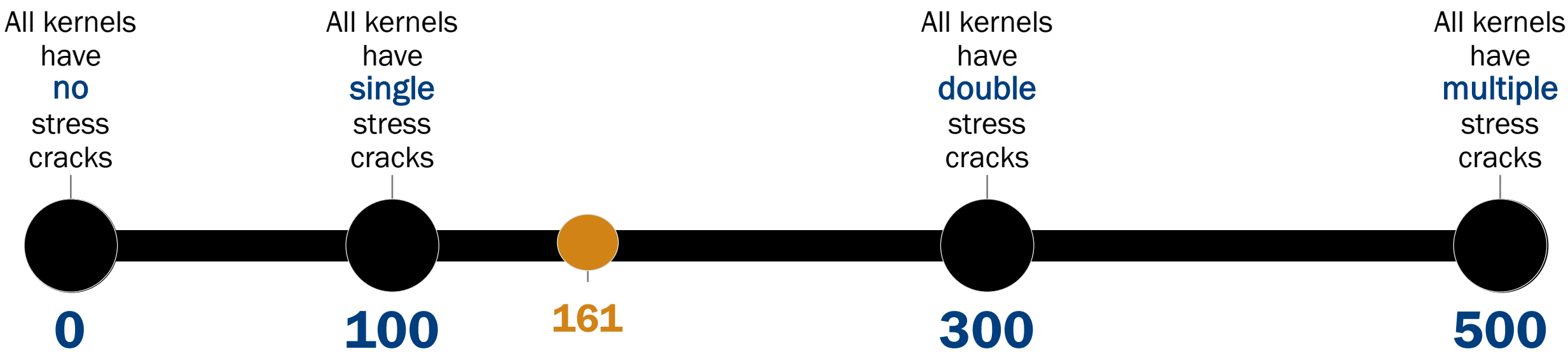
+

% kernels with > 2 stress cracks

× 5

= SCI

# Magnitude of Stress Crack Index



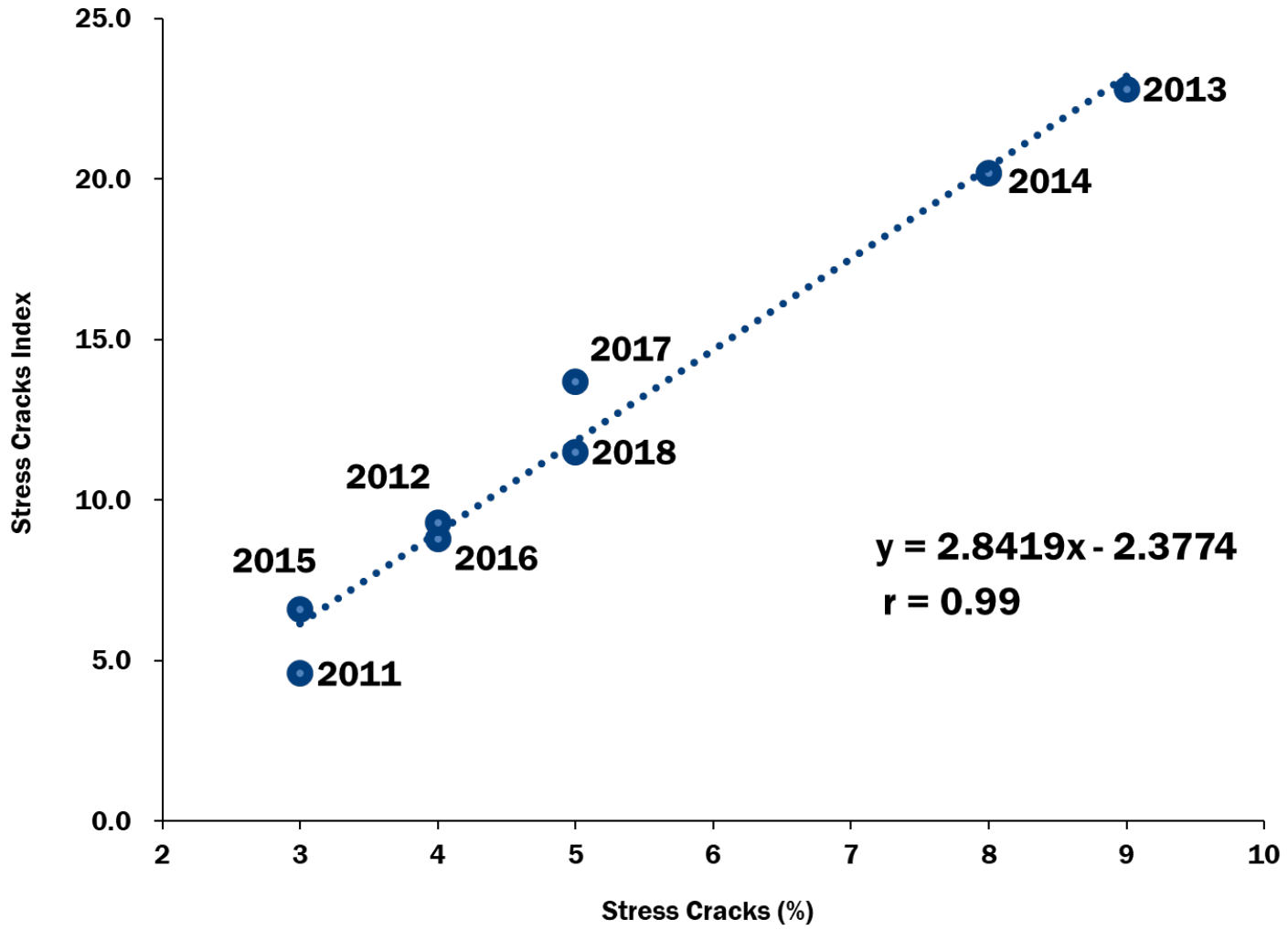

**Example:** **SC% = 43%**

**SCI Calculation**

$$(4\%^{a} \times 1) + (19\%^{b} \times 3) + (20\%^{c} \times 5) = 161$$

a: 4 kernels b: 19 kernels c: 20 kernels

# Stress Cracks (%) vs. Stress Crack Index



# Kernel Weight, Volume and Density

U.S. GRAINS COUNCIL

**100-Kernel Weight**
(grams)

Indicates kernel size which affects

- Drying rates
- Flaking grit yields in dry milling

÷

**Kernel Volume**
(cubic centimeters)

Kernel volume is indicative of growing conditions and genetics

=

**True Density**
(grams per cubic centimeters)

True density reflects kernel hardness

**Higher density** – harder kernels, less susceptible to breakage, more desirable for dry milling and alkaline processing

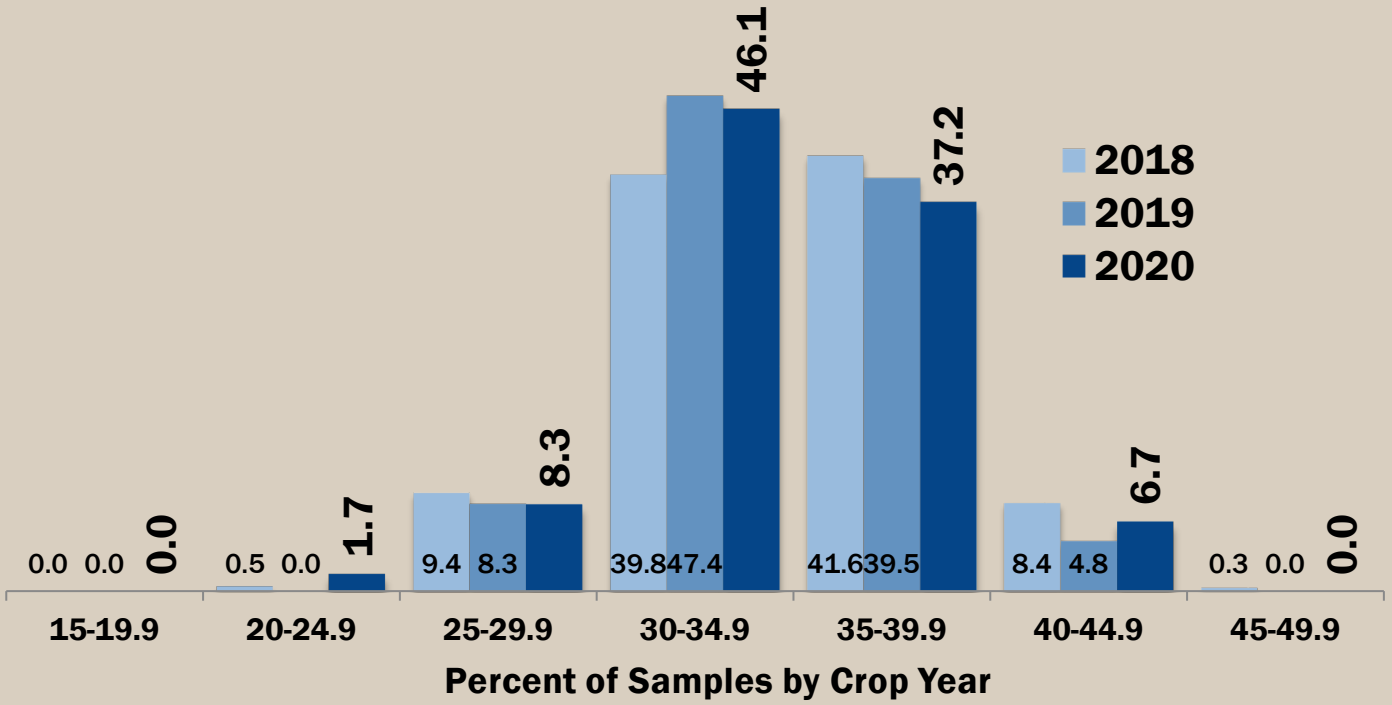
**Lower density** – softer kernels, less at risk for development of stress cracks if high temperature drying is employed, good for wet milling and feed use

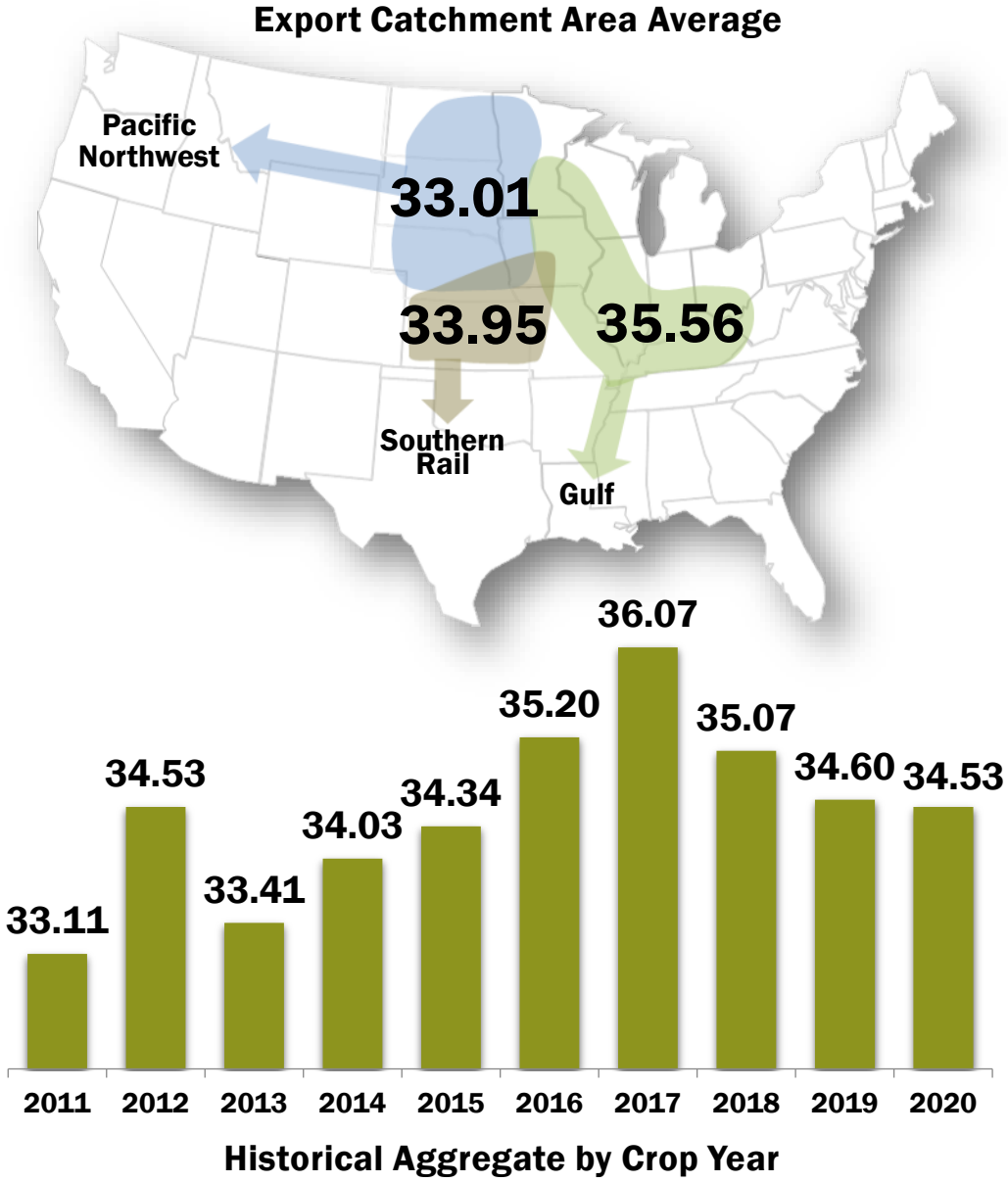
# 100-Kernel Weight (grams)

U.S. GRAINS COUNCIL

## U.S. Aggregate: 34.53 grams

- Average **below** the 5YA (35.06 grams)

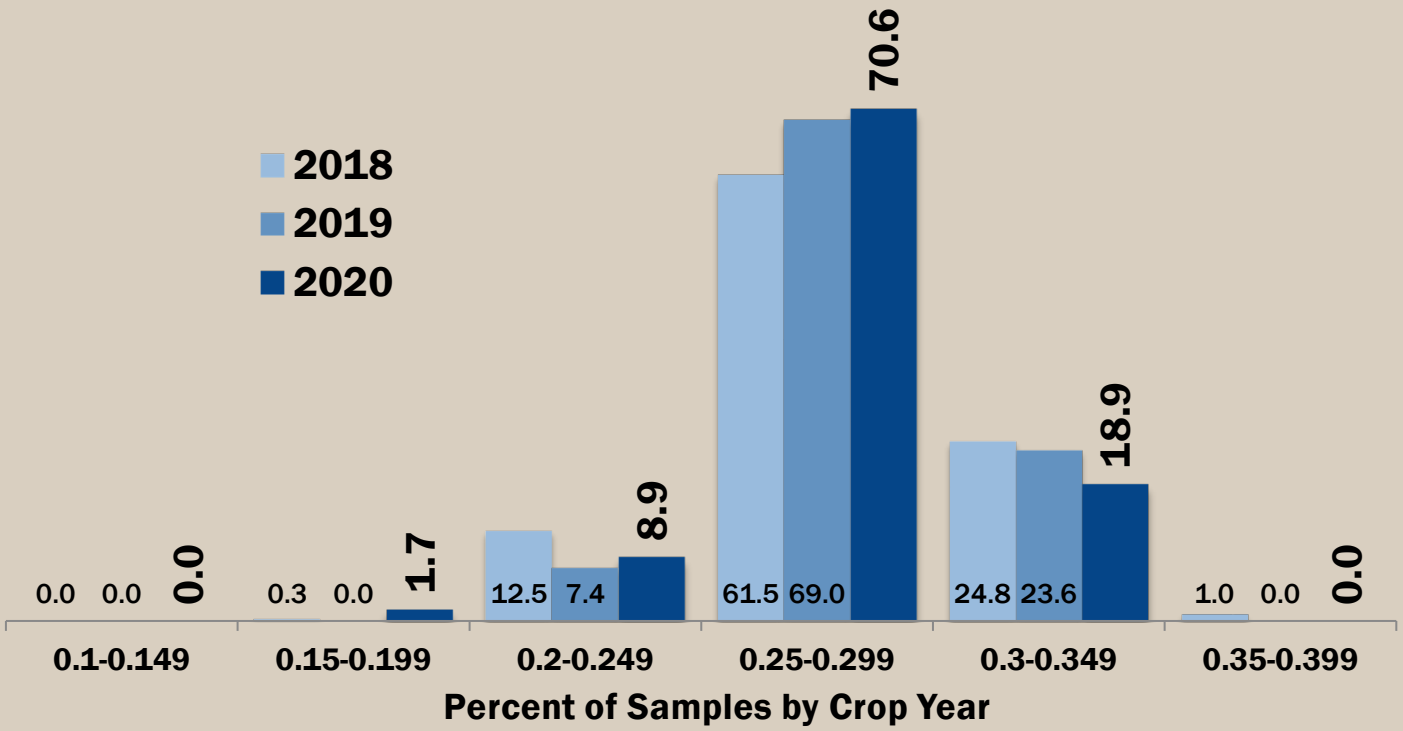


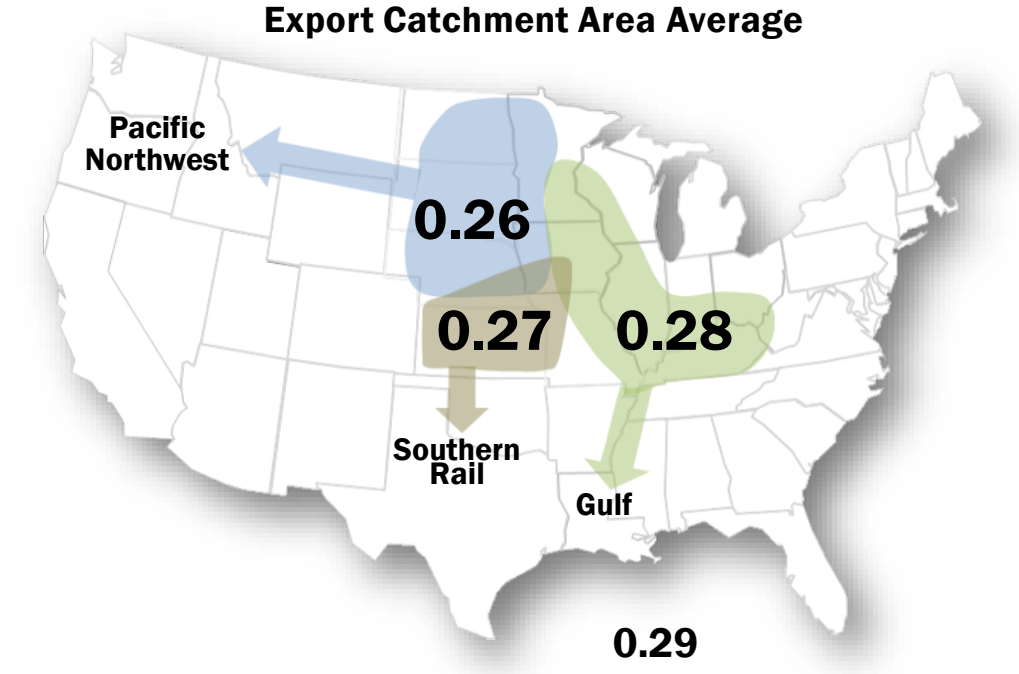



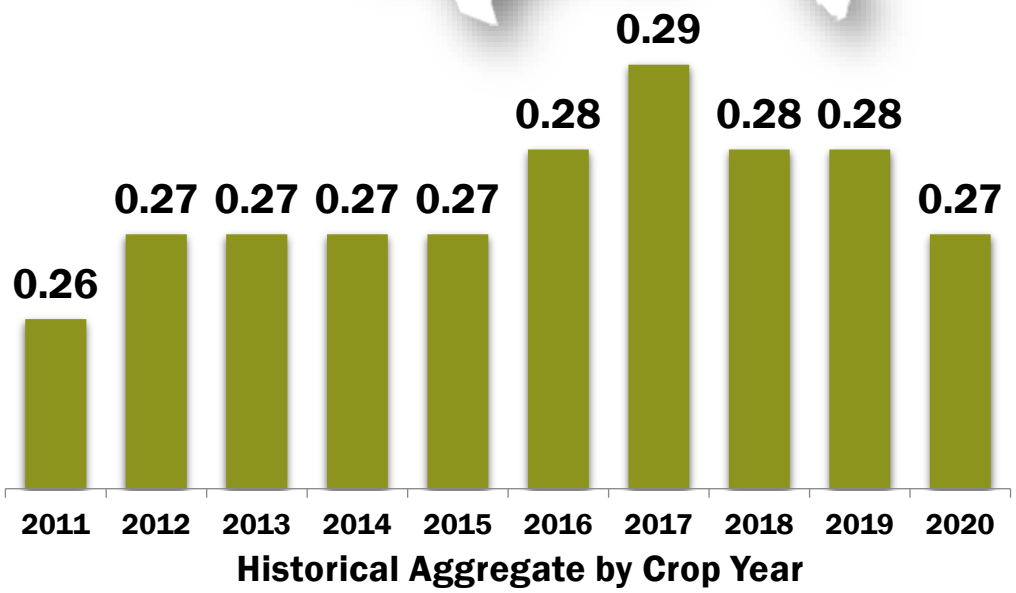
# Kernel Volume ($cm^3$)

## U.S. Aggregate: 0.27 $cm^3$

- Average **similar** to the 5YA (0.28 $cm^3$)



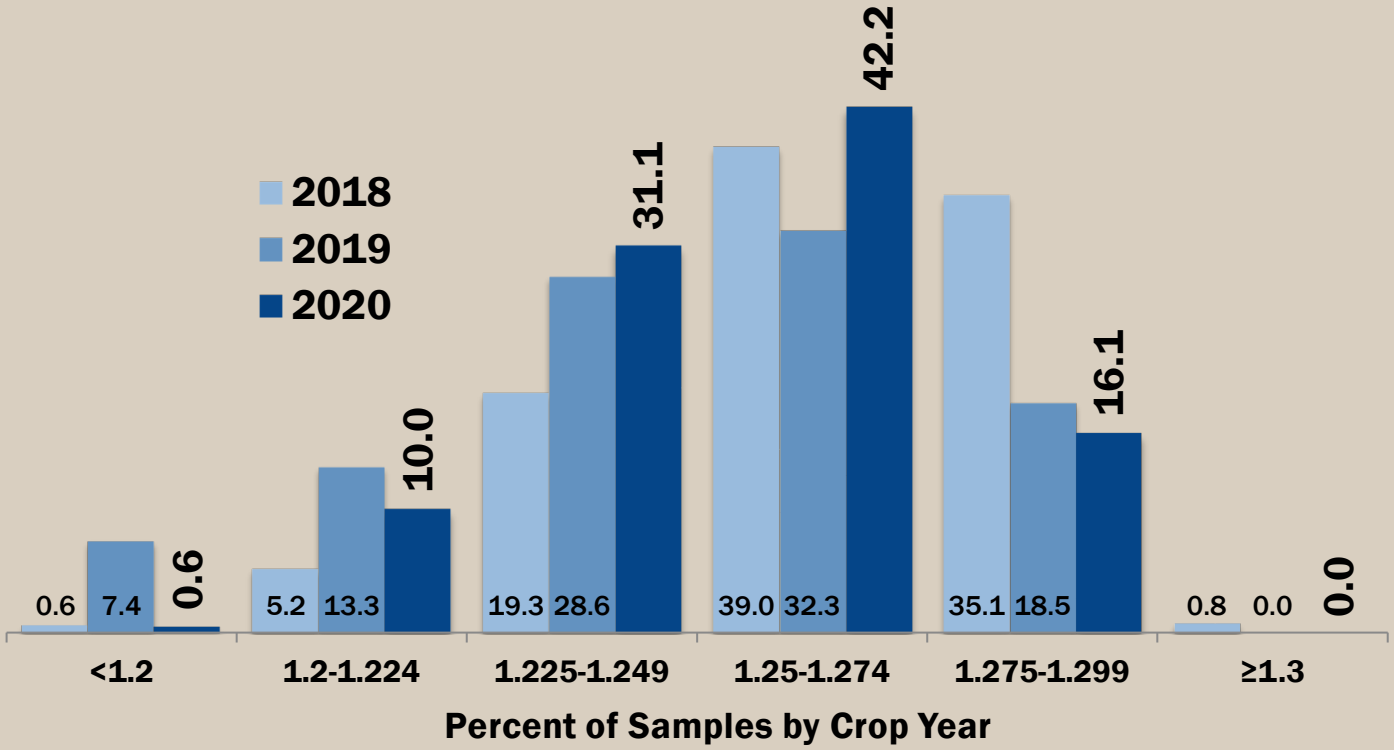



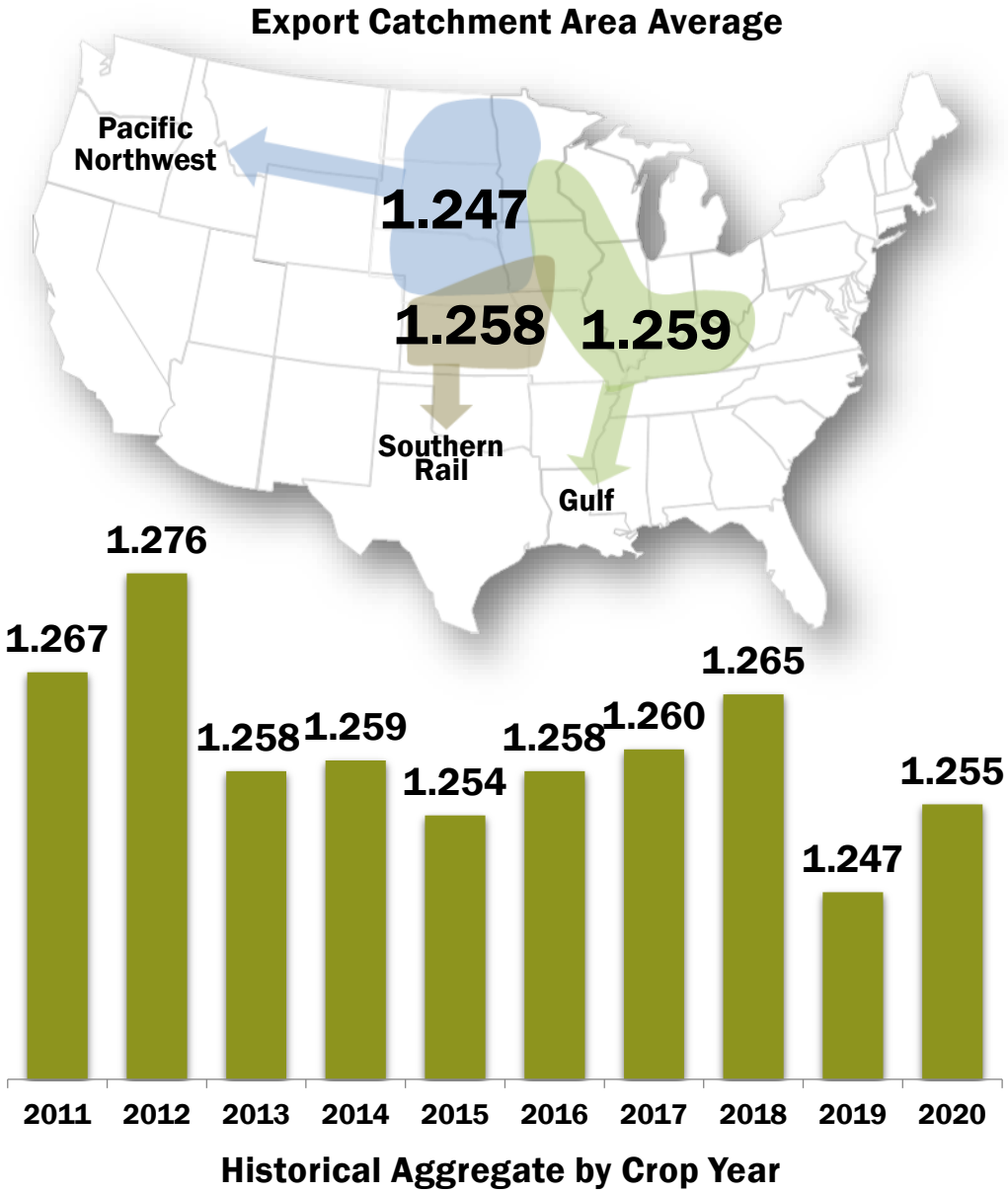



# Kernel True Density (g/cm³)

## U.S. Aggregate: 1.255 g/cm³

- Average **similar** to the 5YA (1.257 g/cm³)



# Other Physical Properties

U.S. GRAINS COUNCIL

## Whole Kernel (%)

Percentage of whole kernels of a 50 gram sample

Broken Corn in BCFM measures only kernel size, not whether it is broken or whole

| < 90% | ≥ 90% |
| --- | --- |
| More susceptible to storage molds and breakage | Desirable, especially for alkaline cookers |

## Horneous (Hard) Endosperm (%)

Measures the percent of the endosperm that is horneous or hard within a range from 70 – 100%

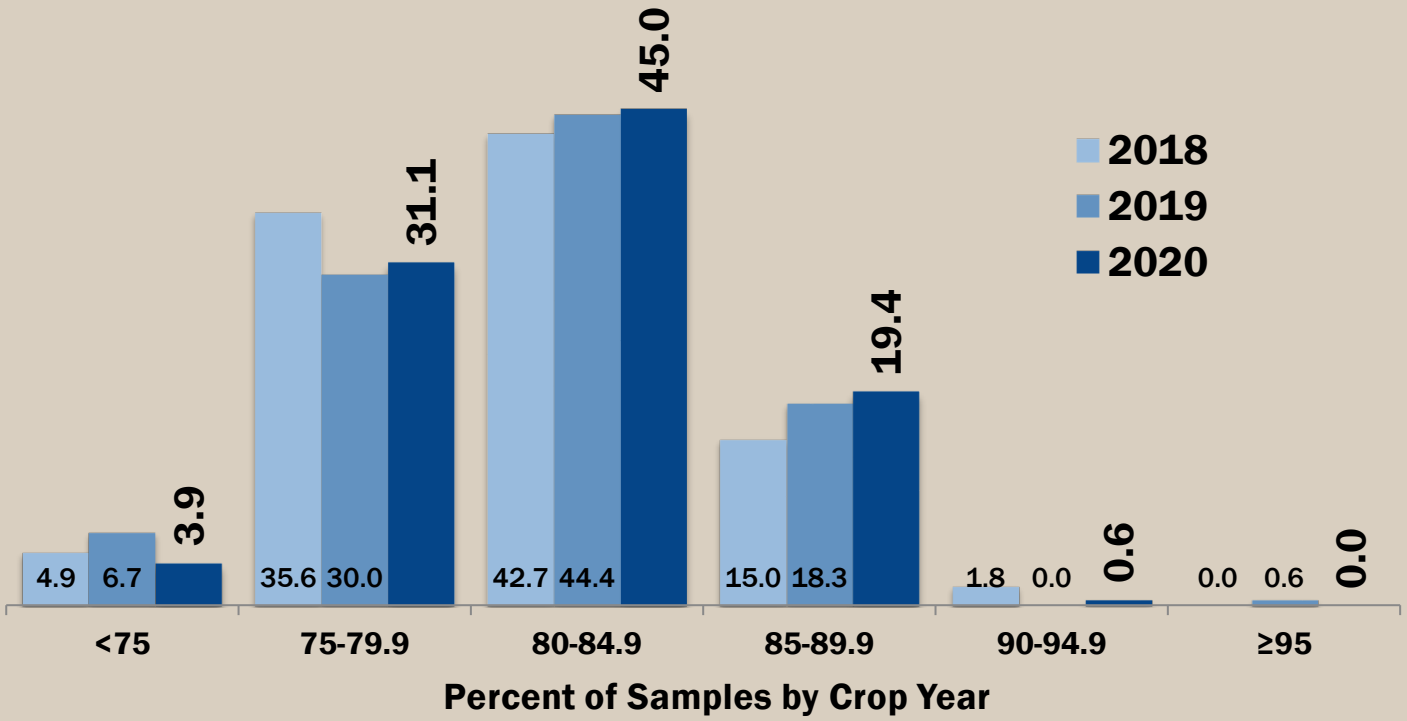
The higher the value, the harder the corn kernel

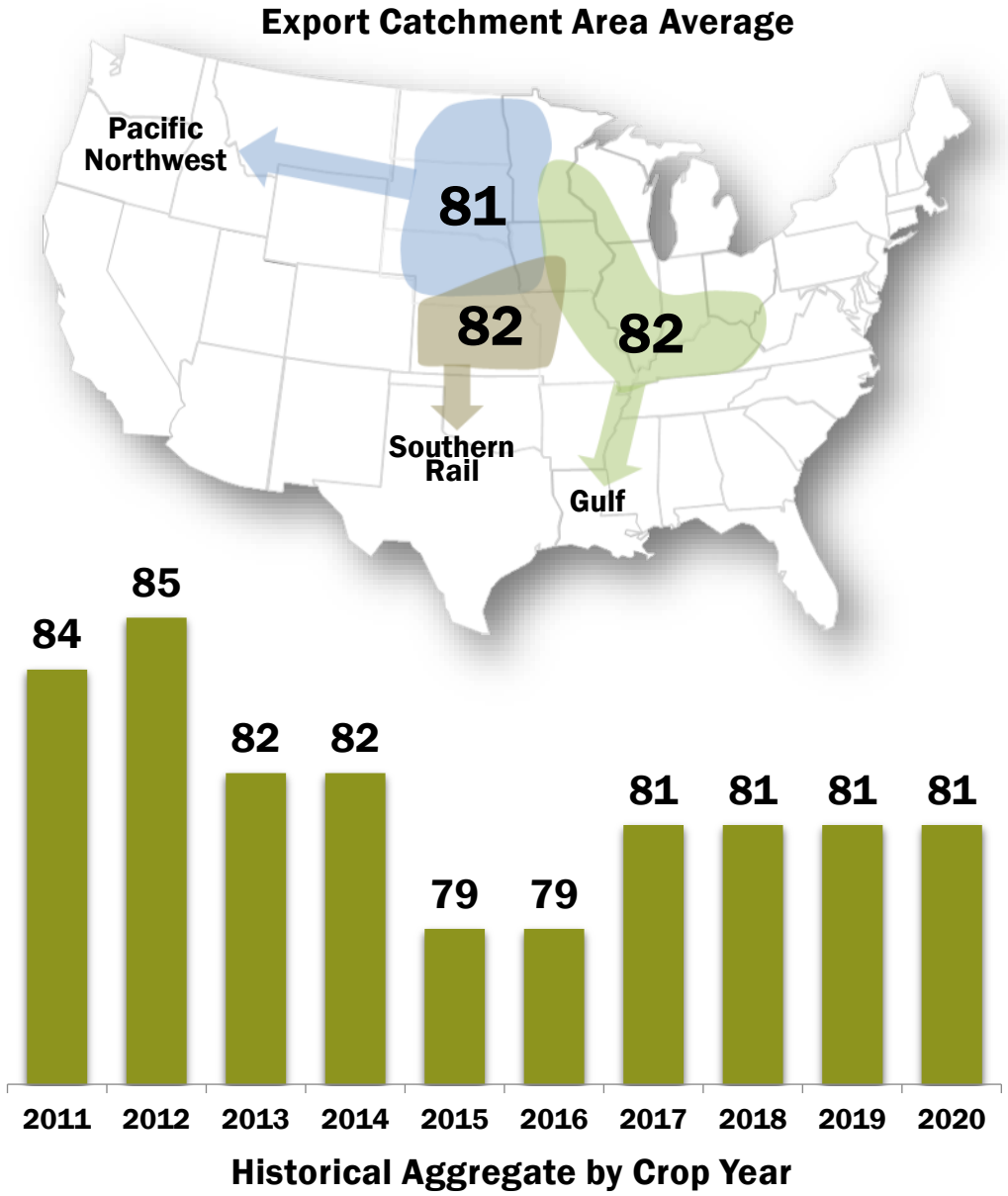
| ≤ 85% | > 85% |
| --- | --- |
| Good for wet millers and feeders | Good for dry millers and alkaline cookers |

# Horneous (Hard) Endosperm (%)

## U.S. Aggregate: 81%

- Higher than the 5YA (80%)



# Mycotoxins:

Aflatoxin,

Deoxynivalenol (DON or Vomitoxin)

Fumonisin

Ochratoxin A

Trichothecenes (T-2)

and Zearalenone

U.S. GRAINS COUNCIL

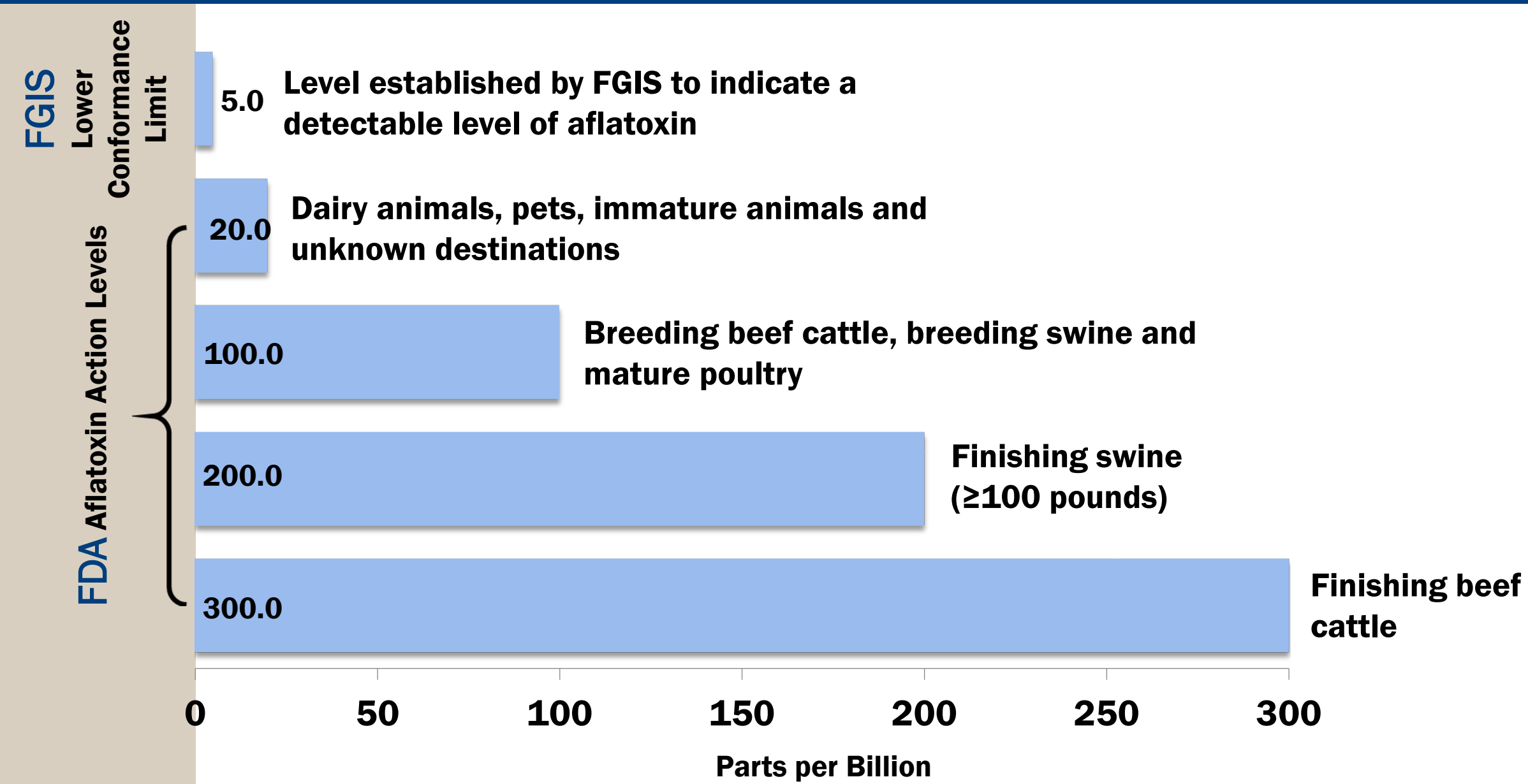
# Mycotoxin Testing

U.S. GRAINS COUNCIL

- *Corn Harvest Quality Report* shows **ONLY** the frequency of detection in harvest samples
- *Corn Harvest Quality Report* does **NOT** predict the presence or levels of mycotoxins in U.S. corn exports
- **Targeting a minimum of 25%** of collected samples, the same as in 2019 and 2018 (Target of 180 samples)
- The final *Corn Harvest Quality Report* contains the results from 180 samples.

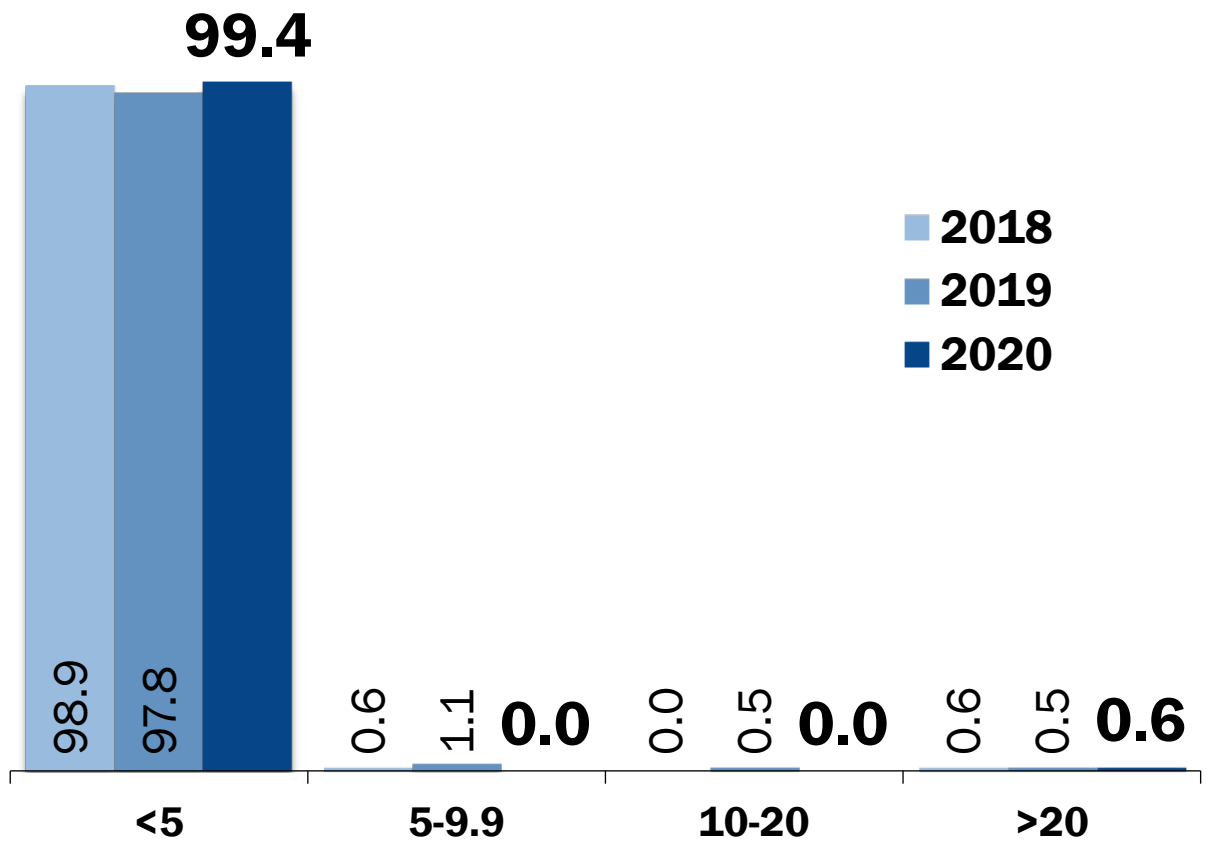
# Key Aflatoxin Levels (ppb)

U.S. GRAINS COUNCIL



# Aflatoxin Testing Results (ppb)

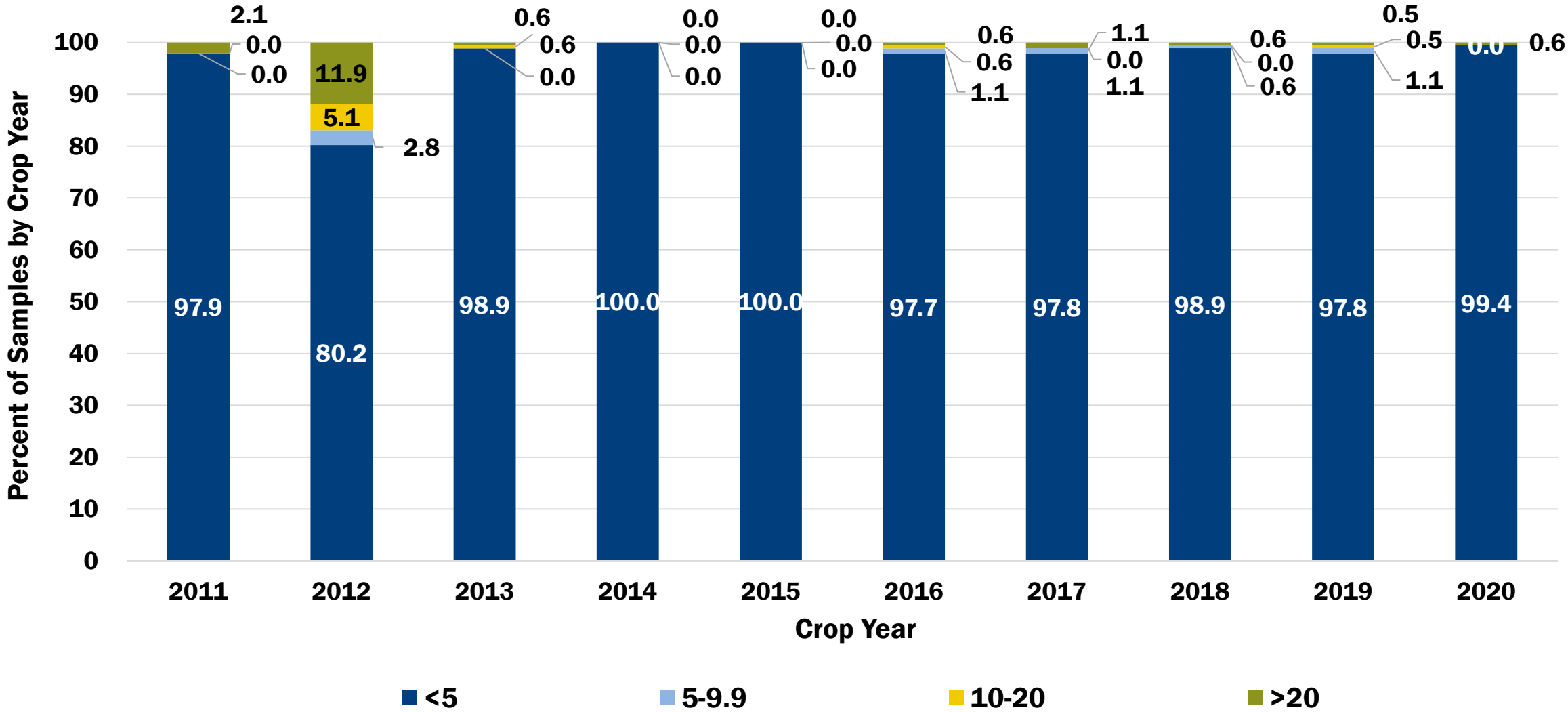
- Samples with **no detectable** levels of aflatoxin **similar** to 2019 and 2018
- **99.4%** of samples tested below the FDA action level of >20.0 ppb
- Growing season conditions **not conducive** to aflatoxin



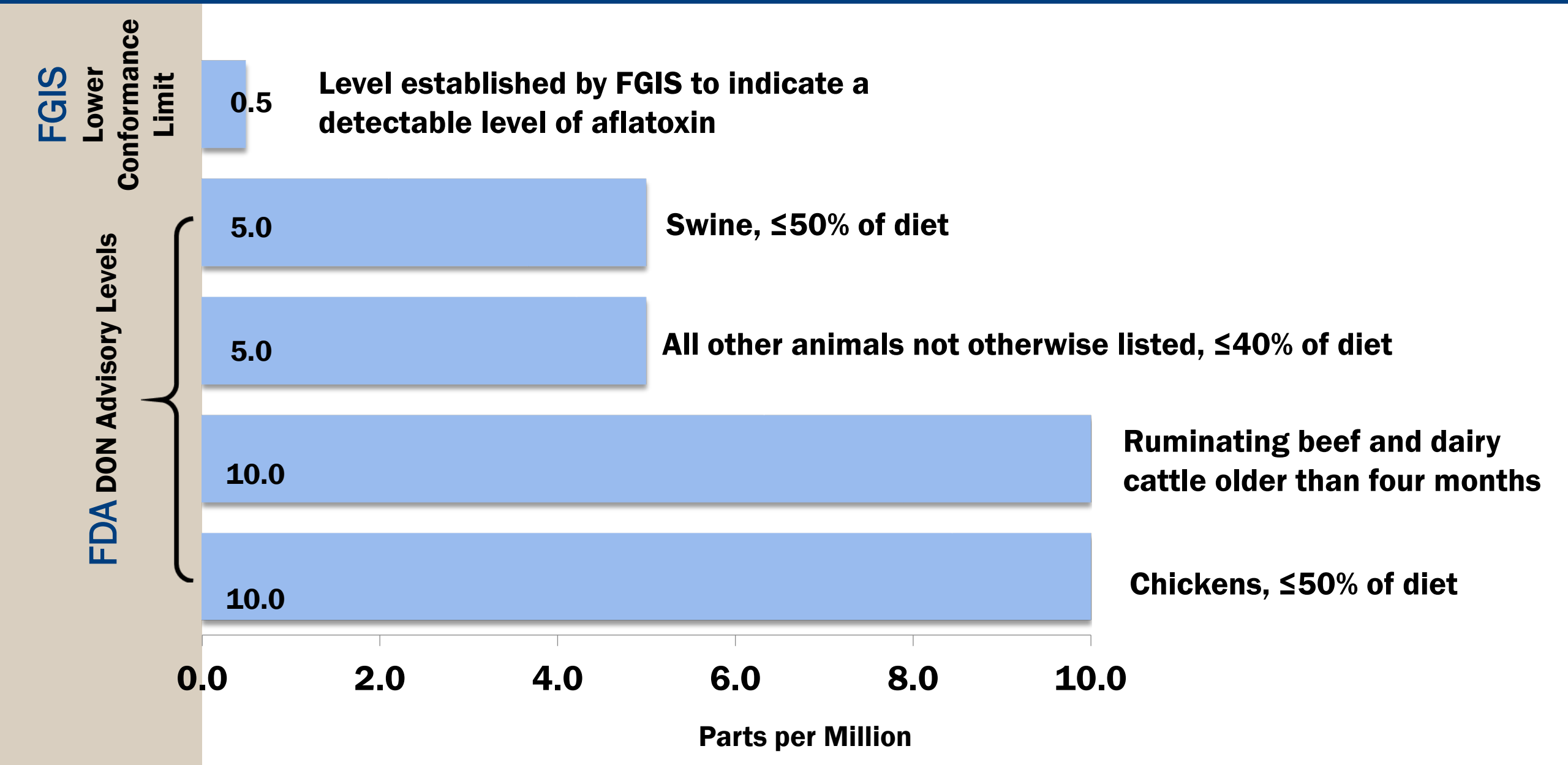

Percent of Samples by Crop Year

# Aflatoxin Testing Results

U.S. GRAINS COUNCIL

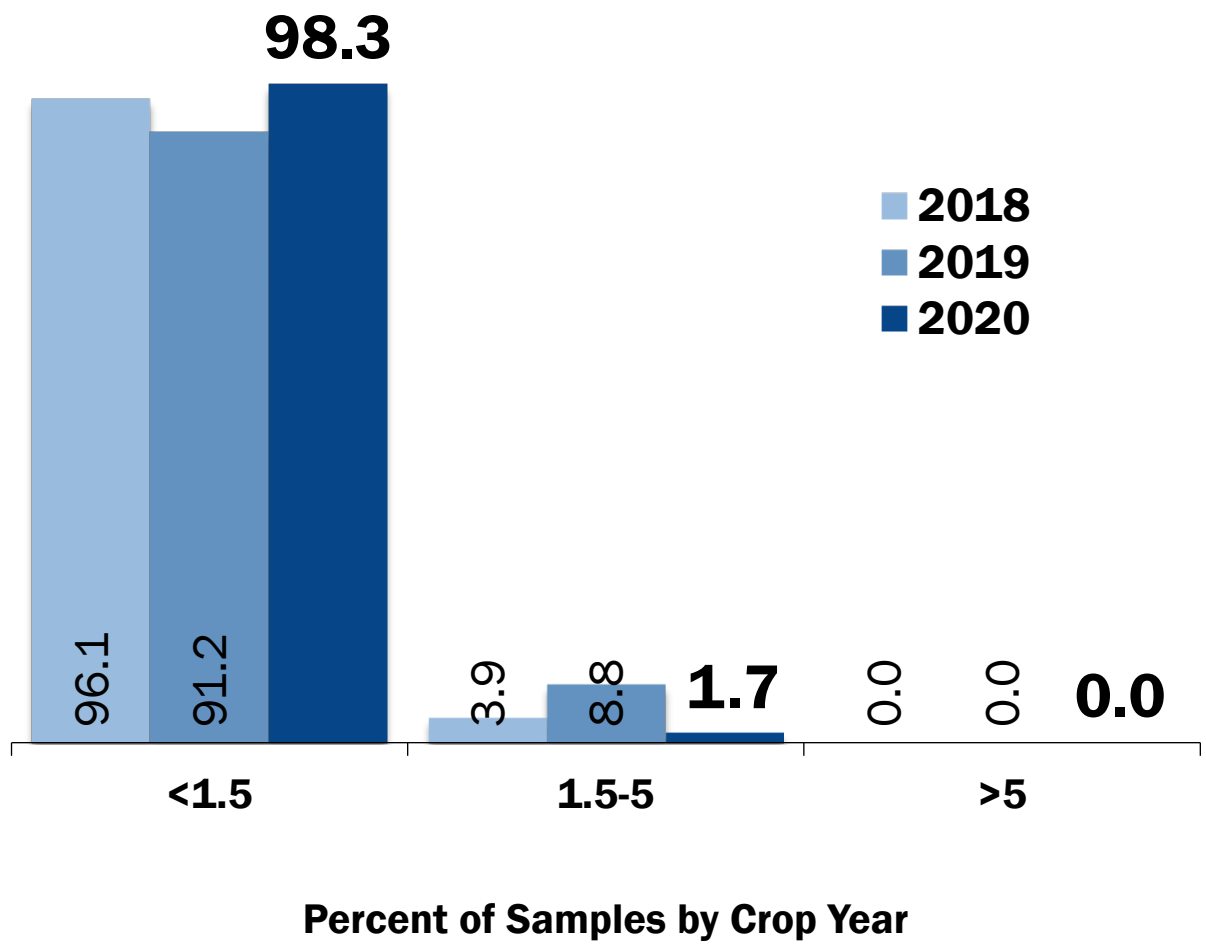


# Key DON Levels (ppm)



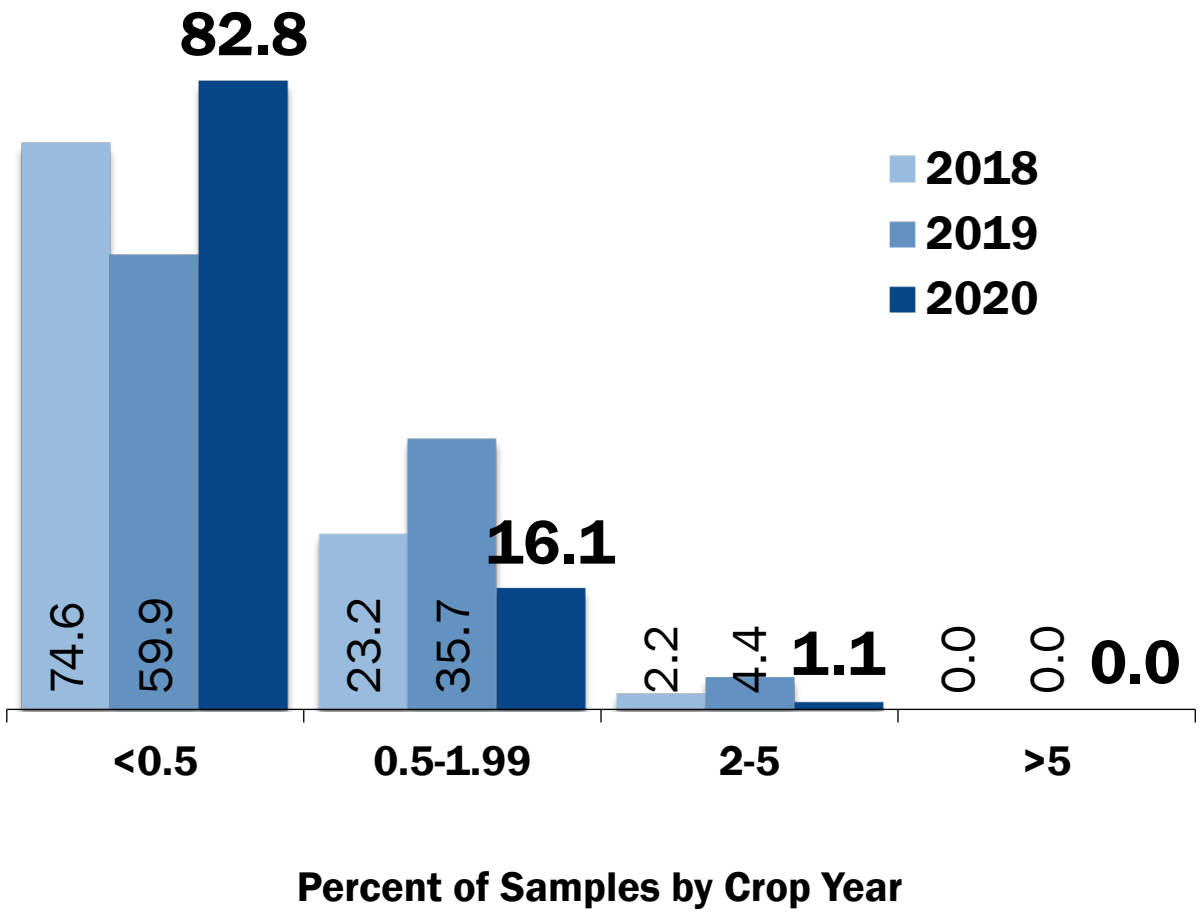
# DON (Vomitoxin) Testing Results (ppm)

- Percentage of samples below 1.5 ppm **higher** than in 2019 and 2018.
- **Zero** samples exceeding the FDA advisory level for DON of 5.0 ppm.

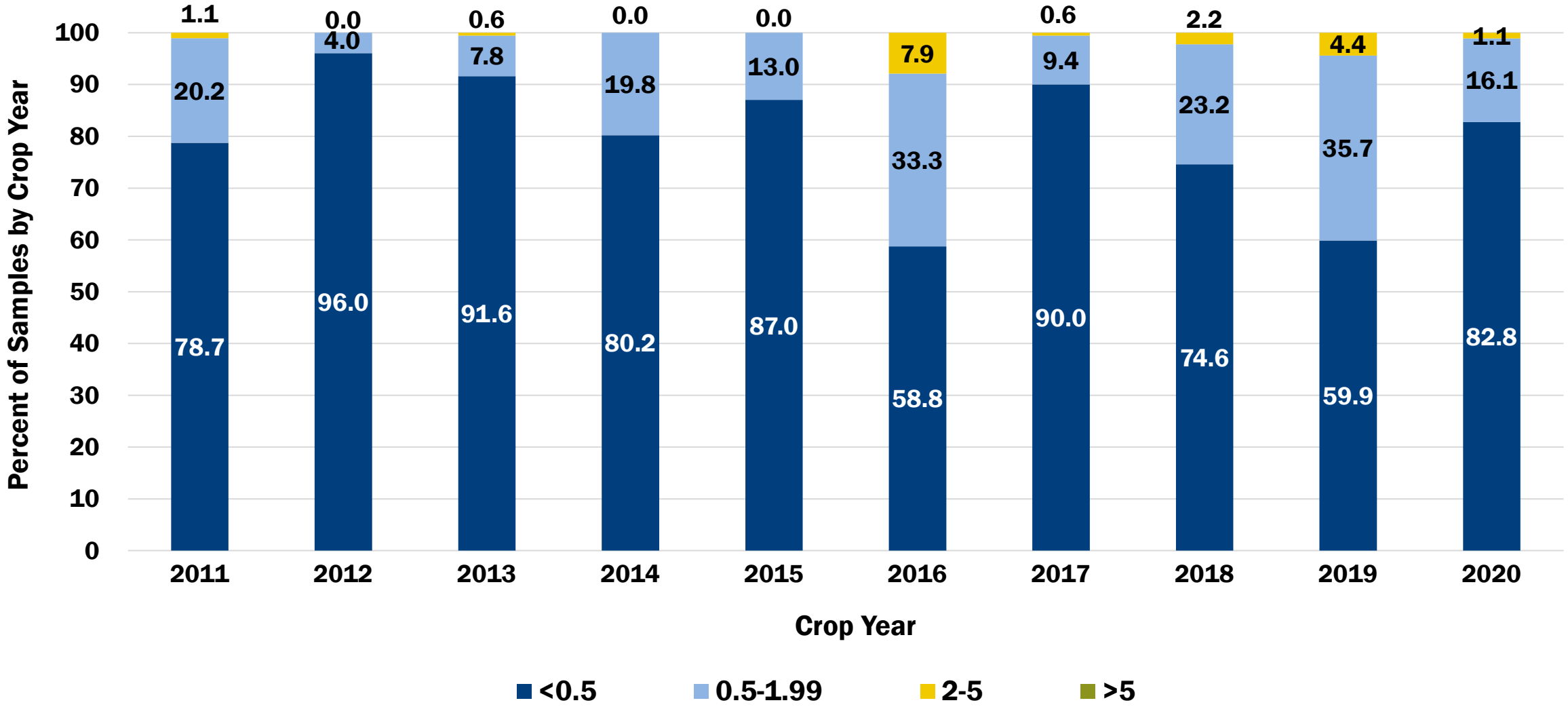


# DON (Vomitoxin) Testing Results (ppm)

- Percentage of samples below 0.5 ppm **higher** than in 2019 and 2018.
- **Zero** samples exceeding the FDA advisory level for DON of 5.0 ppm.

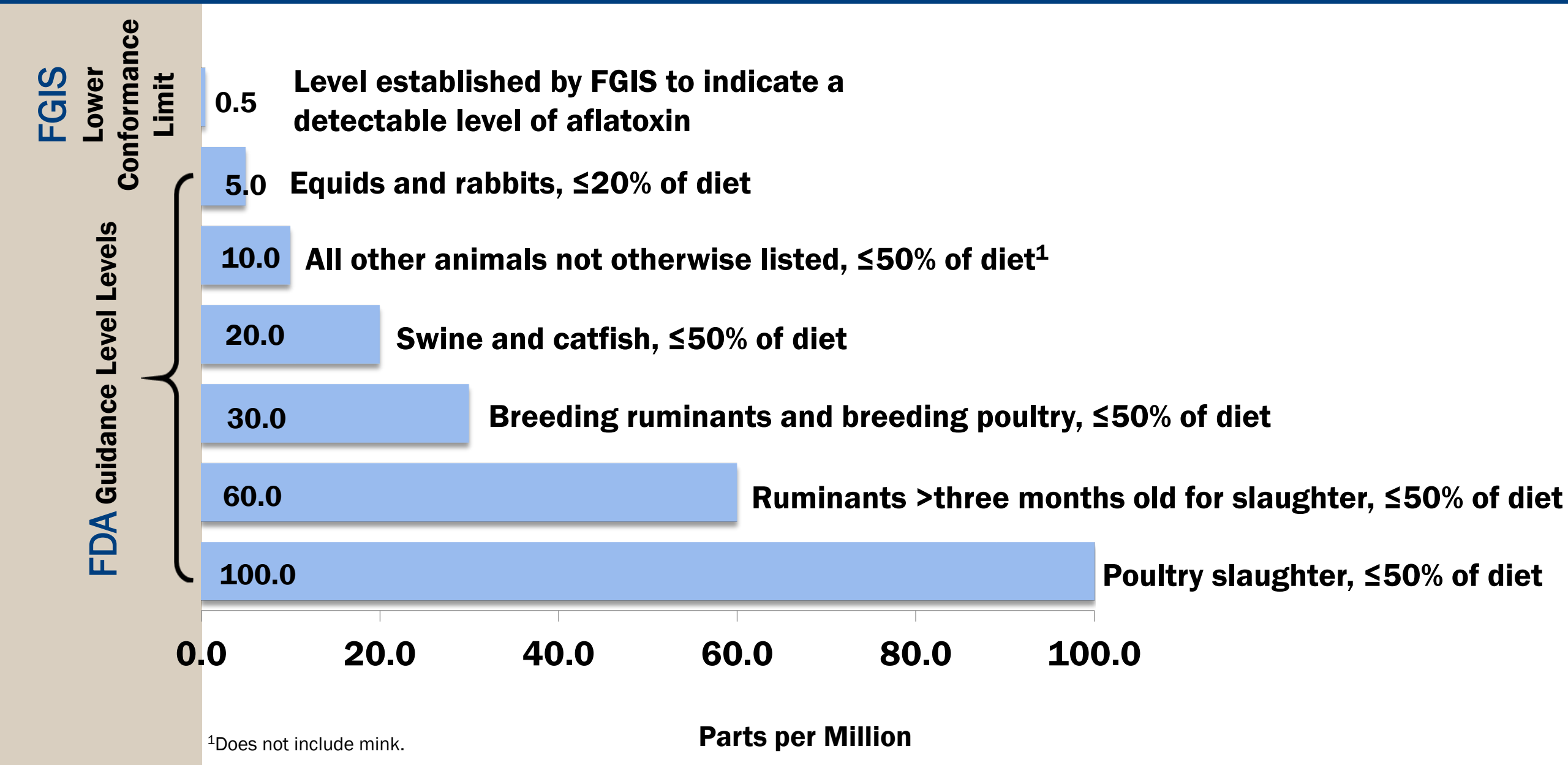


# DON (Vomitoxin) Testing Results



# Key Fumonisin Levels (ppm)

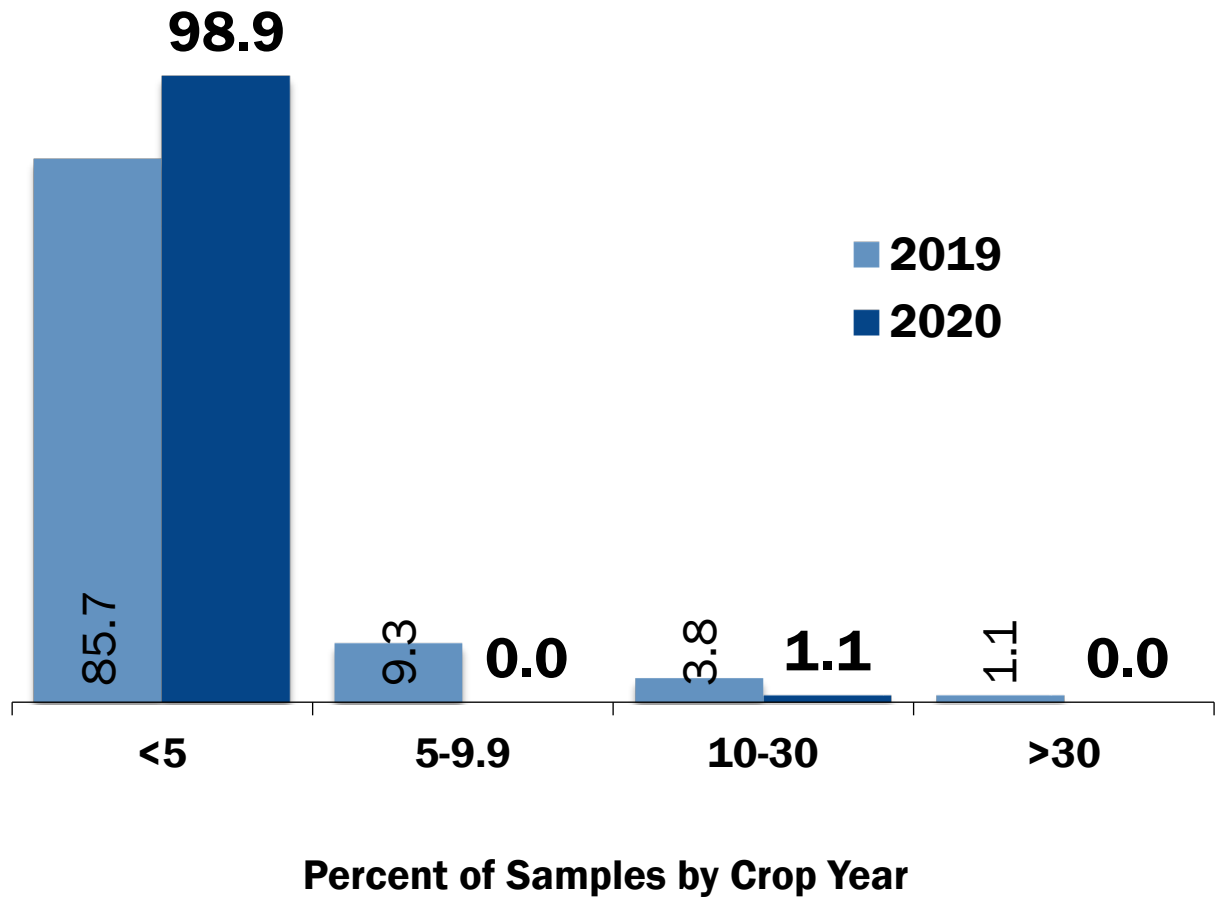
U.S. GRAINS COUNCIL




[1]Does not include mink.

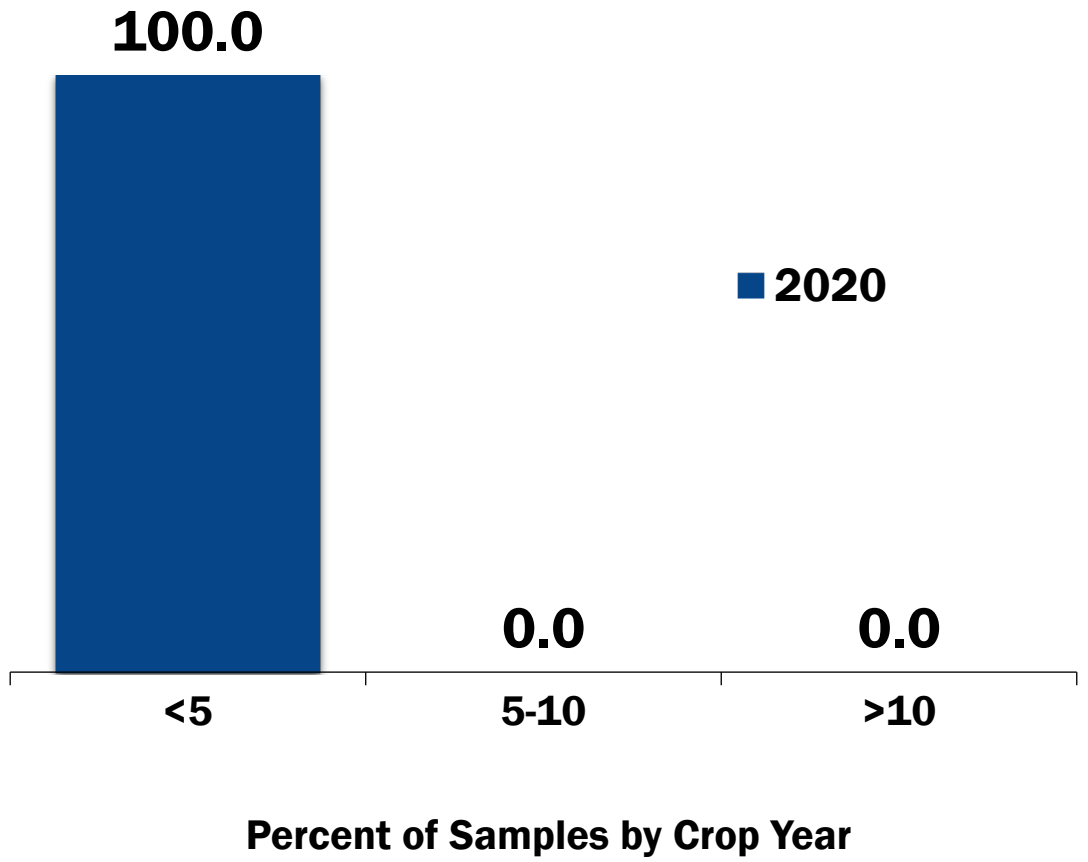
# Fumonisin Testing Results (ppm)

- Second year of Fumonisin testing
- Percentage of samples below 5.0 ppm 98.9%



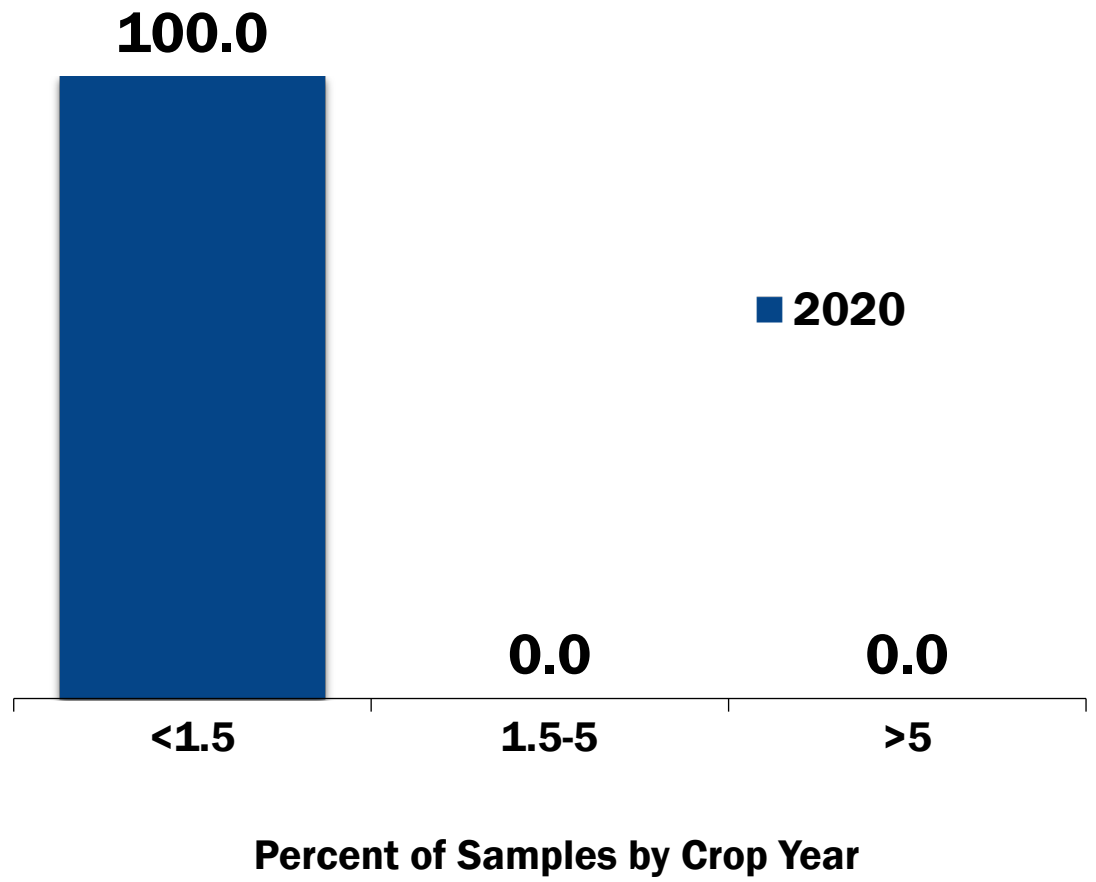
# Ochratoxin A Testing Results (ppb)

- First year of Ochratoxin A testing
- 100% of samples below 5 ppb (European Commission's established maximum level for Ochratoxin A in raw cereals.)



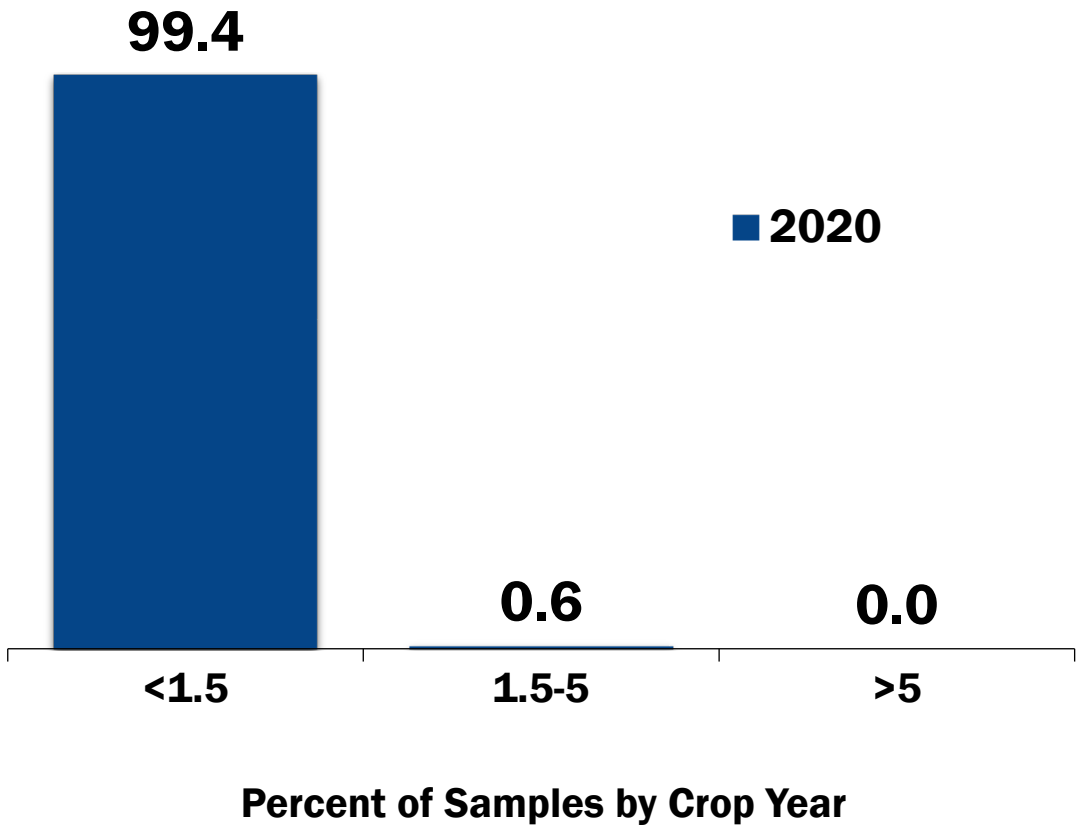
# T-2 Testing Results (ppm)

- First year of T-2 testing
- 100% of samples below 5 ppm



# Zearalenone Testing Results (ppm)

- First year of Zearalenone testing
- 100% of samples below 5 ppm



# Other Components of the Corn Quality Report

U.S. GRAINS COUNCIL

# Other Components of the Report


- Quality Test Results
- Crop and Weather Conditions
- U.S. Corn Production, Usage and Outlook
- Survey and Statistical Analysis Methods
- Testing Analysis Methods
- Historical Perspective

# Harvest Report: Conclusions

U.S. GRAINS COUNCIL

- 2020 harvest samples were, on average, good with **94.5%** of samples grading No. 2 or better, compared to **81.7%** in 2019 and **93.9%** in 2018

- **Test weight** was higher than the 5YA while **total damage and moisture** were **lower** than the 5YA reflecting favorable growing and harvesting conditions

- The growing season was **not conducive** to mycotoxin development

# Building a Tradition:

# Thank You!

U.S. GRAINS COUNCIL

# SUPPLEMENTAL SLIDES

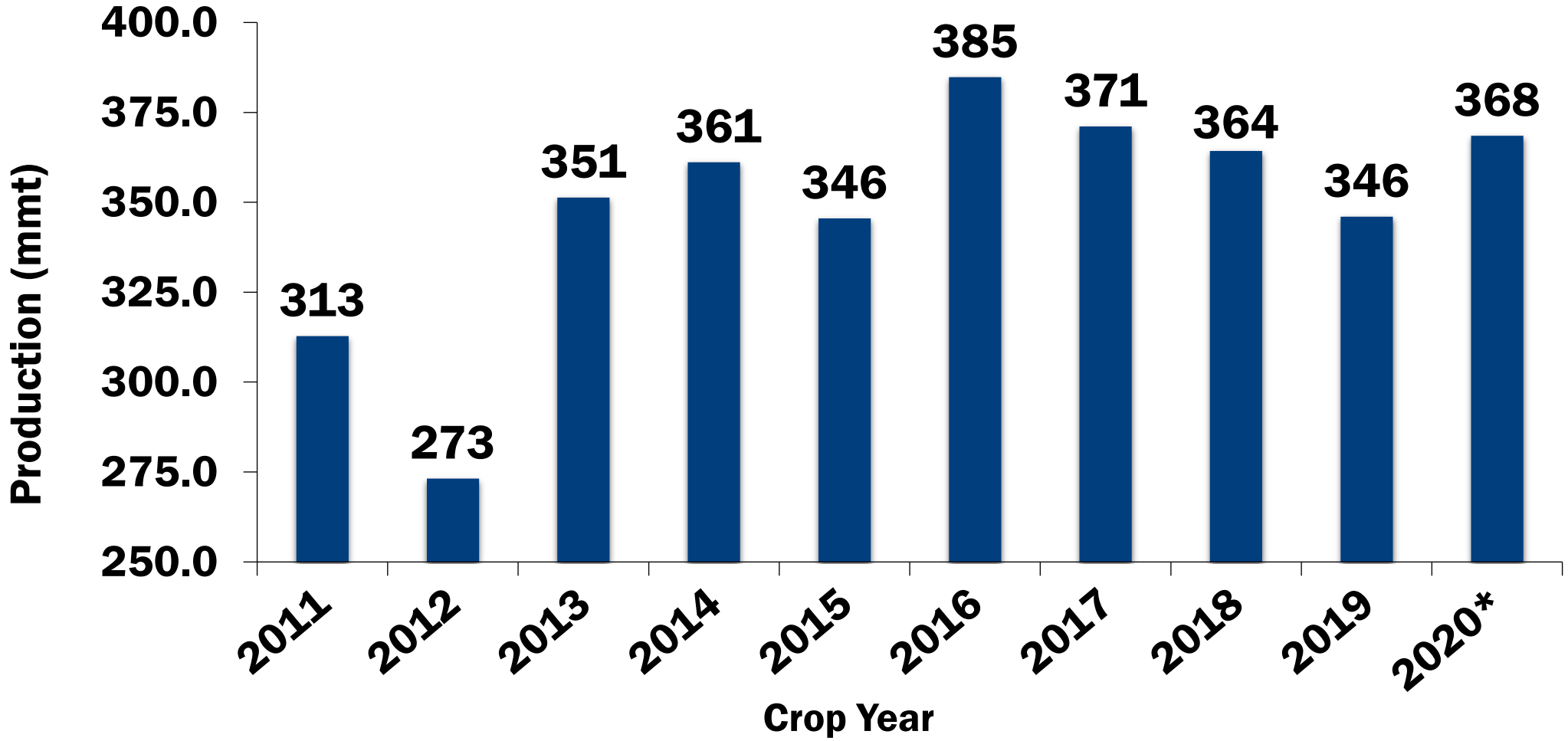
# U.S. Grains Council
# 2020/2021
# Corn Harvest Quality Report

U.S. GRAINS COUNCIL

# U.S. Corn Production Supply & Demand Outlook

U.S. GRAINS COUNCIL

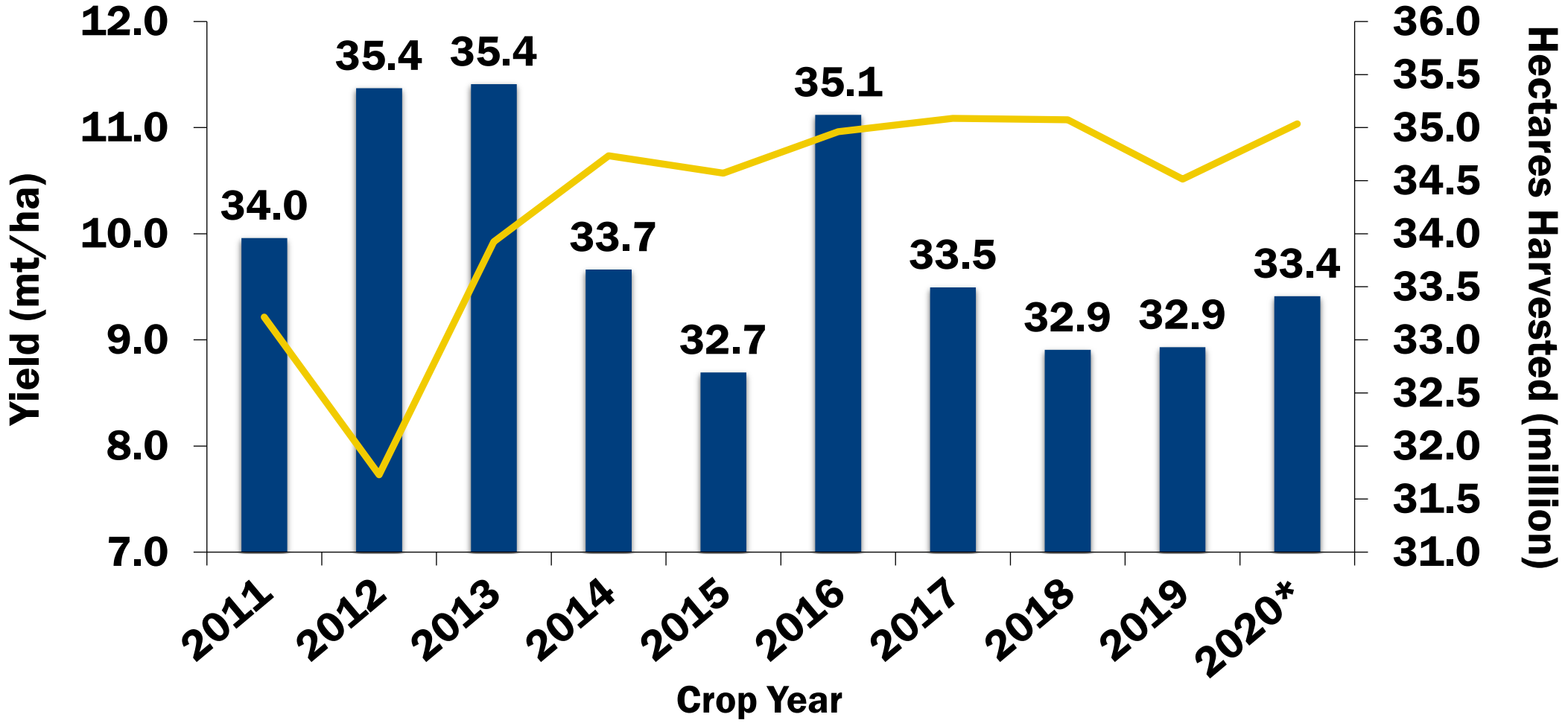
# U.S. Production and Yield




Source: USDA NASS

P=Projected

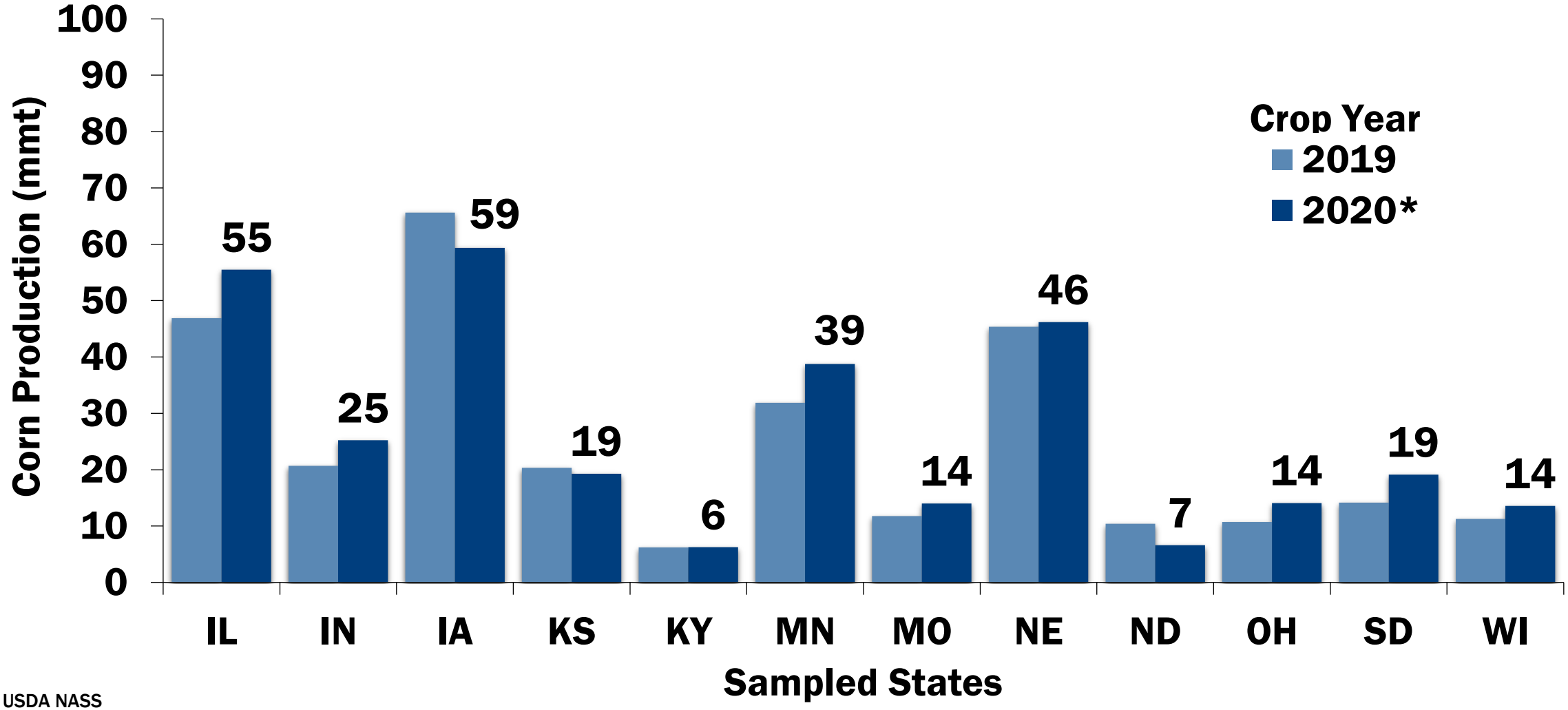
# U.S. Production and Yield




Source: USDA NASS

P=Projected

# U.S. Production by State




Source: USDA NASS

*Projected

# Surveyed State Production (MMT)

U.S. GRAINS COUNCIL

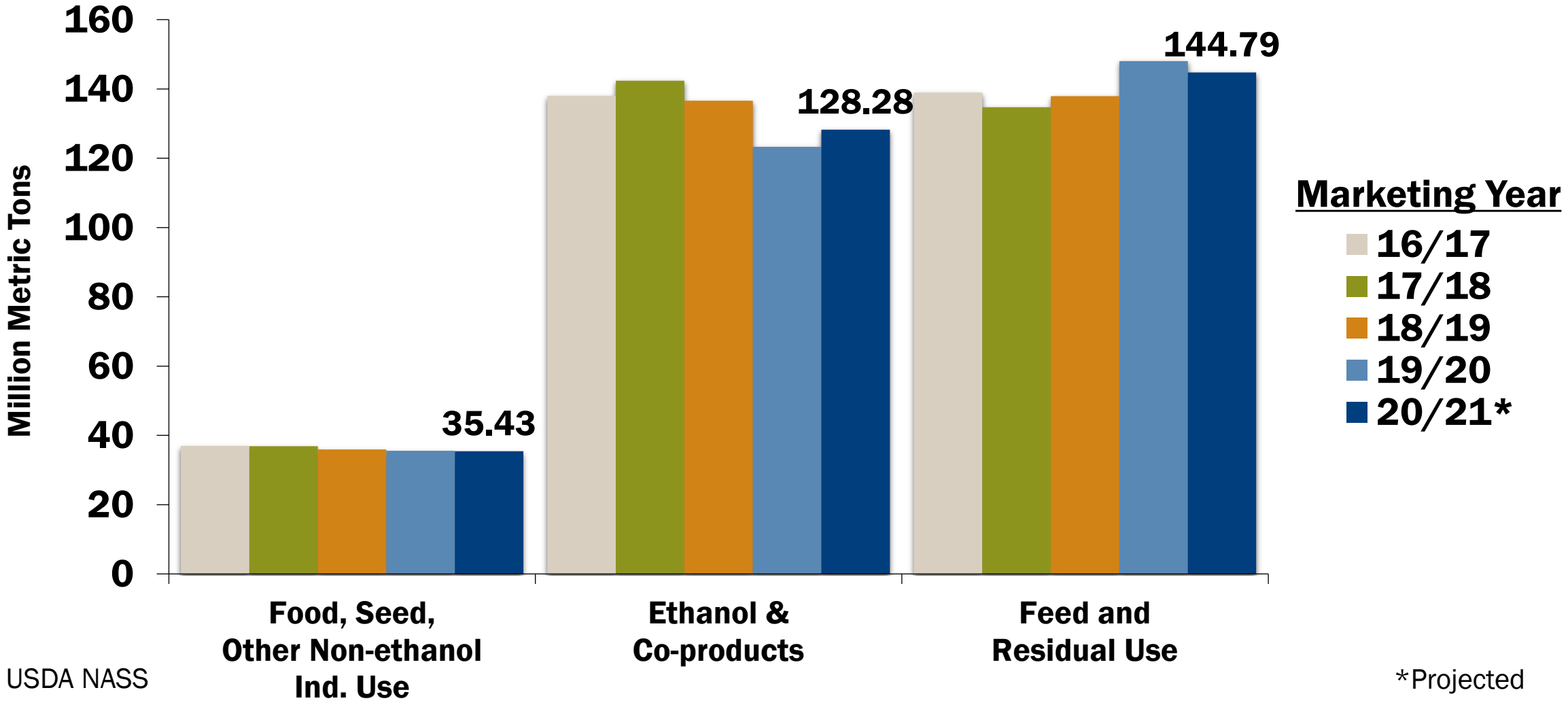
| | | | Difference | | Relative % Change† | |
|---|---|---|---|---|---|---|
| State | 2019 | 2020* | MMT | Percent | Acres | Yield |
| Illinois | 46.9 | 55.5 | 8.6 | 18.3% | | |
| Indiana | 20.7 | 25.2 | 4.5 | 21.8% | | |
| Iowa | 65.6 | 59.4 | (6.3) | -9.6% | | |
| Kansas | 20.3 | 19.3 | (1.1) | -5.2% | | |
| Kentucky | 6.2 | 6.3 | 0.0 | 0.5% | | |
| Minnesota | 31.9 | 38.7 | 6.9 | 21.6% | | |
| Missouri | 11.8 | 14.0 | 2.2 | 18.9% | | |
| Nebraska | 45.3 | 46.2 | 0.8 | 1.9% | | |
| North Dakota | 10.4 | 6.6 | (3.8) | -36.7% | | |
| Ohio | 10.7 | 14.1 | 3.4 | 31.5% | | |
| South Dakota | 14.2 | 19.1 | 5.0 | 35.0% | | |
| Wisconsin | 11.3 | 13.6 | 2.3 | 20.4% | | |
| Total U.S. | 345.9 | 368.5 | 22.5 | 6.5% | | |

†Green indicates 2020 is higher than in 2019; red indicates 2020 is lower than in 2019; bar height indicates the relative amount.

*Projected

Source: USDA NASS

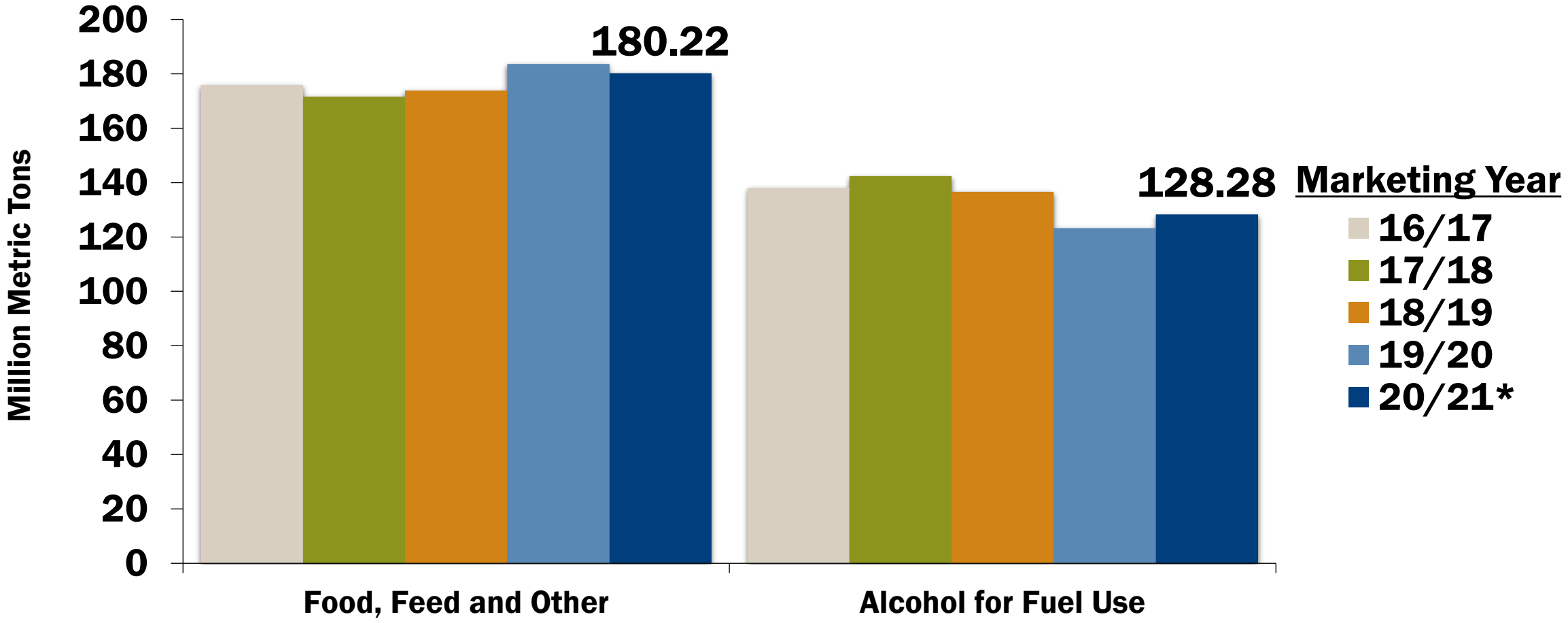
# U.S. Production and Use




Source: USDA NASS

*Projected

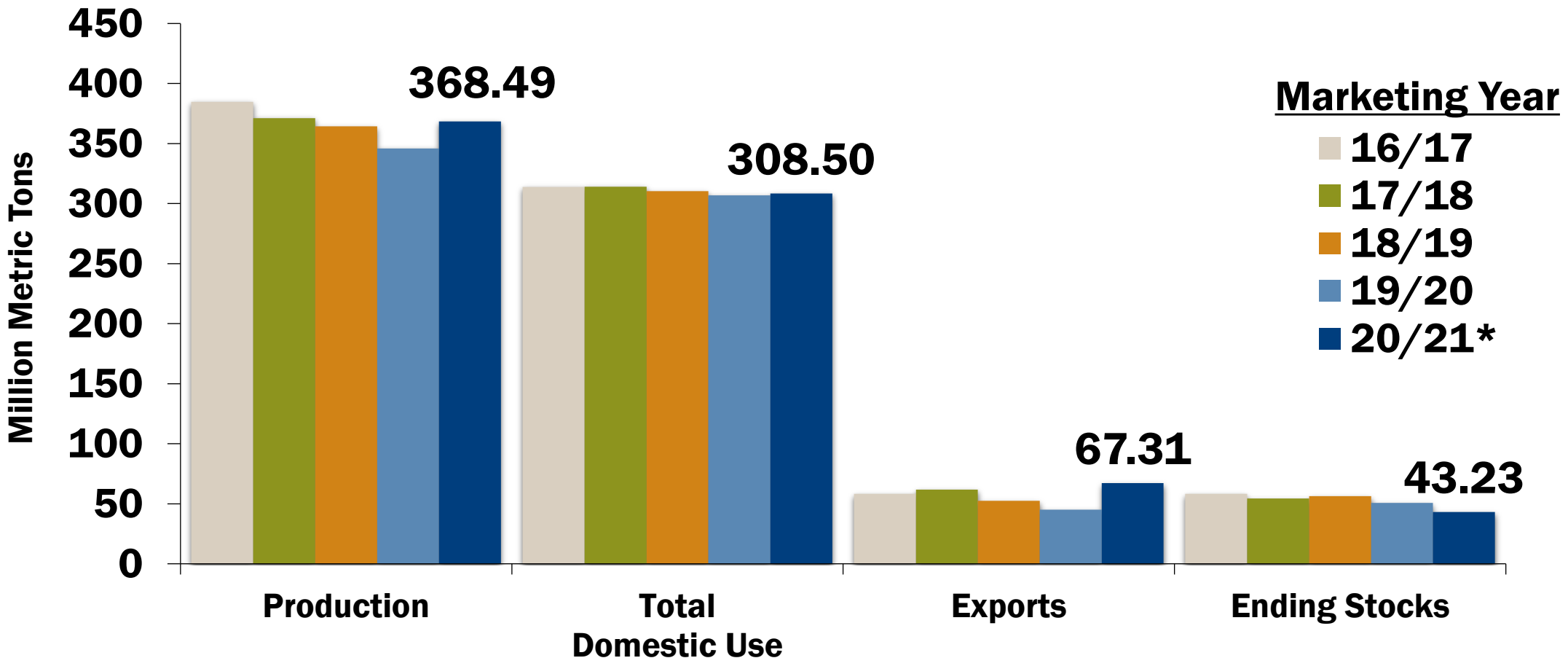
# U.S. Domestic Corn Use




Source: USDA NASS

*Projected

# U.S. Production and Disappearance




Source: USDA NASS

*Projected

# U.S. Corn Supply and Usage Summary — Metric Units

U.S. GRAINS COUNCIL

| | 16/17 | 17/18 | 18/19 | 19/20 | 20/21* |
|---|---|---|---|---|---|
| **Acreage (million hectares)** | | | | | |
| Planted | 38.06 | 36.50 | 35.99 | 36.32 | 36.84 |
| Harvested | 35.12 | 33.50 | 32.91 | 32.93 | 33.41 |
| Yield (metric ton/hectare) | 10.96 | 11.09 | 11.07 | 10.51 | 11.04 |
| | | | *In Millions of Metric Tons* | | |
| **Supply (million metric tons)** | | | | | |
| Beginning Stocks | 44.12 | 58.25 | 54.37 | 56.41 | 50.68 |
| Production | 384.78 | 371.10 | 364.26 | 345.96 | 368.49 |
| Imports | 1.45 | 0.91 | 0.71 | 1.06 | 0.64 |
| **Total Supply** | 430.35 | 430.27 | 419.34 | 403.44 | 419.81 |
| **Usage (million metric tons)** | | | | | |
| Food, seed, other non-ethanol ind. use | 36.92 | 36.88 | 35.93 | 35.54 | 35.43 |
| Ethanol and co-products | 137.98 | 142.37 | 136.61 | 123.26 | 128.28 |
| Feed and residual | 138.89 | 134.73 | 137.91 | 148.02 | 144.79 |
| Exports | 58.31 | 61.92 | 52.48 | 45.17 | 67.31 |
| **Total Use** | 372.10 | 375.90 | 362.93 | 351.99 | 375.81 |
| **Ending Stocks** | 58.25 | 54.37 | 56.41 | 50.68 | 43.23 |
| **Average farm price (dollar per metric ton†)** | 132.28 | 132.28 | 142.12 | 140.15 | 157.47 |

*Projected
†The average farm price for 20/21 based on WASDE November projected price

Source: USDA WASDE, November 2020

# U.S. Corn Supply and Usage Summary — English Units

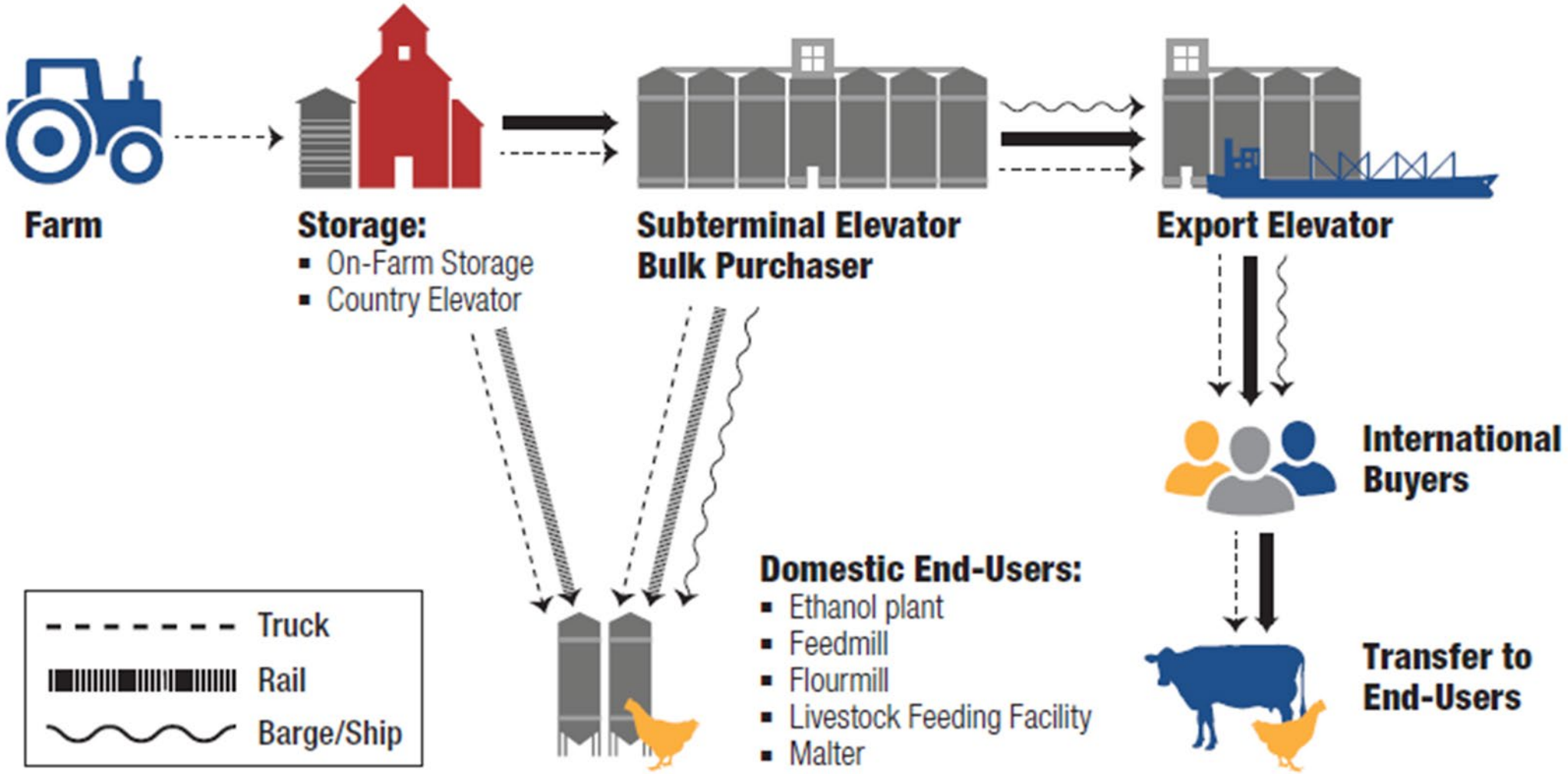
U.S. GRAINS COUNCIL

| | 16/17 | 17/18 | 18/19 | 19/20 | 20/21* |
|---|---|---|---|---|---|
| **Acreage (million acres)** | | | | | |
| Planted | 94.0 | 90.2 | 88.9 | 89.7 | 91.0 |
| Harvested | 86.7 | 82.7 | 81.3 | 81.3 | 82.5 |
| Yield (metric ton/hectare) | 174.6 | 176.6 | 176.4 | 167.5 | 175.8 |
| | | | *In Millions of Bushels* | | |
| **Supply (million bushels)** | | | | | |
| Beginning Stocks | 1,737 | 2,293 | 2,140 | 2,221 | 1,995 |
| Production | 15,148 | 14,609 | 14,340 | 13,620 | 14,507 |
| Imports | 57 | 36 | 28 | 42 | 25 |
| **Total Supply** | 16,942 | 16,939 | 16,509 | 15,883 | 16,527 |
| **Usage (million bushels)** | | | | | |
| Food, seed, other non-ethanol ind. use | 1,453 | 1,452 | 1,415 | 1,399 | 1,395 |
| Ethanol and co-products | 5,432 | 5,605 | 5,378 | 4,852 | 5,050 |
| Feed and residual | 5,468 | 5,304 | 5,429 | 5,827 | 5,700 |
| Exports | 2,296 | 2,438 | 2,066 | 1,778 | 2,650 |
| **Total Use** | 14,649 | 14,798 | 14,288 | 13,857 | 14,795 |
| **Ending Stocks** | 2,293 | 2,140 | 2,221 | 1,995 | 1,702 |
| **Average farm price (dollar per bushel†)** | 3.36 | 3.36 | 3.61 | 3.56 | 4.00 |

*Projected
†The average farm price for 20/21 based on WASDE November projected price

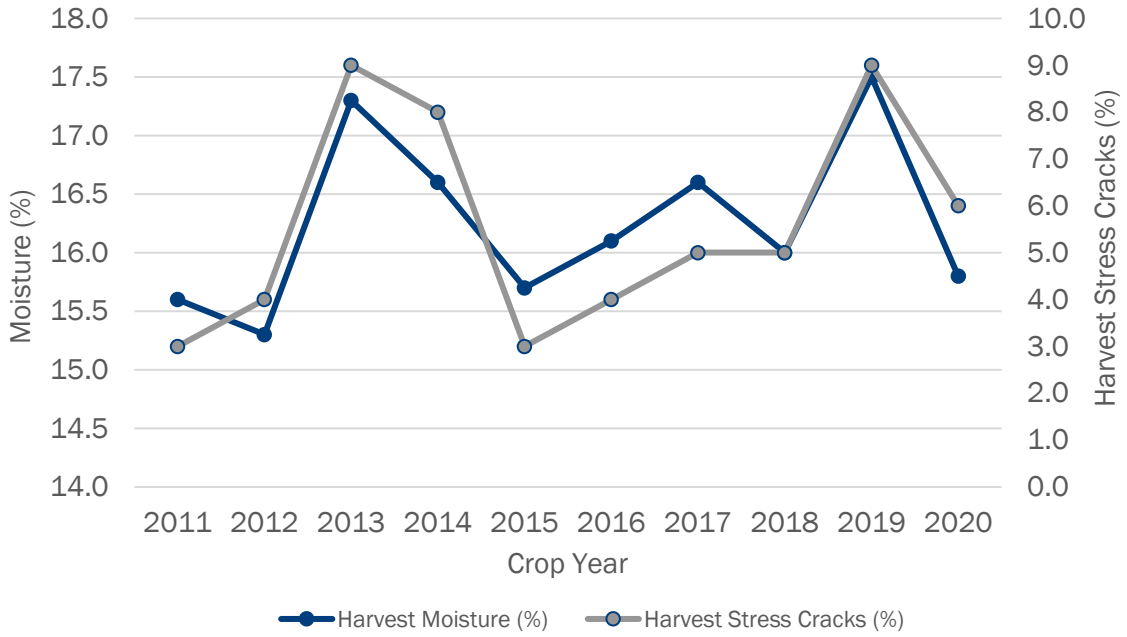
Source: USDA WASDE, November 2020

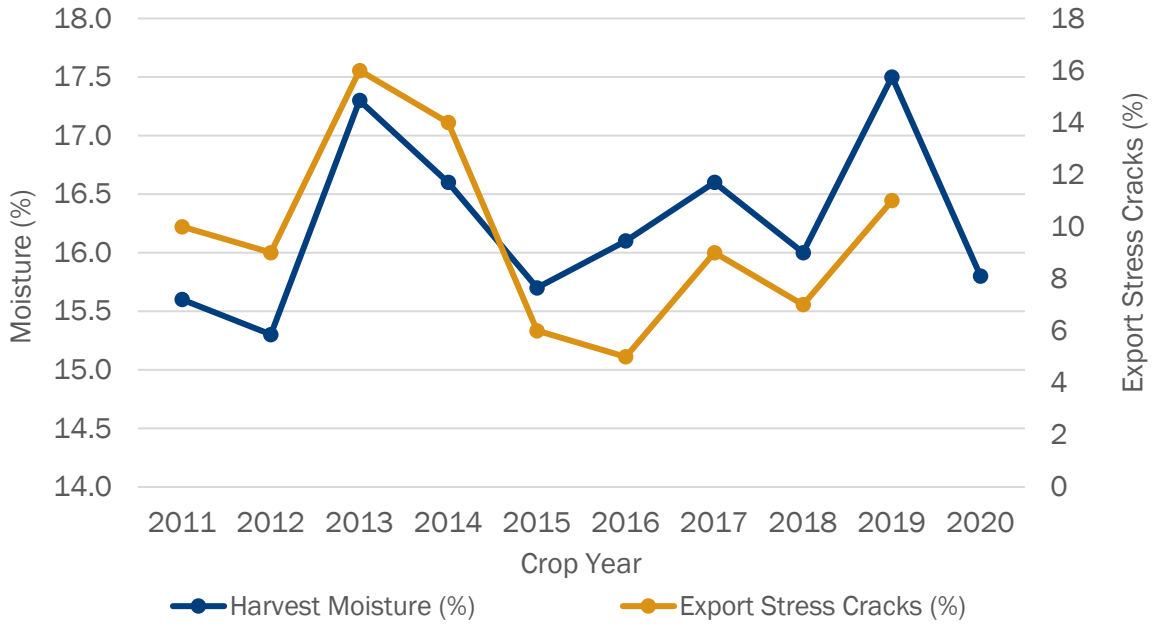
# How Does U.S. Grain Move?



# Harvest Moisture (%) vs. Stress Cracks (%)

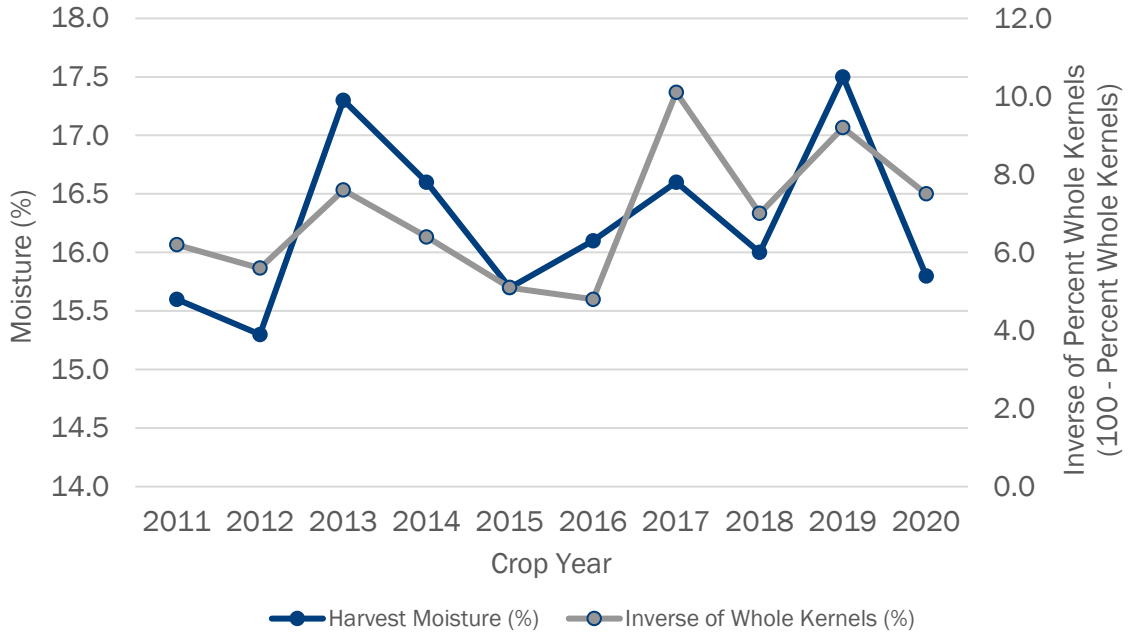
- The Council has observed that Harvest Moisture (%) tends to impact Stress Cracks (%) in both the Harvest and Export Cargo reports.
- The 2020 crop's relatively low harvest moisture should help promote low levels of stress cracks.



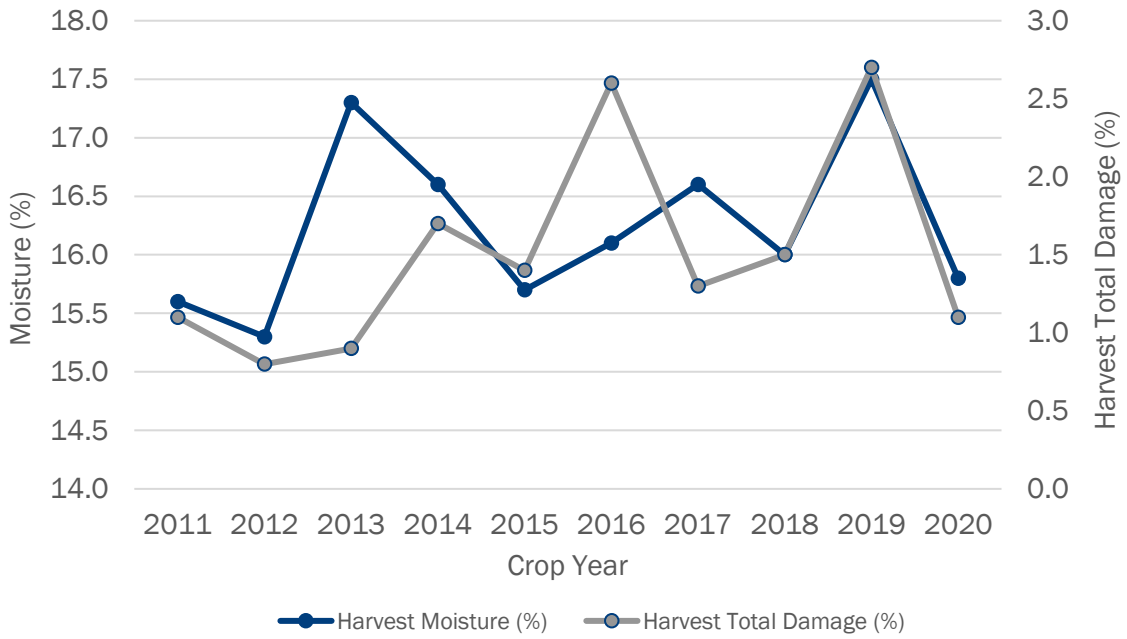
# Harvest Moisture (%) vs. Broken Kernels (%) *(Inverse of Whole Kernels)*

- The Council has observed that Harvest Moisture (%) tends to impact the percentage of broken kernels at harvest. This is likely due to:
  - Lower breakage created during harvest
  - Less handling and artificial drying required to reduce moisture to levels safe for storage
- The 2020 crop's relatively low harvest moisture likely helped keep a high percentage of kernels fully intact.



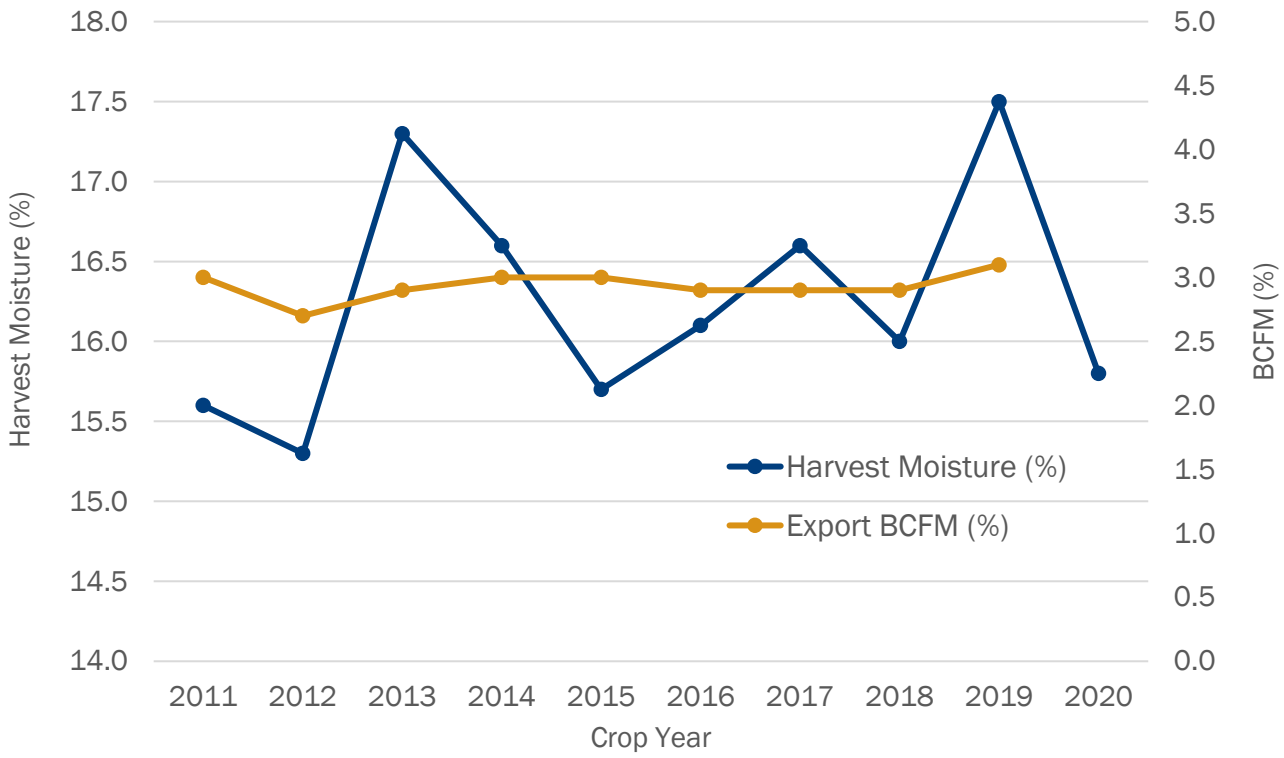
# Harvest Moisture (%) vs. Harvest Total Damage (%)

- High moisture may be a precursor to mold damage and possible mycotoxin development later in storage or transport.
- In some years, Harvest Moisture (%) may be a contributing factor to higher levels of Total Damage (%) at harvest.



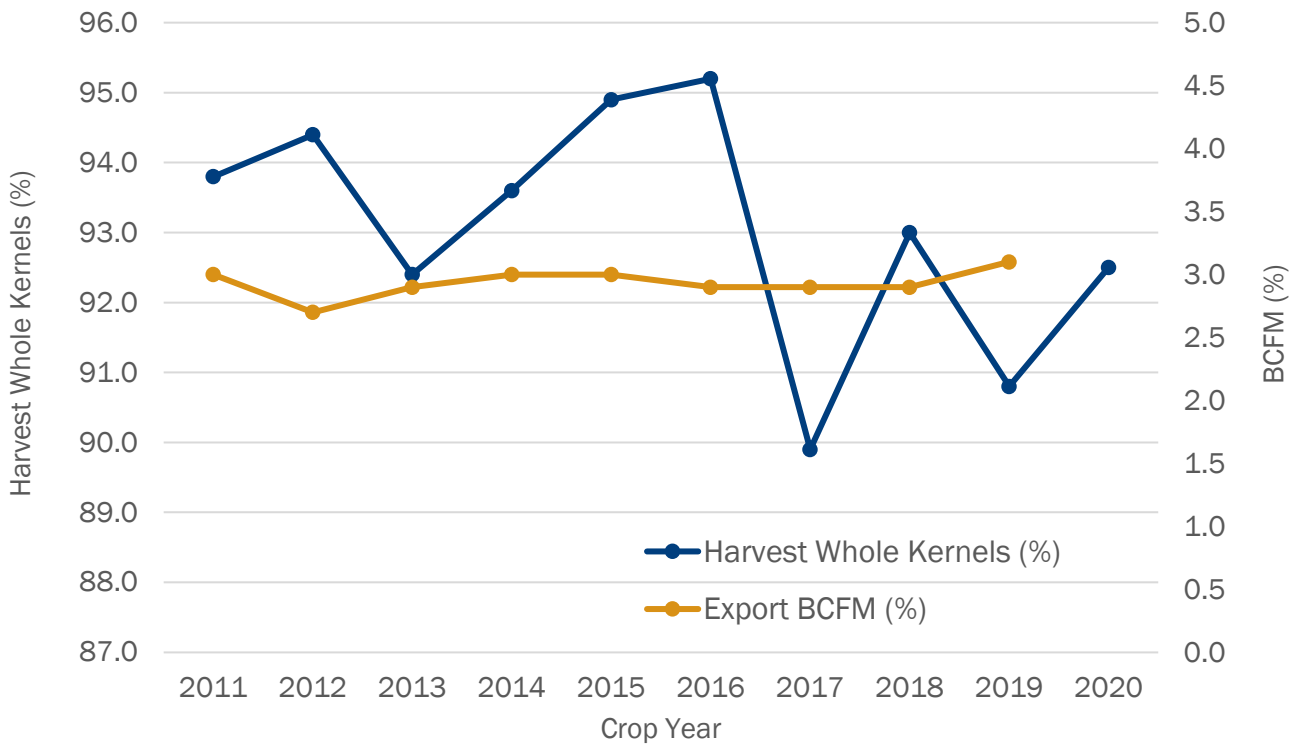
# Harvest Moisture (%) vs. Export BCFM (%)

- It is difficult to predict BCFM (%) observed in the Export Cargo Report using quality factor results from the Harvest Quality Reports.
- BCFM within 0.3% of 3.0% in each of the past nine years.
- Note the following quality factors' relationships with BCFM (%) at export:
  - **Harvest Moisture (%)**
  - Harvest Whole Kernels (%)
  - Harvest Stress Cracks (%)



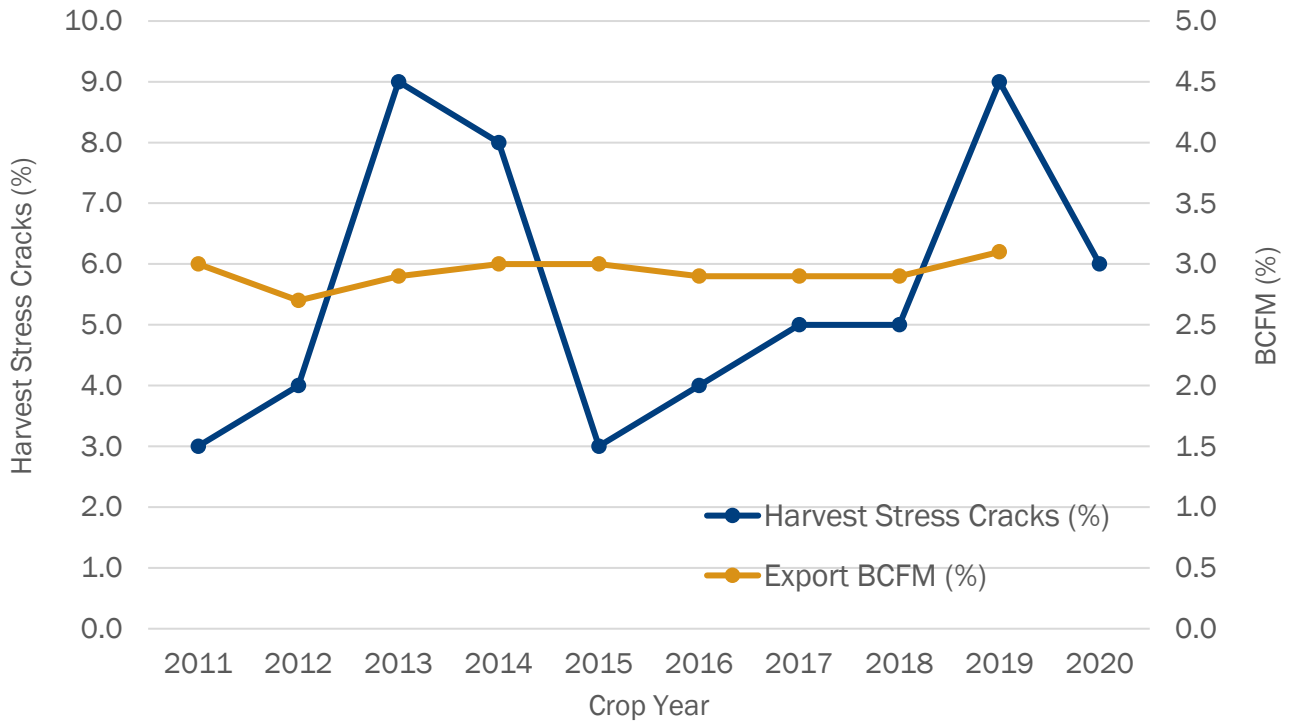
# Harvest Whole Kernels (%) vs. Export BCFM (%)

- It is difficult to predict BCFM (%) observed in the Export Cargo Report using quality factor results from the Harvest Quality Reports.
- BCFM within 0.3% of 3.0% in each of the past nine years.
- Note the following quality factors' relationships with BCFM (%) at export:
  - Harvest Moisture (%)
  - **Harvest Whole Kernels (%)**
  - Harvest Stress Cracks (%)



# Harvest Stress Cracks (%) vs. Export BCFM (%)

- It is difficult to predict BCFM (%) observed in the Export Cargo Report using quality factor results from the Harvest Quality Reports.
- BCFM within 0.3% of 3.0% in each of the past nine years.
- Note the following quality factors' relationships with BCFM (%) at export:
  - Harvest Moisture (%)
  - Harvest Whole Kernels (%)
  - **Harvest Stress Cracks (%)**



# Harvest Stress Cracks (%) vs. Export Stress Cracks (%)