U.S. Grains Council

2017/2018 Corn Export Cargo Quality Report

Developing Markets • Enabling Trade • Improving Lives

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Quality, Reliability, Transparency

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Building partnerships based on trust

Bridge to world's largest, most reliable grain supply

Corn Quality Report

Systematic survey of corn quality at harvest and of early exports

Transparent and Consistent Methodology

Reliable and Comparable Data

Harvest Quality Report

Export Cargo Quality Report

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USGC Corn Quality Reports

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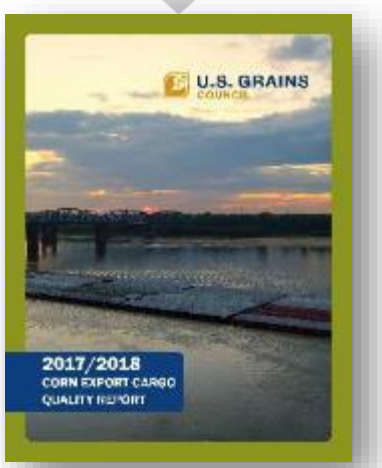
2011/2012 through 2016/2017

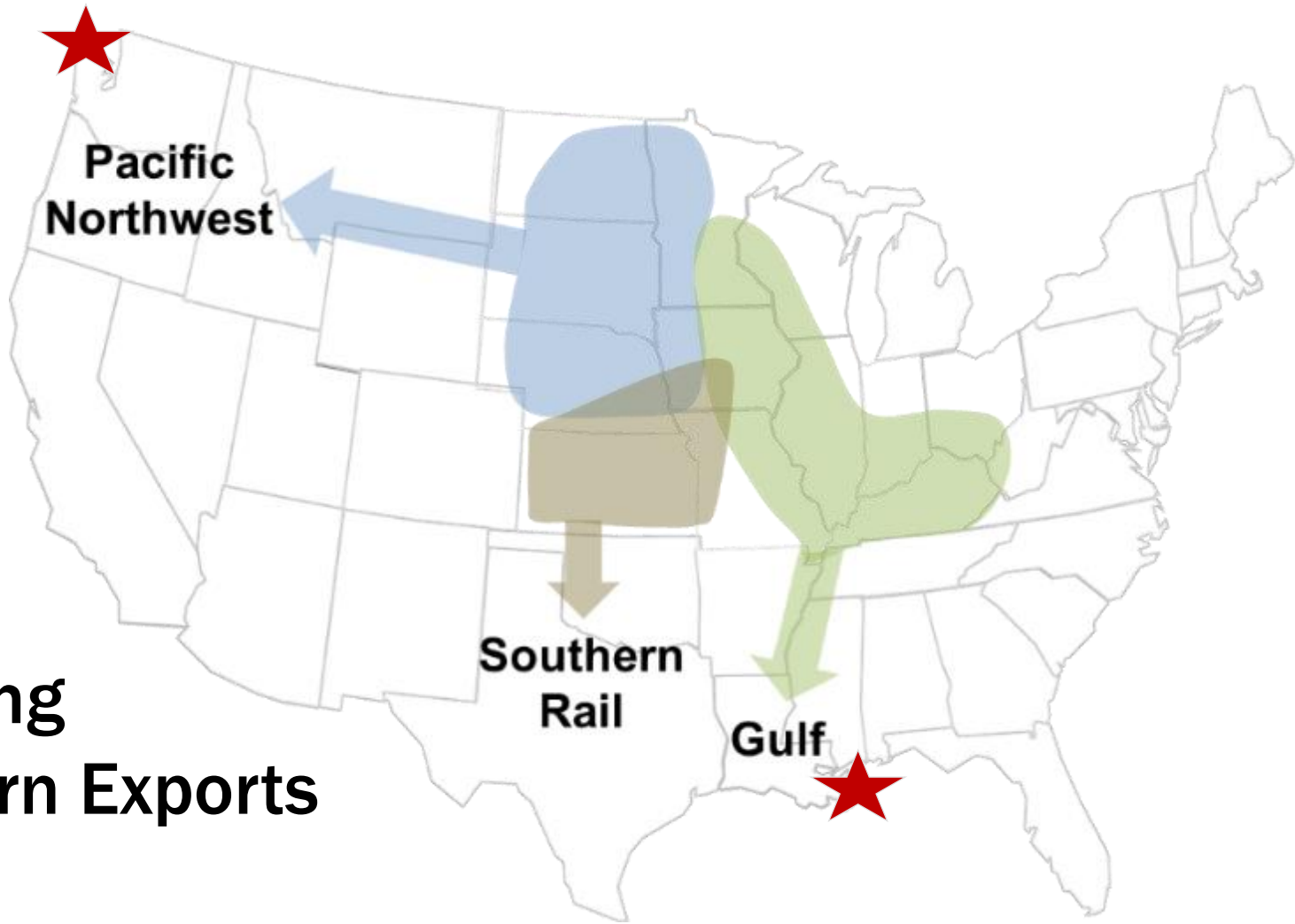
2017/2018

Harvest

Export Cargo



“Export Catchment Areas” (ECA)



430 export samples
from ECAs representing
over 93.1% of U.S. Corn Exports

Quality Factors Tested

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Grading Factors

- Test weight
- Broken corn/foreign material
- Total damage
- Heat damage

Physical Factors

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

Moisture

Chemical Composition

- Protein
- Starch
- Oil

Mycotoxins

- Aflatoxins
- DON

2017/2018 Corn Export Cargo Quality Highlights

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Overall Crop

Aggregate averages rated at U.S. No. 2 or better on **ALL** grade factors

Grade Factors/ Moisture

Test Weight
Same
as 2016/2017

BCFM
Same
as 5YA*

Total Damage
Lower
than 2016/2017 and 5YA

Moisture
Same
as 5YA

Chemical Composition

Protein
Same

Starch
Lower

Oil
Higher

Compared to the 5YA

Physical Factors

Stress Cracks
Slightly lower

100-Kernel Weight and Kernel Volume
Higher

True Density
Similar

Whole Kernels
Lower

Horneous Endosperm
Slightly lower

Compared to the 5YA

Mycotoxins

ALL samples below FDA action level of 20 ppb for aflatoxin

ALL samples below FDA advisory level of 5 ppm for DON

* 5YA = 2012/2013-2016/2017 marketing years

Export Cargo 2017/2018 Highlights

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Grade Factors

- Average U.S. Aggregate better than or equal to U.S. No. 2 on all attributes
- Test weight same as 2016/2017
- Same BCFM as 2016/2017 and 5YA*
- Total damage lower than 2016/2017 and 5YA

Moisture

- Slightly higher than 2016/2017, but same as 5YA

Chemical Composition

- Same protein and higher oil concentrations than 2016/2017 and 5YA
- Slightly lower starch concentration than 2016/2017 and lower than 5YA

Physical Factors

- Slightly higher stress cracks and SCI than 2016/2017, yet slightly lower than 5YA
- Higher 100-kernel weight and kernel volume than 2016/2017 and 5YA
- Slightly higher true density than 2016/2017
- Lower percent of whole kernels, but higher horneous endosperm than 2016/2017

**5YA: simple average of the U.S. Aggregate quality factor's average in 2012/2013, 2013/2014, 2014/2015, 2015/2016 and 2016/2017*

Export Cargo 2017/2018 Highlights (cont'd)

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Mycotoxins

Aflatoxins

- All export samples tested below the FDA action level of 20 ppb for aflatoxins
- A higher proportion of the export samples had no detectable levels of aflatoxins than 2016/2017 and 2015/2016

Deoxynivalenol (DON) or Vomitoxin

- 100% of the corn export samples tested below the 5 ppm FDA advisory level for DON
- A higher proportion of the export samples had no detectable levels of DON than 2016/2017

Grade Factors and Moisture

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Grades and Grade Requirements

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Grade	Min. Test Weight per Bushel (Pounds)	Maximum Limits of Damaged Kernels		BCFM (%)
		Heat Damaged (%)	Total (%)	
U.S. No. 1	56.0	0.1	3.0	2.0
U.S. No. 2	54.0	0.2	5.0	3.0
U.S. No. 3	52.0	0.5	7.0	4.0
U.S. No. 4	49.0	1.0	10.0	5.0
U.S. No. 5	46.0	3.0	15.0	7.0

Grade Factors and Moisture

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	No. of Samples	Avg.	Std. Dev.	Min.	Max.
Test Weight (lb/bu)	430	57.4	0.85	54.2	61.1
Test Weight (kg/hl)	430	73.9	1.10	69.8	78.6
BCFM (%)	430	2.9	0.59	0.5	5.4
Total Damage (%)	430	1.9	1.02	0.0	10.4
Heat Damage (%)	430	0.0	0.01	0.0	0.2
Moisture (%)	430	14.4	0.29	13.1	15.3

Test Weight – U.S. Units (lb/bu)

U.S. Aggregate: 57.4 lb/bu

Indicates good overall grain quality

Same as 2016/2017,
and similar to 5YA*
(57.5 lb/bu)

Average well above the limit of
U.S. No. 1 grade

Southern Rail ECA average
higher than Gulf
and Pacific Northwest ECAs

*5YA: simple average of U.S. Aggregate quality factor's average in 2012/2013, 2013/2014, 2014/2015, 2015/2016 and 2016/2017.

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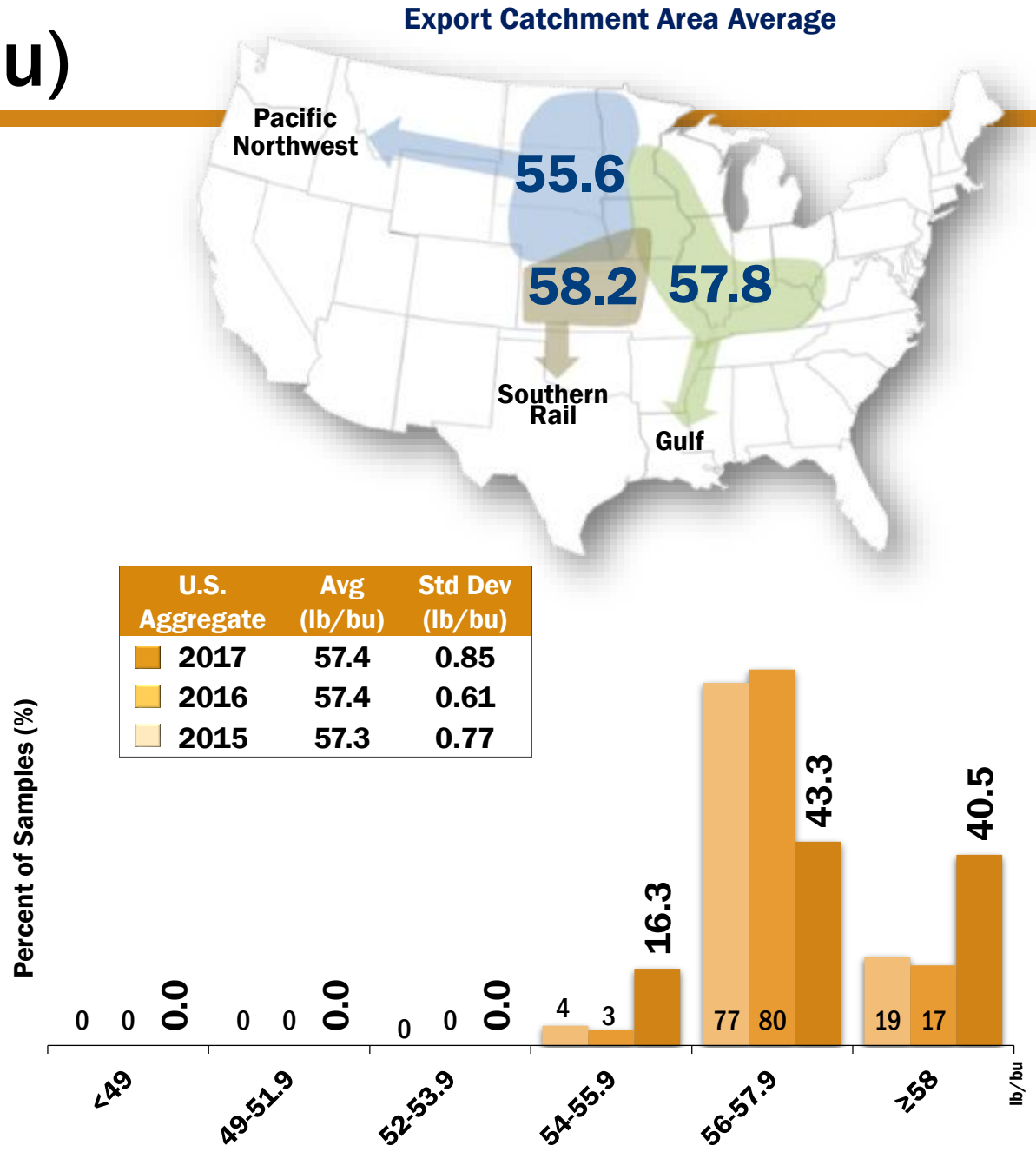

Test Weight – Metric (kg/hl)

U.S. Aggregate: 73.9 kg/hl

Indicates good overall grain quality

Same as 2016/2017,
and similar to 5YA*
(74.0 kg/hl)

Average well above the limit of
U.S. No. 1 grade

Southern Rail ECA average
higher than Gulf
and Pacific Northwest ECAs

*5YA: simple average of U.S. Aggregate quality factor's average in 2012/2013, 2013/2014, 2014/2015, 2015/2016 and 2016/2017.

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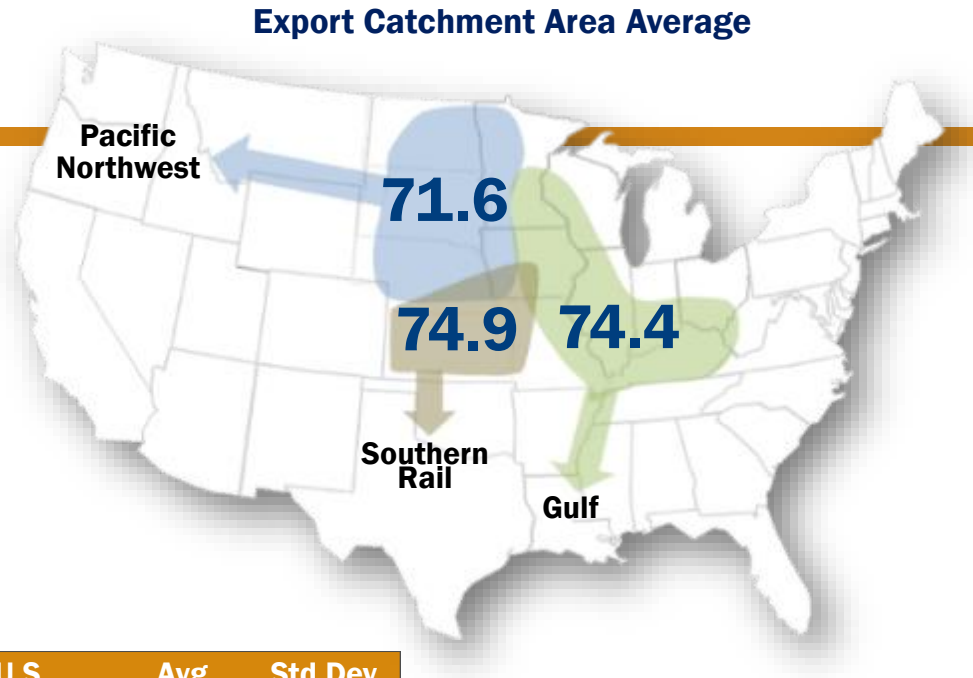
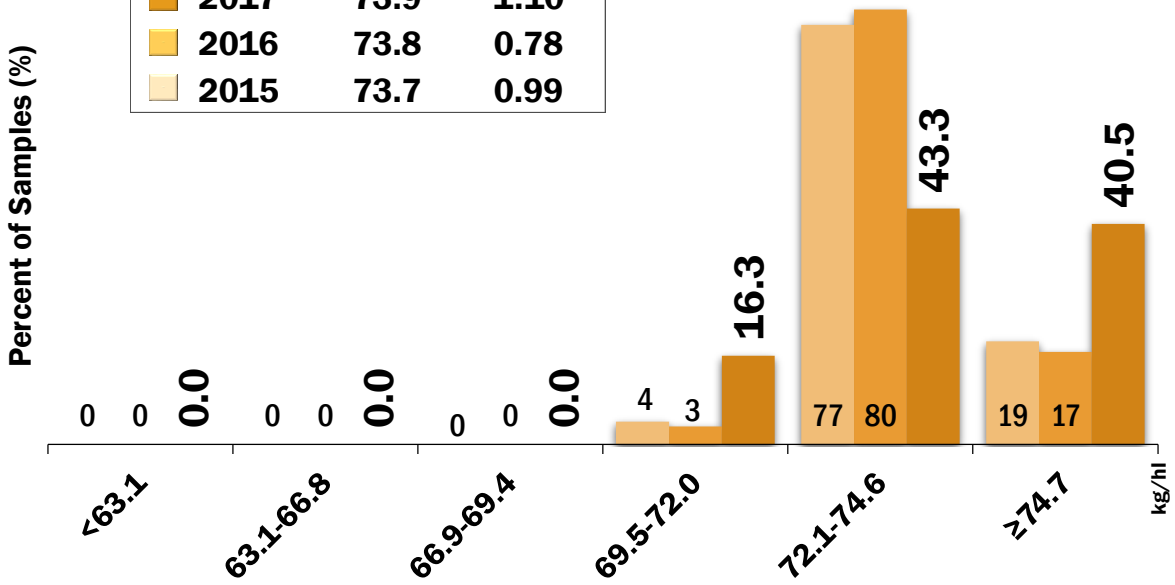
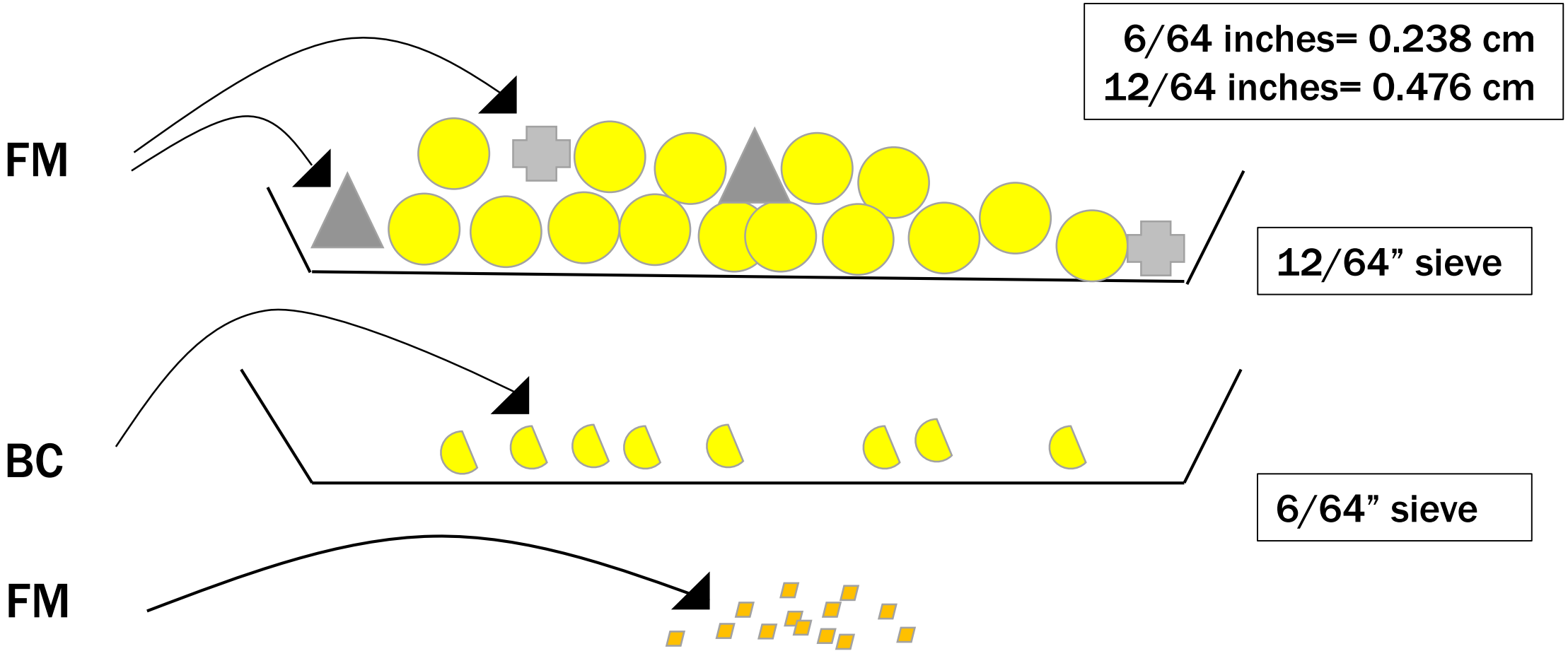


U.S. Aggregate	Avg (kg/hl)	Std Dev (kg/hl)
2017	73.9	1.10
2016	73.8	0.78
2015	73.7	0.99



Broken Corn & Foreign Material*



* Measured as % of weight

Broken Corn & Foreign Material (%)

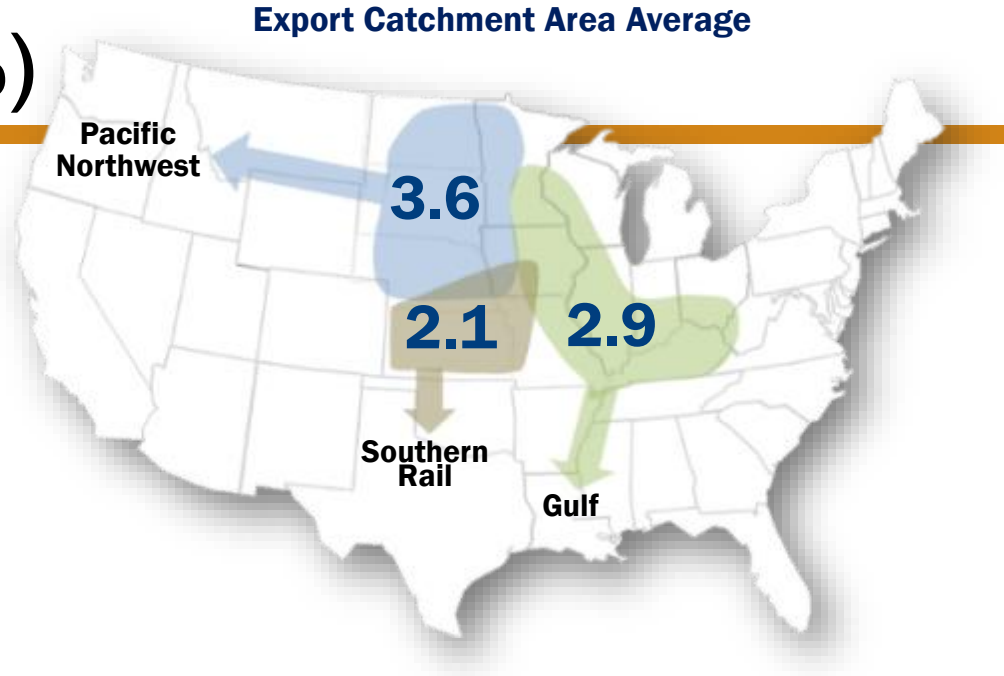
U.S. Aggregate: 2.9%

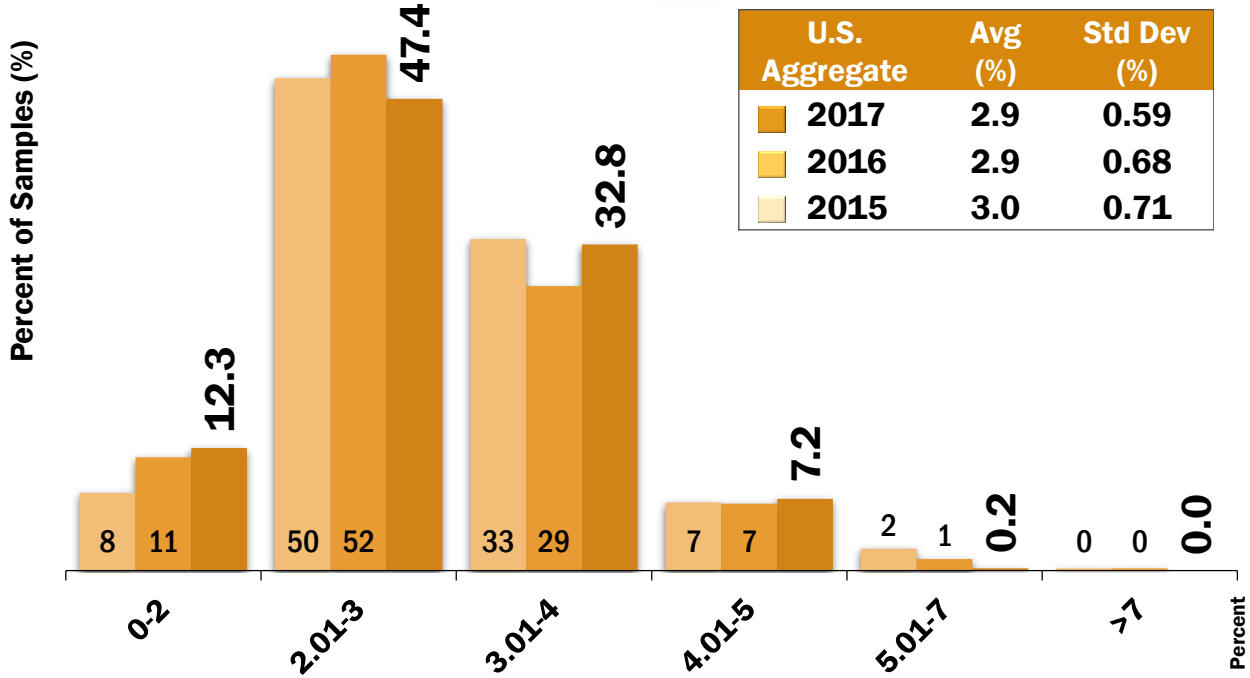
Same as
2016/2017 and 5YA (2.9%)

Average was below
U.S. No. 2 grade

About 60% of the samples
had ≤ 3% BCFM

Lower in Southern Rail ECA than in
Pacific Northwest and Gulf ECAs





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Total Damage (%)

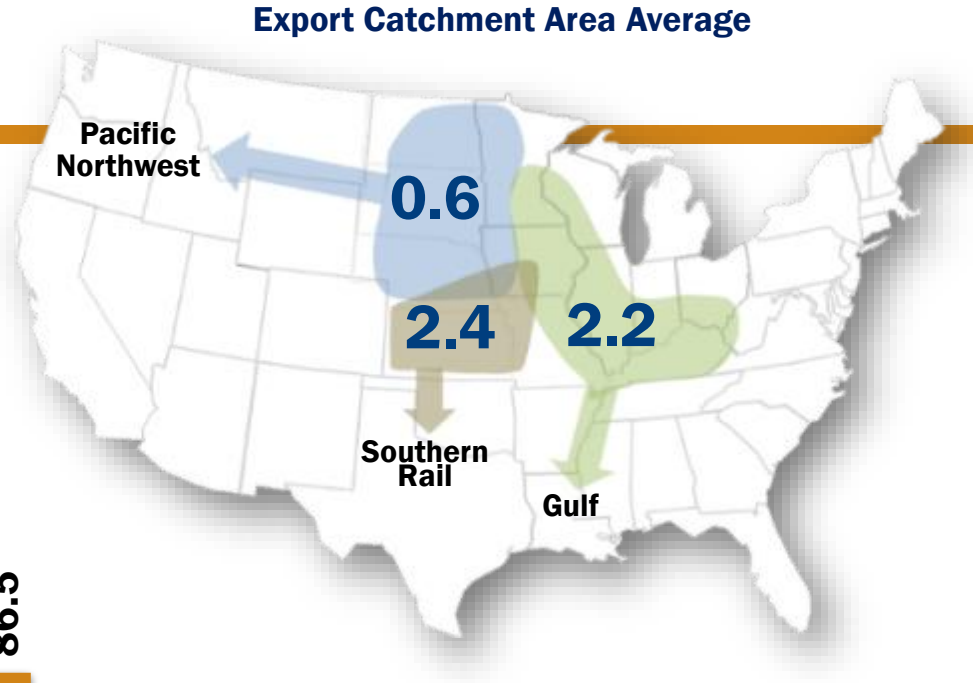
U.S. Aggregate: 1.9%

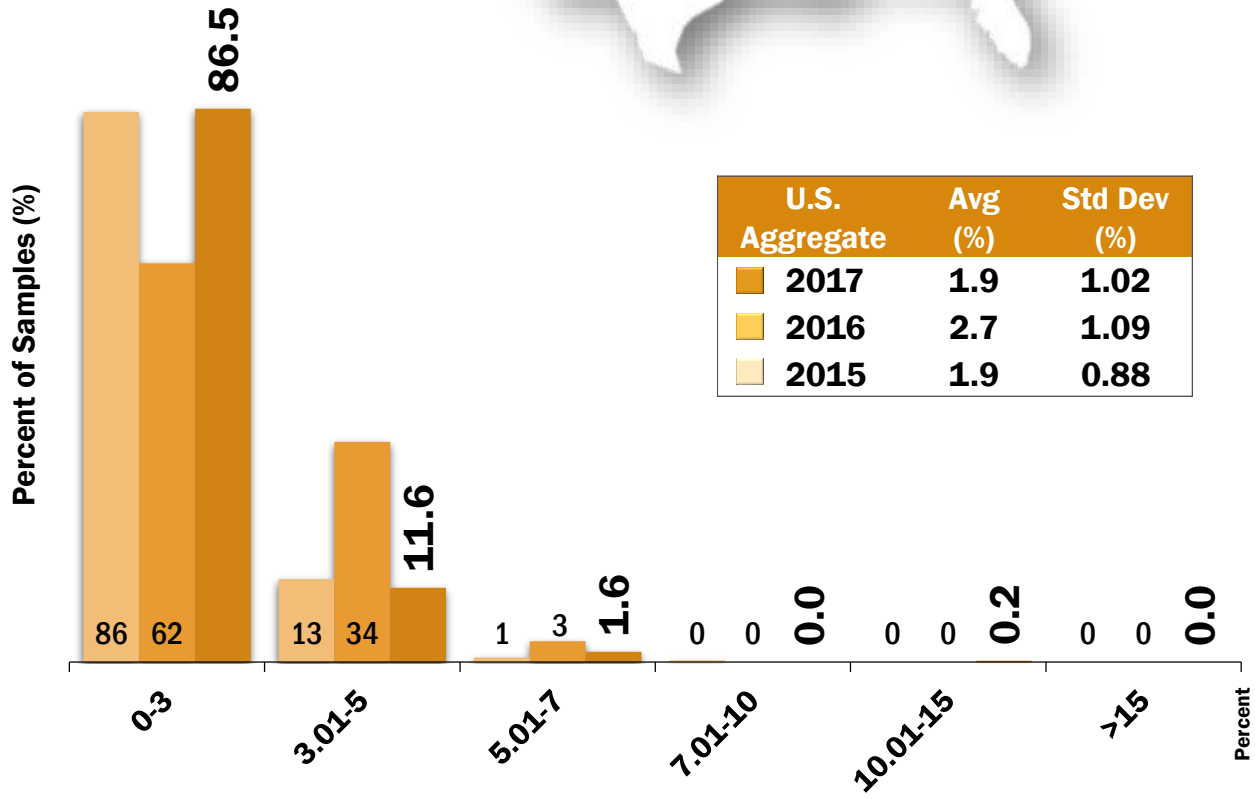
Lower than 2016/2017 and 5YA, same as 2015/2016

98.1% of all samples meet standard for U.S. No. 2

Nominal increase in average from harvest

Pacific Northwest ECA has consistently had lowest total damage of the three ECAs





U.S. Aggregate	Avg (%)	Std Dev (%)
2017	1.9	1.02
2016	2.7	1.09
2015	1.9	0.88

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Heat Damage (%)

Heat Damage

Only four samples
in the entire sample set
showed any heat damage
(0.1, 0.1, 0.2 and 0.2%)

Average below the limit for
U.S. No. 1 Grade

Indicates good management
of the drying and storage of corn

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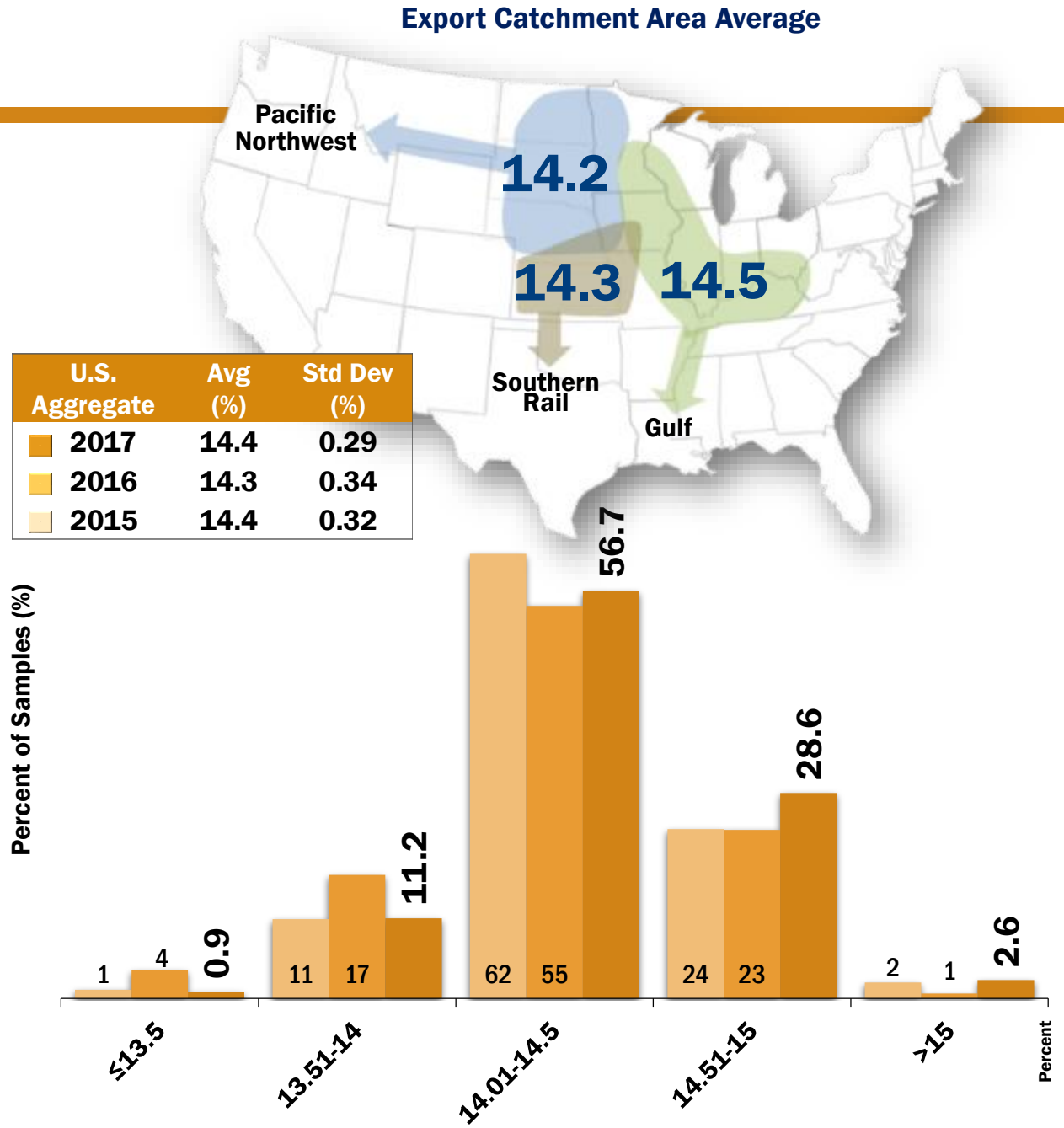
Moisture (%)

Not a grade factor
U.S. Aggregate: 14.4%

Slightly higher than 2016/2017, yet the same as 5YA (14.4%)

Higher percentage of samples with > 14.5% moisture than previous 2 years

Pacific Northwest ECA had the lowest average for 2016/2017, 2015/2016 and 5YA



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Chemical Composition

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Chemical Composition

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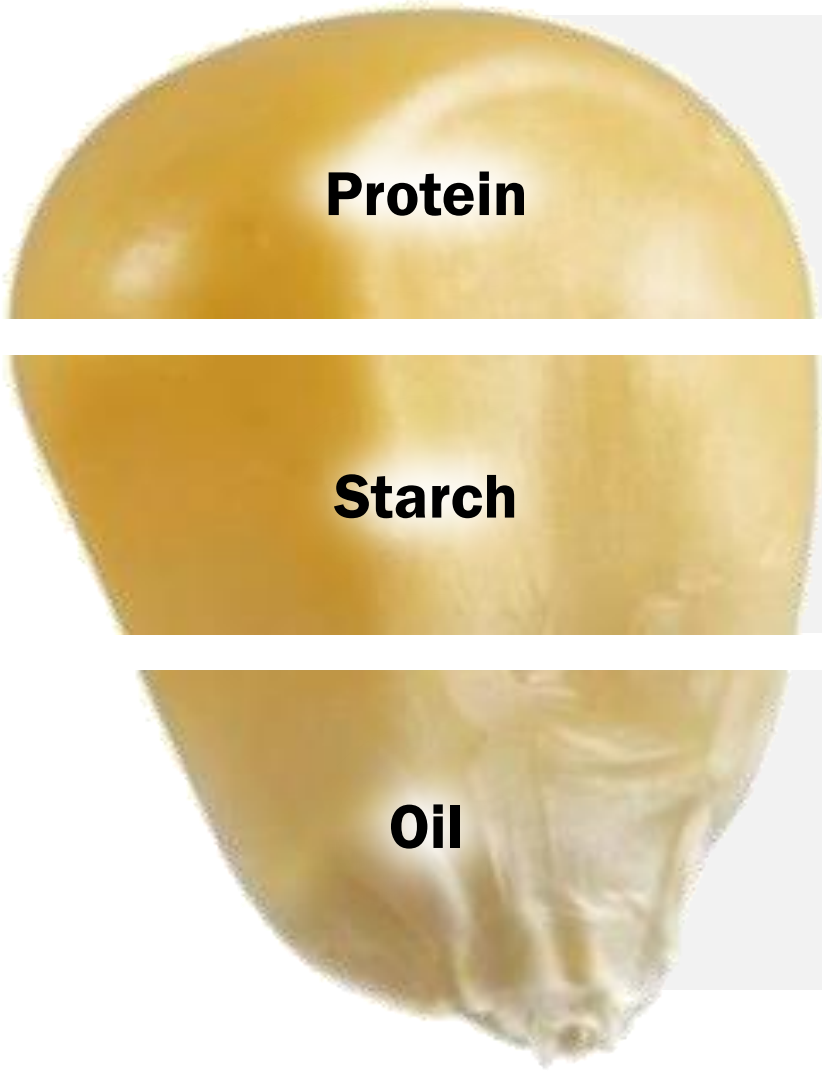


Protein	Important for poultry and livestock feeding Supplies essential amino acids	Influenced by	Genetics, weather, crop yields and available nitrogen during the growing season
Starch	Important for wet millers and dry-grind ethanol manufacturers	Influenced by	Genetics, weather and crop yields
Oil	Important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

Chemical Composition

	No. of Samples	Avg.	Std. Dev.	Min.	Max.
Protein (Dry Basis %)	430	8.6	0.29	7.7	9.9
Starch (Dry Basis %)	430	72.1	0.39	70.8	73.2
Oil (Dry Basis %)	430	4.1	0.12	3.8	4.6

Protein (Dry Basis %)

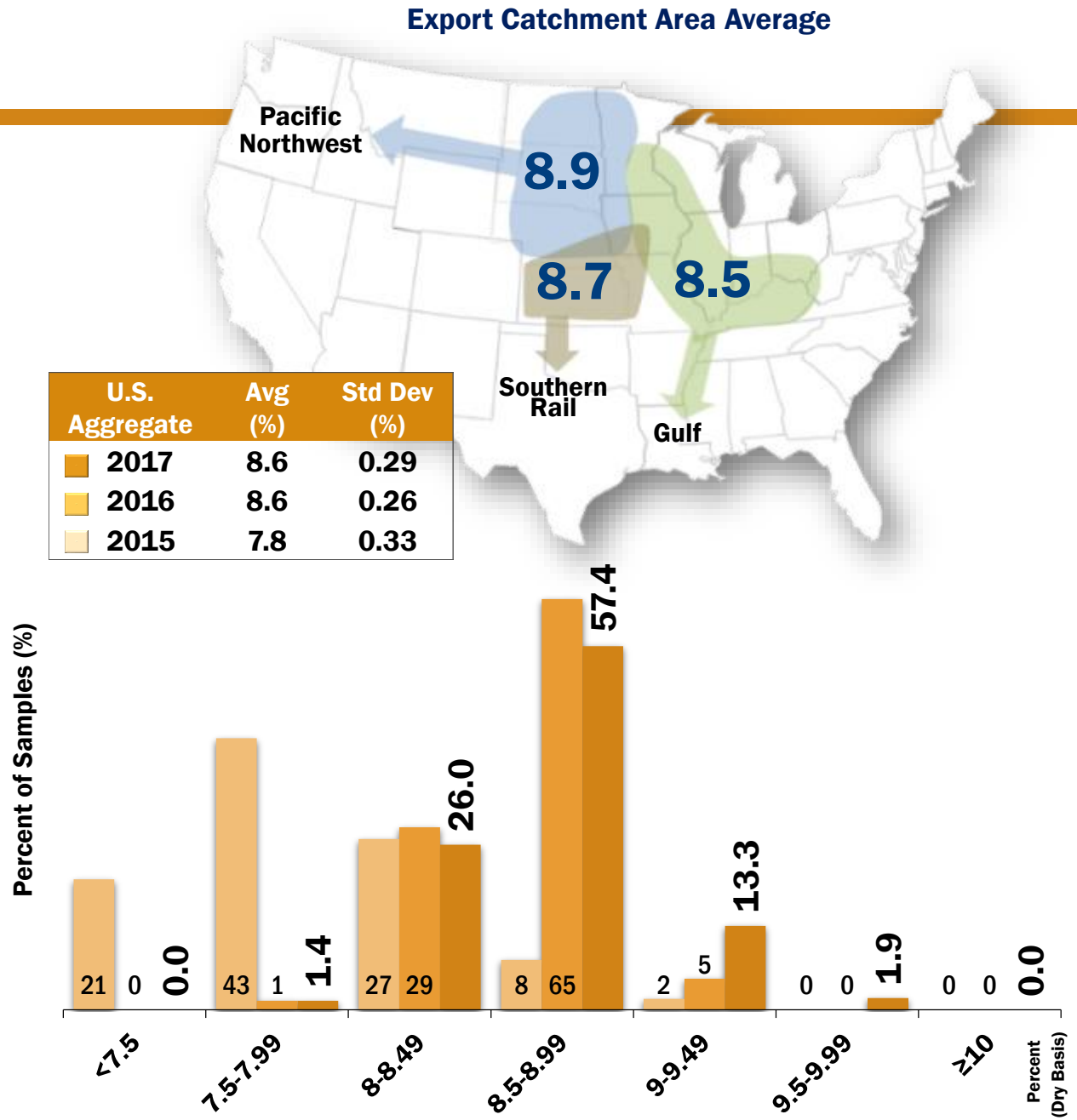
U.S. Aggregate: 8.6%

Same as 2016/2017 and 5YA

Corn with protein ≥ 8.5%:

2017/2018: 72.6%
2016/2017: 70%
2015/2016: 10%

Pacific Northwest ECA had highest protein concentration, same as 2015/16 and 5YA



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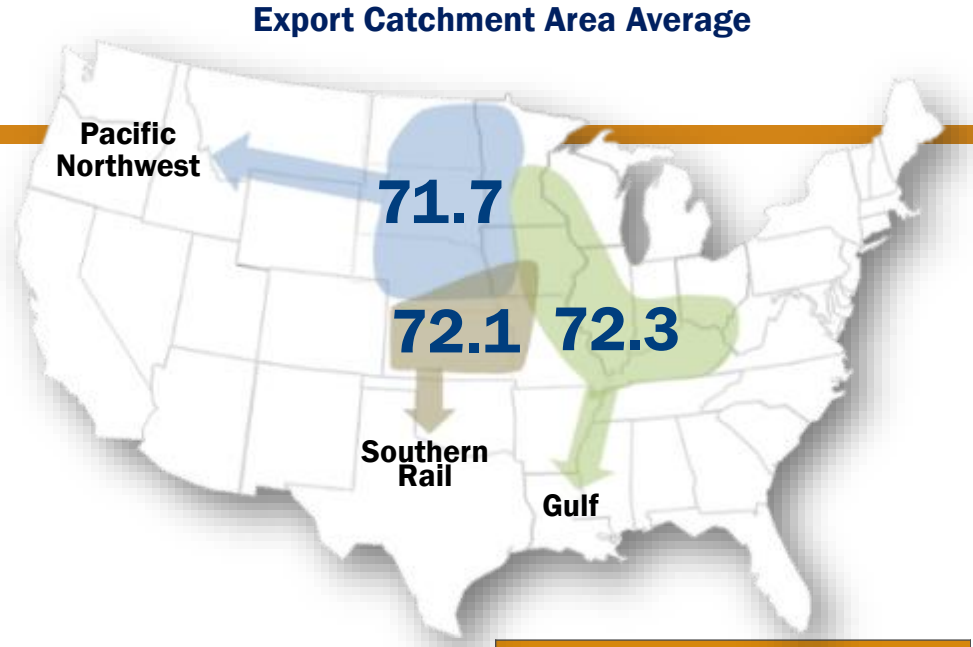
Starch (Dry Basis %)

U.S. Aggregate: 72.1%

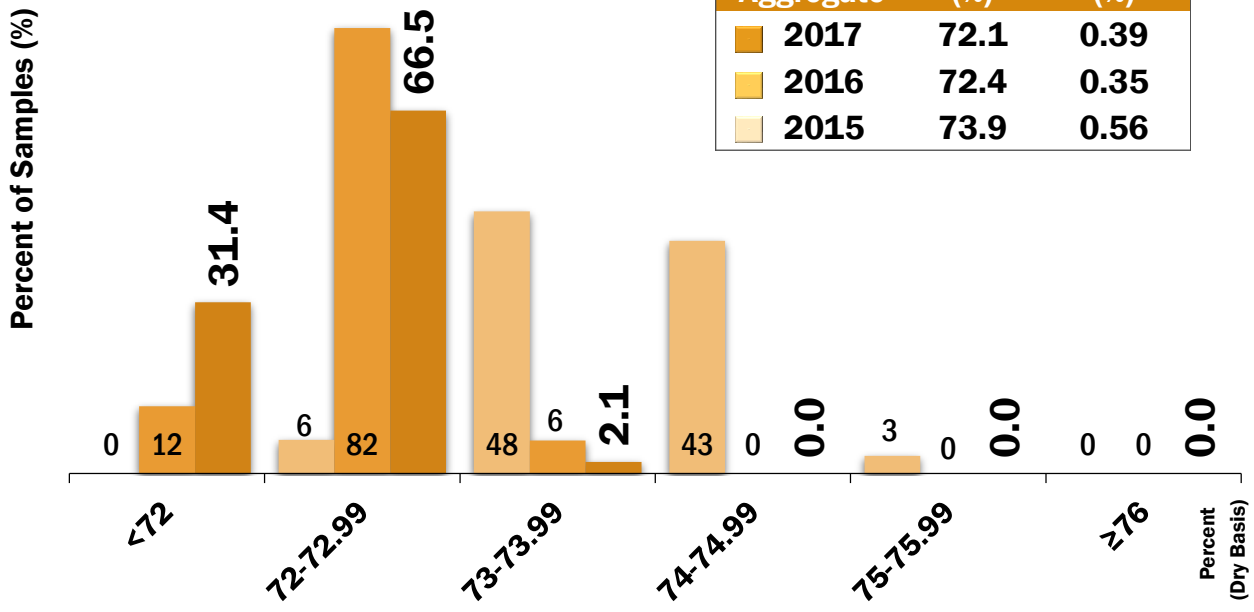
Slightly lower than 2016/2017 and lower than 5YA (73.4%)

Fewer samples had 73% or higher starch concentration than the previous 2 years

Gulf ECA had highest starch concentration, same as 2015/2016 and 5YA



U.S. Aggregate	Avg (%)	Std Dev (%)
2017	72.1	0.39
2016	72.4	0.35
2015	73.9	0.56



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Oil (Dry Basis %)

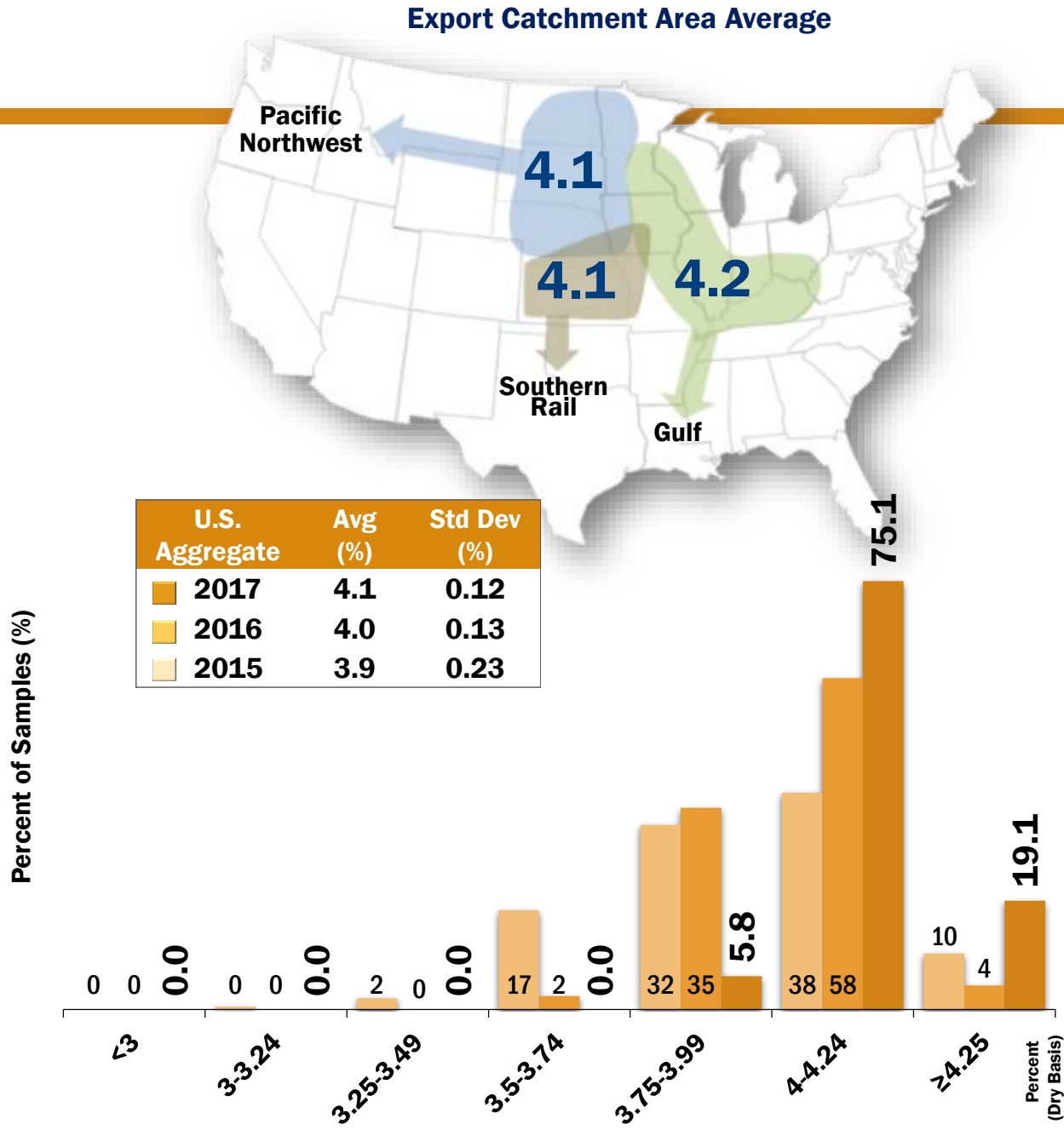
U.S. Aggregate: 4.1%

Higher than 2016/2017, 2015/2016 and 5YA (3.9%)

Corn with oil concentration ≥ 4%

2017/2018: 94.2%
2016/2017: 62%
2015/2016: 48%

Gulf ECA had slightly higher average concentration than Pacific Northwest and Southern Rail ECAs



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Physical Factors

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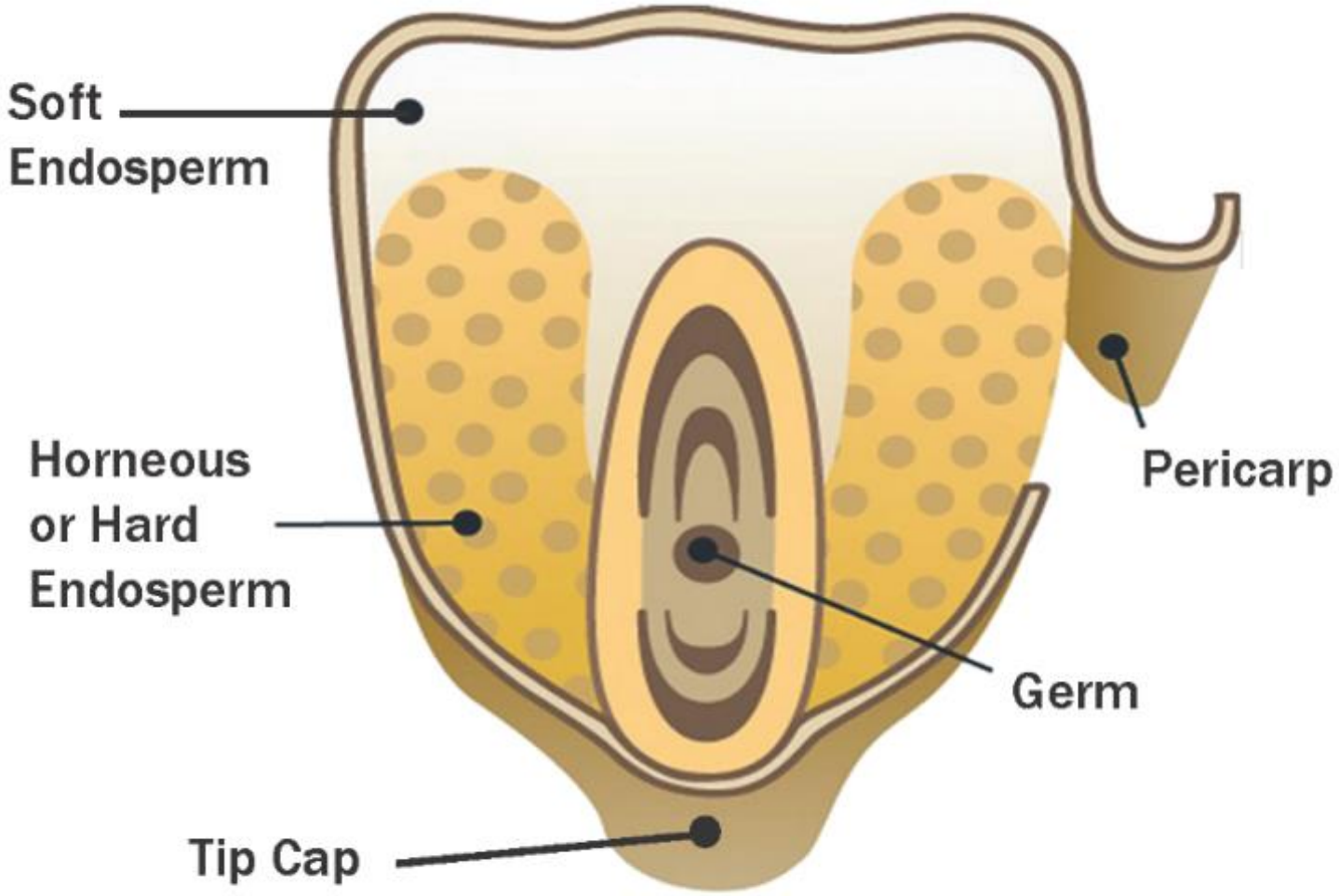
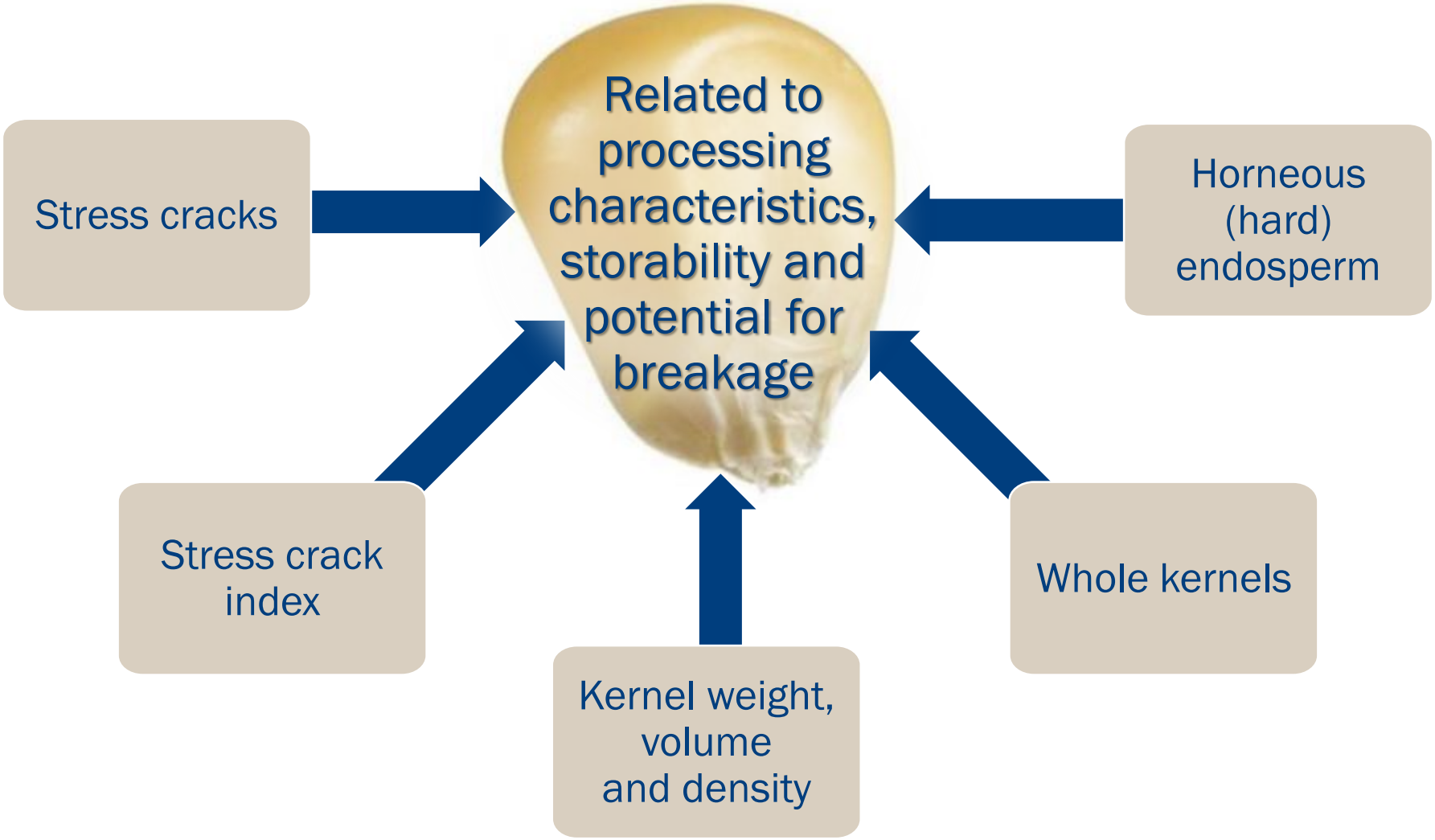
Corn Morphology



Source: Adapted from Corn Refiners Association, 2011

Physical Factors – Overview



Physical Factors

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	No. of Samples	Avg.	Std. Dev.	Min.	Max.
Stress Cracks (%)	430	9	5	0	36
Stress Crack Index	430	22.4	15.6	0	120
100-Kernel Weight (g)	430	36.07	1.43	27.45	41.05
Kernel Volume (cm^3)	430	0.28	0.01	0.22	0.32
True Density (g/cm^3)	430	1.287	0.012	1.211	1.334
Whole Kernels (%)	430	84.4	5.0	64.0	97.6
Horneous Endosperm (%)	430	81	2	75	90

Stress Cracks

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Stress Cracks (%)

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

Stress Crack Index (SCI)

- Indicates severity of stress cracking
- Measures single, double and multiple stress cracks
- Range 0 – 500 (100 kernel sample)

Stress Crack Index (SCI)

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% kernels with 1 stress crack

X 1

+

% kernels with 2 stress cracks

X 3

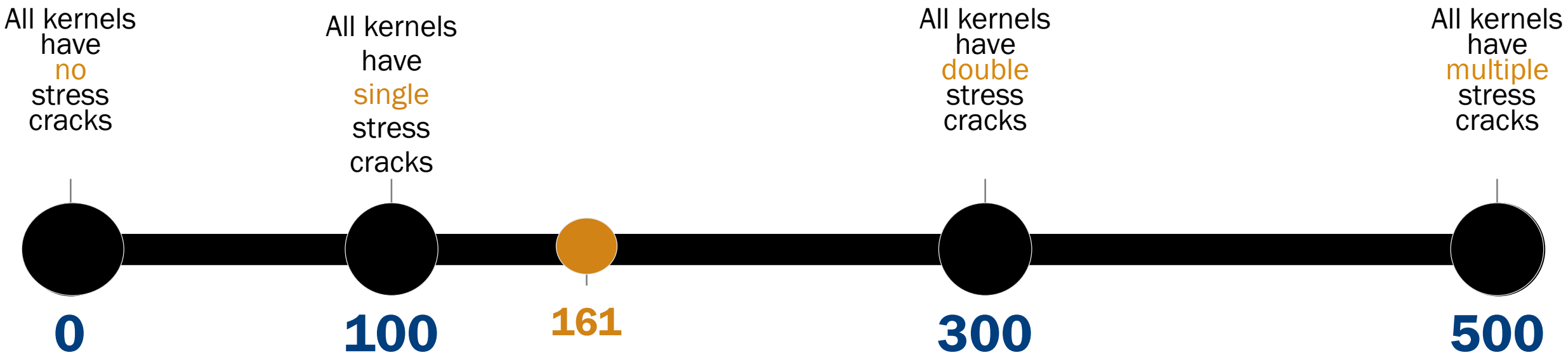
+

% kernels with >2 stress cracks

X 5

= SCI

Magnitude of SCI



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

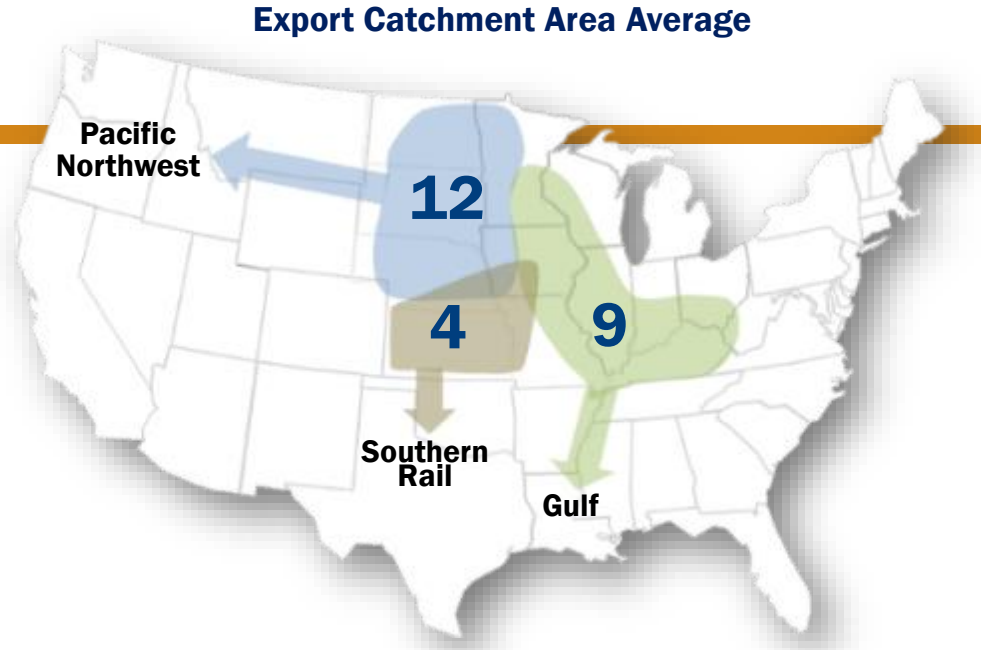
Stress Cracks (%)

U.S. Aggregate: 9%

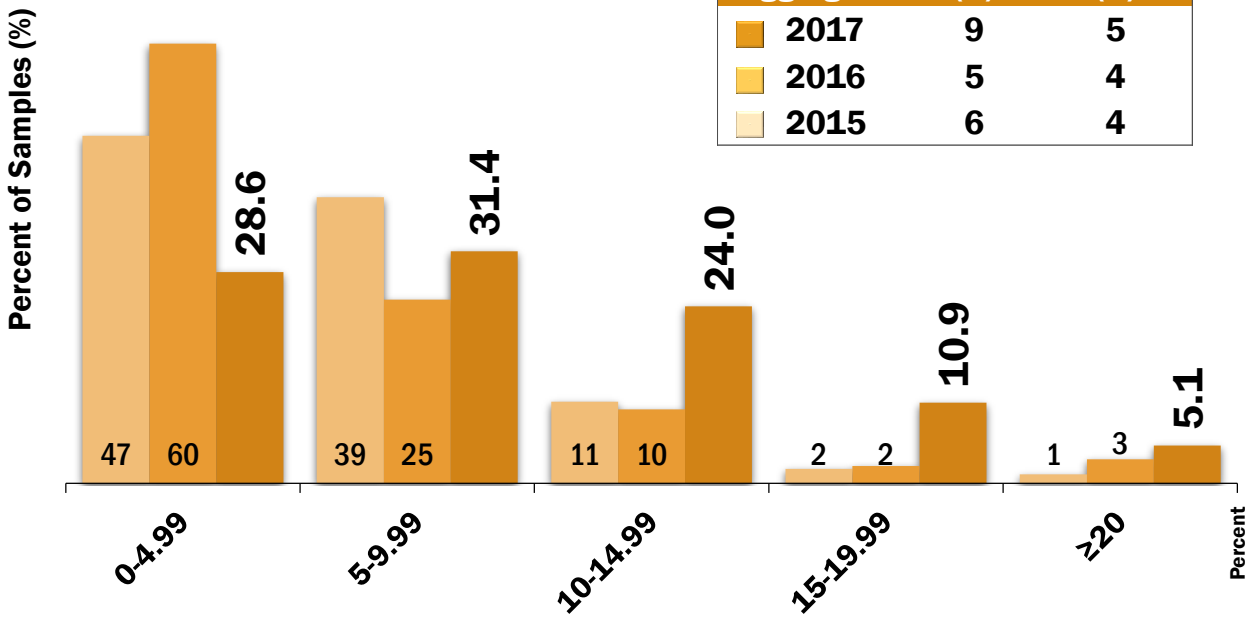
Slightly higher than 2016/2017
slightly lower than 5YA (10%)

Fewer percentage of samples with < 15% stress cracks than previous 2 years

Pacific Northwest experienced slightly higher average stress cracks than Gulf and Southern Rail ECAs for 2017/2018, the previous two years and 5YA



U.S. Aggregate	Avg (%)	Std Dev (%)
2017	9	5
2016	5	4
2015	6	4



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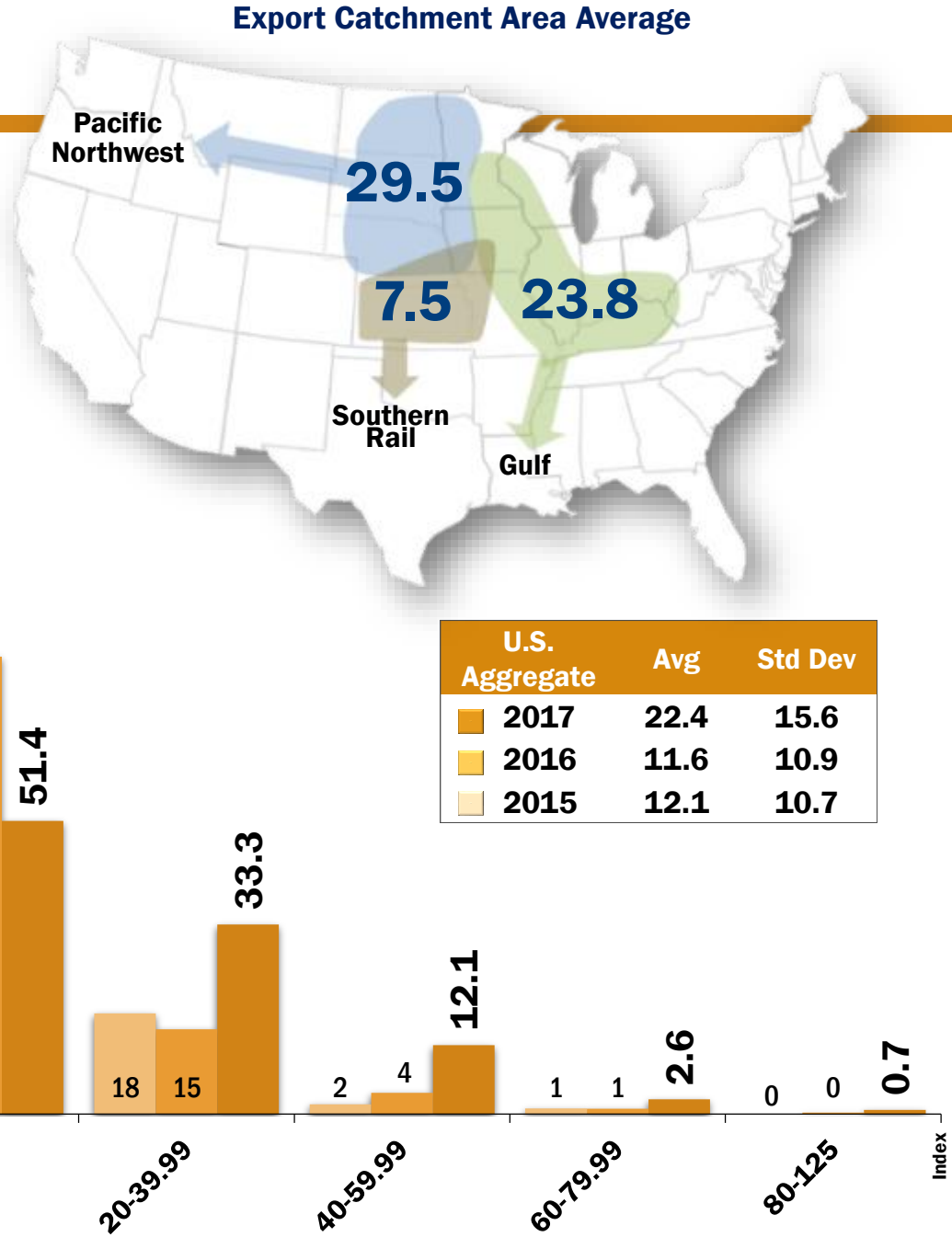
Stress Cracks Index (SCI)

U.S. Aggregate: 22.4

Slightly higher than 2016/2017 but slightly lower than 5YA (25.8)

Slightly more samples had double or multiple stress cracks than in 2016/2017 and 2015/2016

Southern Rail ECA had the lowest SCI of the 3 ECAs for 2017/2018, 2016/2017 and 5YA



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Kernel Weight, Volume, Density

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100-Kernel Weight (mass) (g)	÷	Kernel Volume (cm^3)	=	True Density (g/cm^3)
Indicates kernel size which affects Drying rates Flaking grit yields in dry milling		Kernel volume is indicative of growing conditions and genetics		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 (100-k) Weight (grams)

U.S. Aggregate: 36.07 g

Higher than 2016/2017 and 5YA (35.37 g)

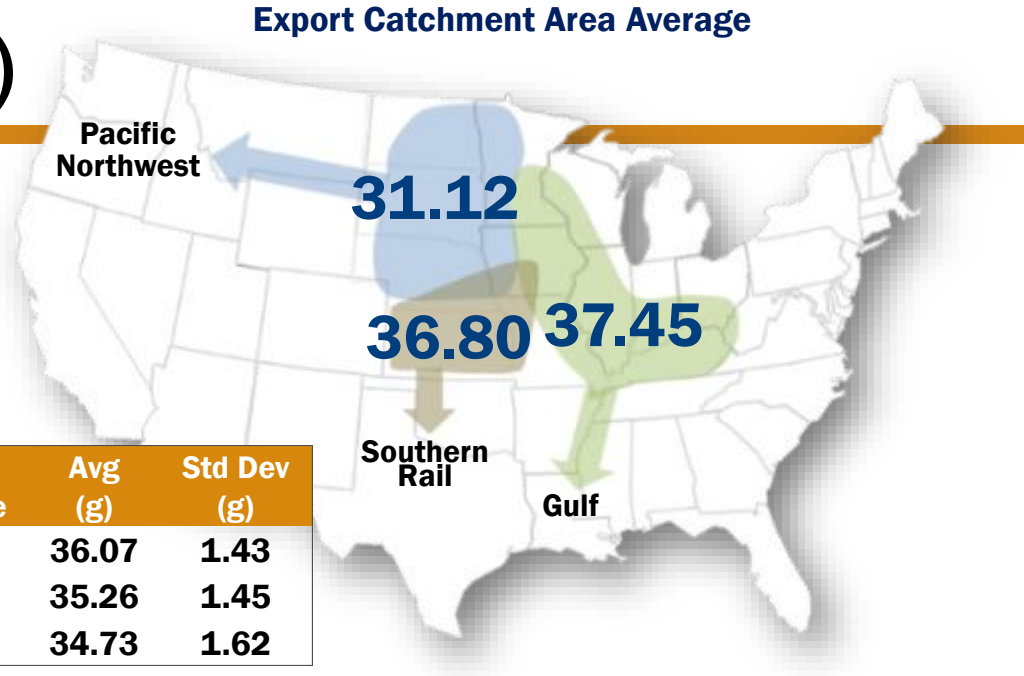
Corn with 100-k weight ≥ 36.5 g

2017/2018: 58.1%

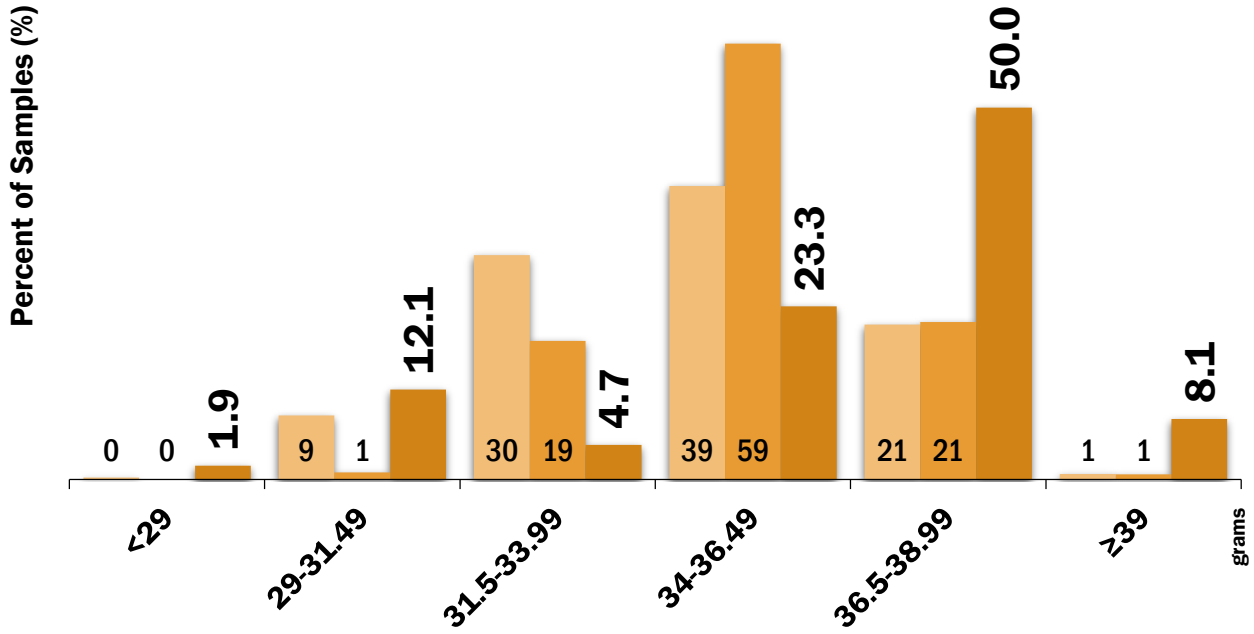
2016/2017: 22%

2015/2016: 22%

Gulf ECA had highest 100-k weight of the 3 ECAs for 2017/2018, 2016/2017 and 5YA



U.S. Aggregate	Avg (g)	Std Dev (g)
2017	36.07	1.43
2016	35.26	1.45
2015	34.73	1.62



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Kernel Volume (cm^3)

U.S. Aggregate: 0.28 cm^3

Higher than 2016/2017, 2015/2016 and 5YA

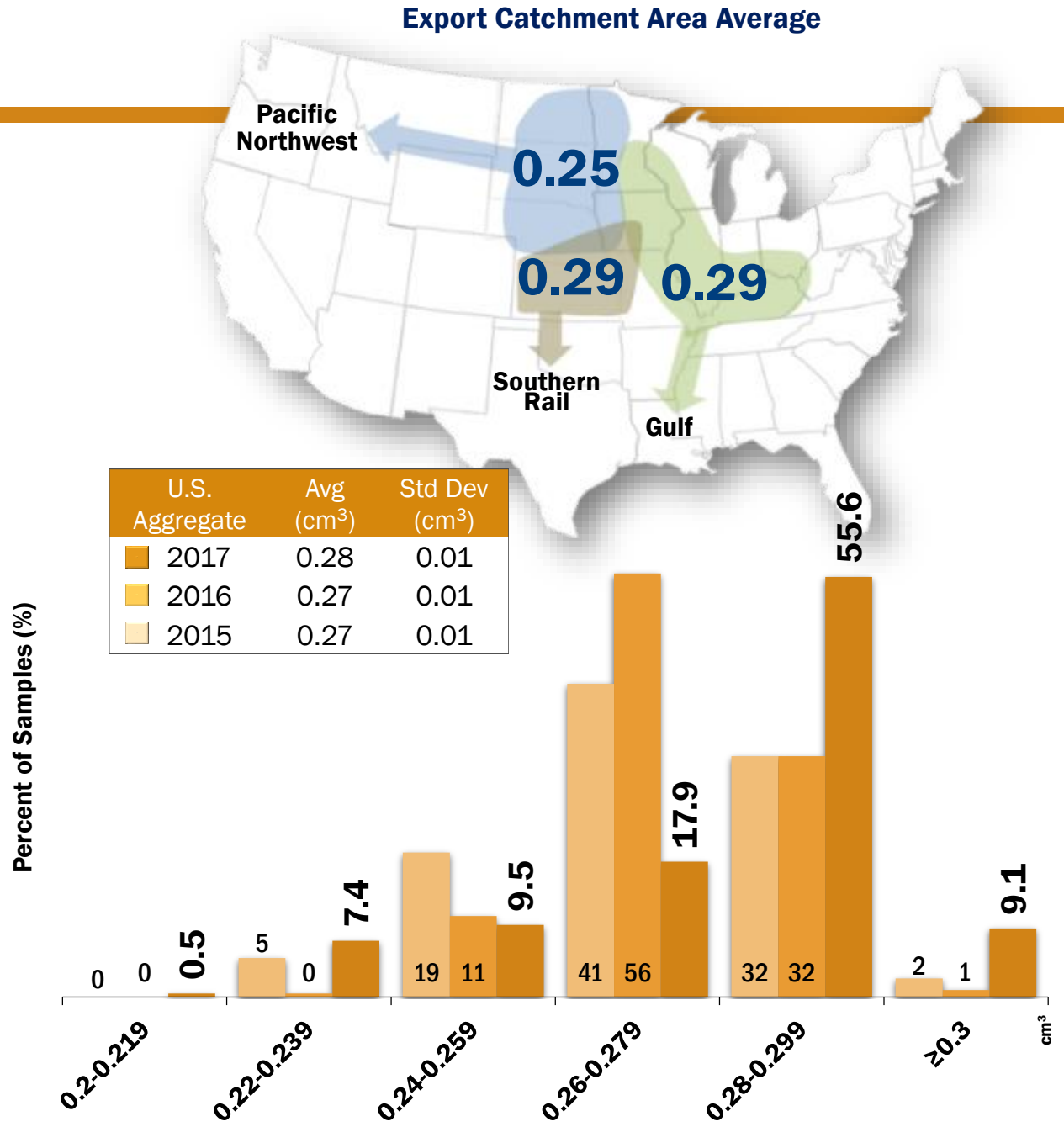
Corn with kernel volume ≥ 0.28 cm^3

2017/2018: 64.7%

2016/2017: 33%

2015/2016: 34%

Gulf and Southern Rail ECAs had higher kernel volume than Pacific Northwest ECA in 2017/2018 and 5YA



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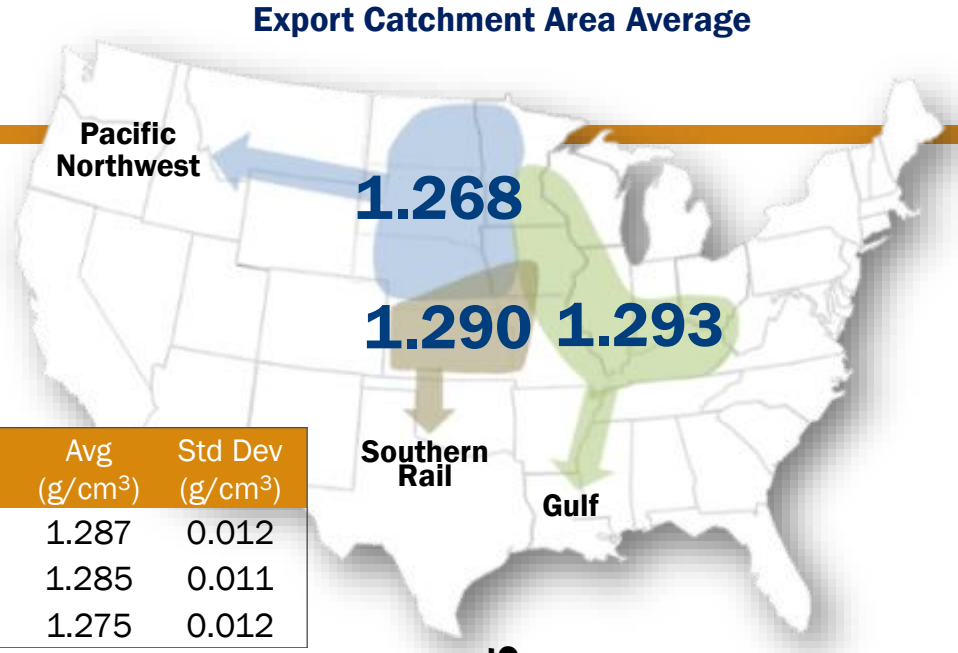
Kernel True Density (g/cm³)

U.S. Aggregate: 1.287 g/cm³

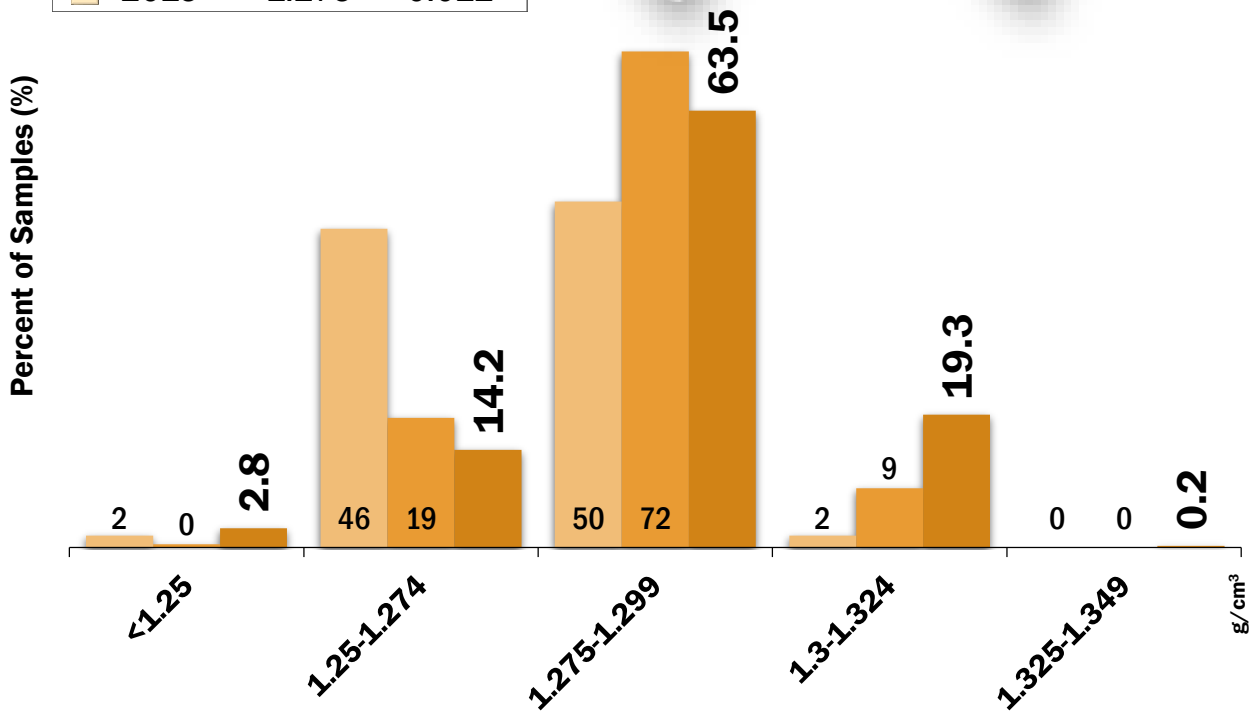
Slightly higher than 2016/2017, but similar to 5YA (1.288 g/cm³)

Similar percentage of kernels with high true densities (≥ 1.275) in 2017/2018 and 2016/2017

Gulf ECA had the highest true density of the 3 ECAs for 2017/2018; however, no pattern in true densities has been observed across the years



U.S. Aggregate	Avg (g/cm³)	Std Dev (g/cm³)
2017	1.287	0.012
2016	1.285	0.011
2015	1.275	0.012



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Other Physical Properties

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Whole Kernel (%)

Percentage of whole kernels of a 50 g sample

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

Impacts alkaline cooking operations and susceptibility to mold invasion and breakage

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

Whole Kernels (%)

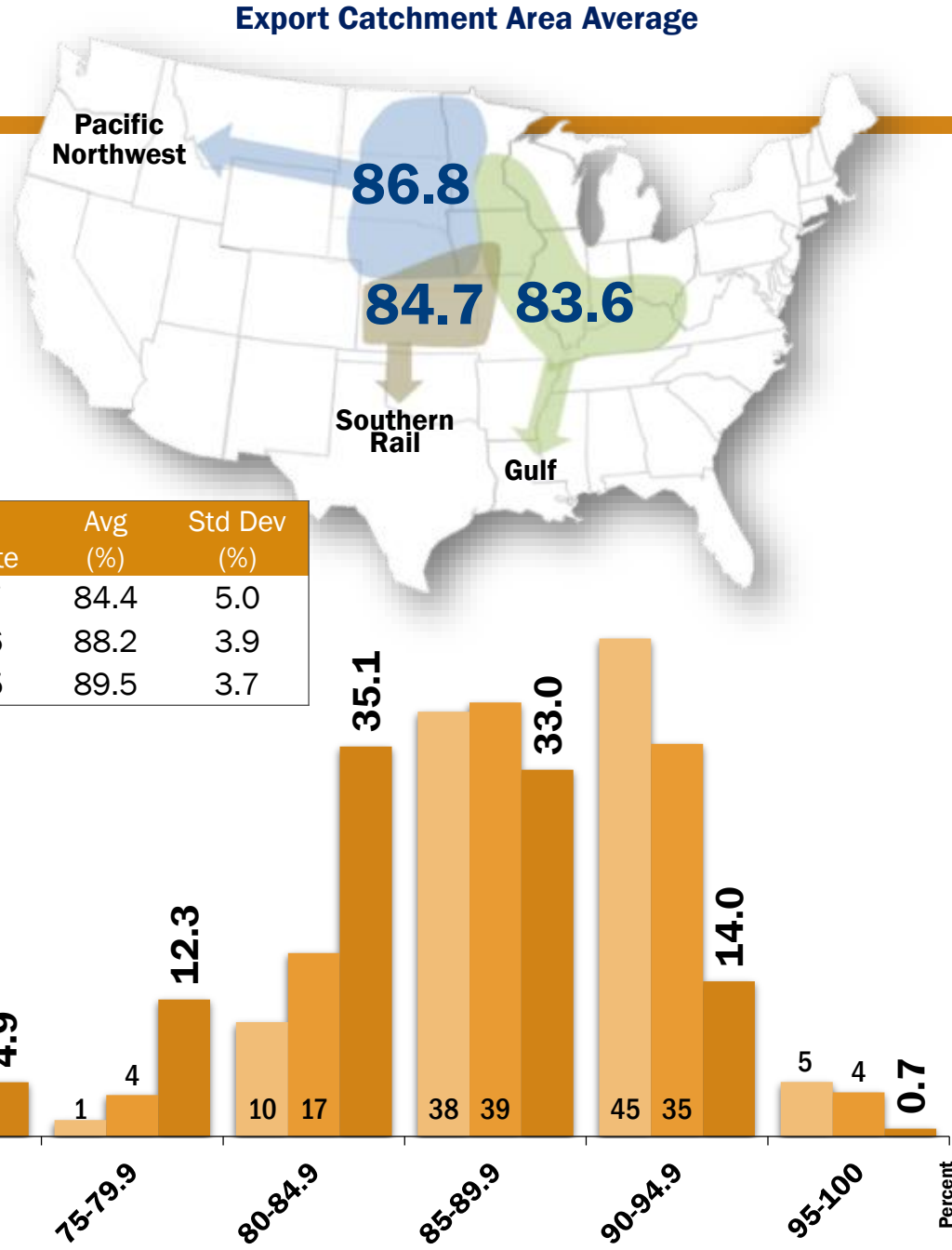
U.S. Aggregate: 84.4%

Lower than 2016/2017, 2015/2016 and 5YA (88.9%)

Corn with whole kernels ≥ 90%

2017/2018: 14.7%
2016/2017: 39%
2015/2016: 50%

Pacific Northwest ECA had the highest percentage of the three ECAs



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Horneous (Hard) Endosperm (%)

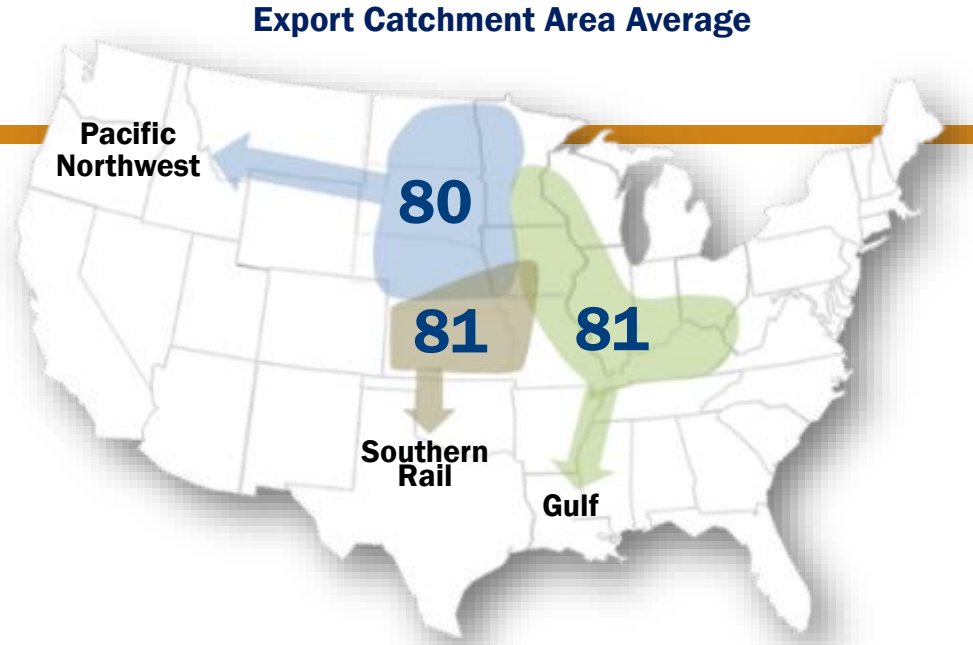
U.S. Aggregate: 81%

Higher than 2016/2017 but slightly lower than 5YA (82%)

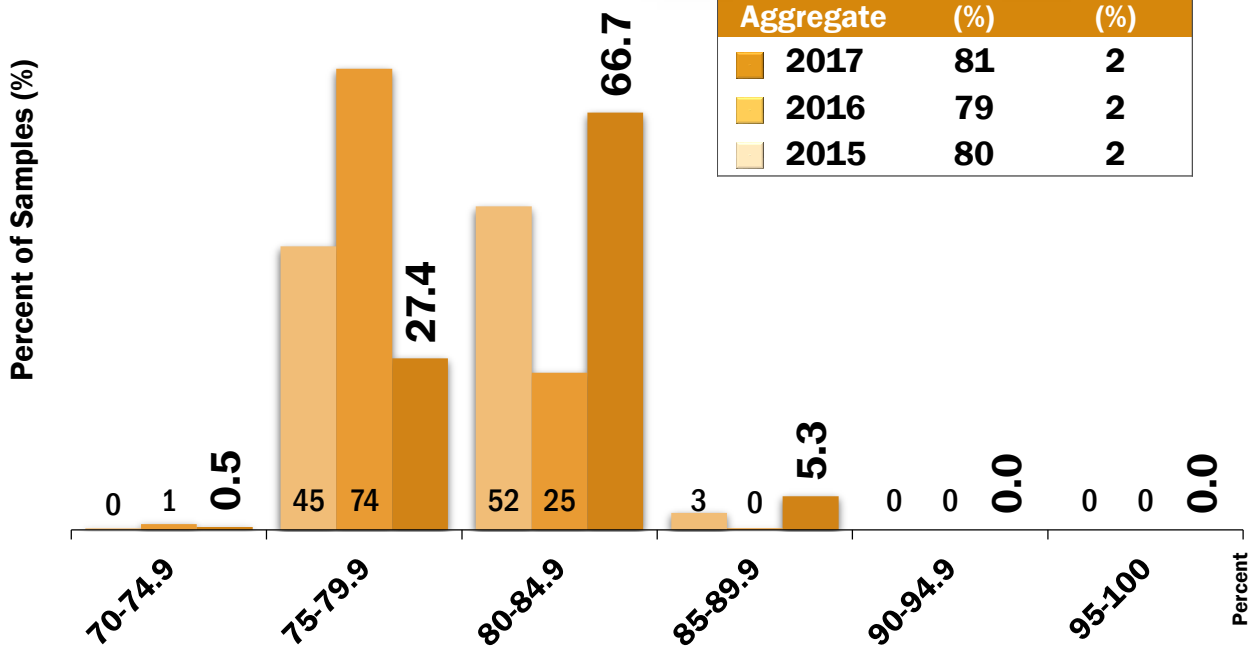
Corn with horneous endosperm ≥ 80%

2017/2018: 72.0%
2016/2017: 25%
2015/2016: 55%

All 3 ECAs have had similar horneous endosperm percentages



U.S. Aggregate	Avg (%)	Std Dev (%)
2017	81	2
2016	79	2
2015	80	2



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Mycotoxins: Aflatoxins and DON

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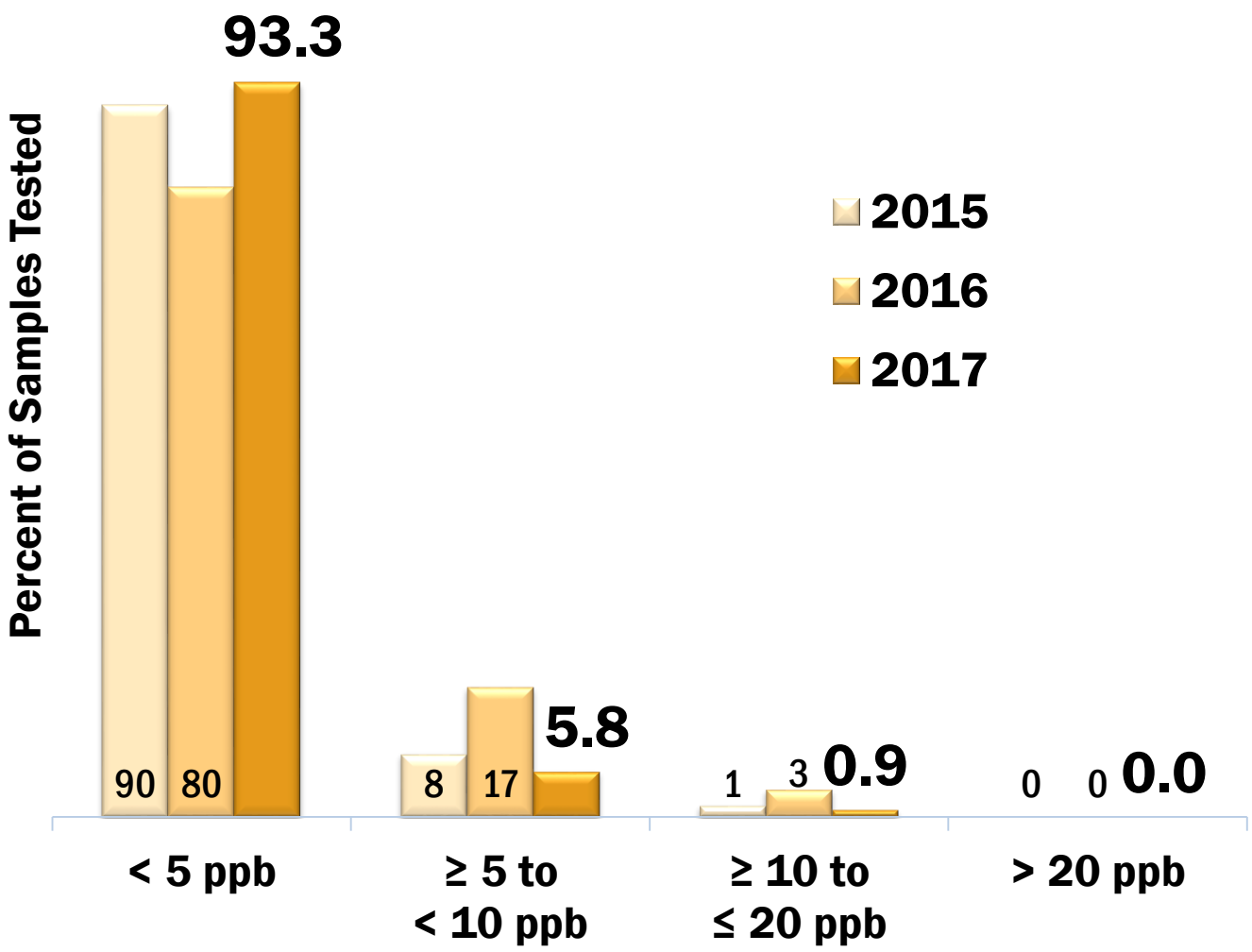
Export Cargo Mycotoxin Testing

- Provides an assessment of the presence of aflatoxins and deoxynivalenol (DON) in U.S. corn as it reaches export points early in the marketing year
- All export cargo samples are tested
- Reports ONLY the frequency of detected elevated levels of the mycotoxins in export samples
- Positive results if above the FGIS Lower Conformance Level (LCL)
  - Aflatoxins: 5.0 ppb
  - DON: 0.5 ppm

Aflatoxin Testing Results

A higher proportion of the export samples had no detectable levels of aflatoxins than 2016/2017 and 2015/2016

All samples were below the FDA action level



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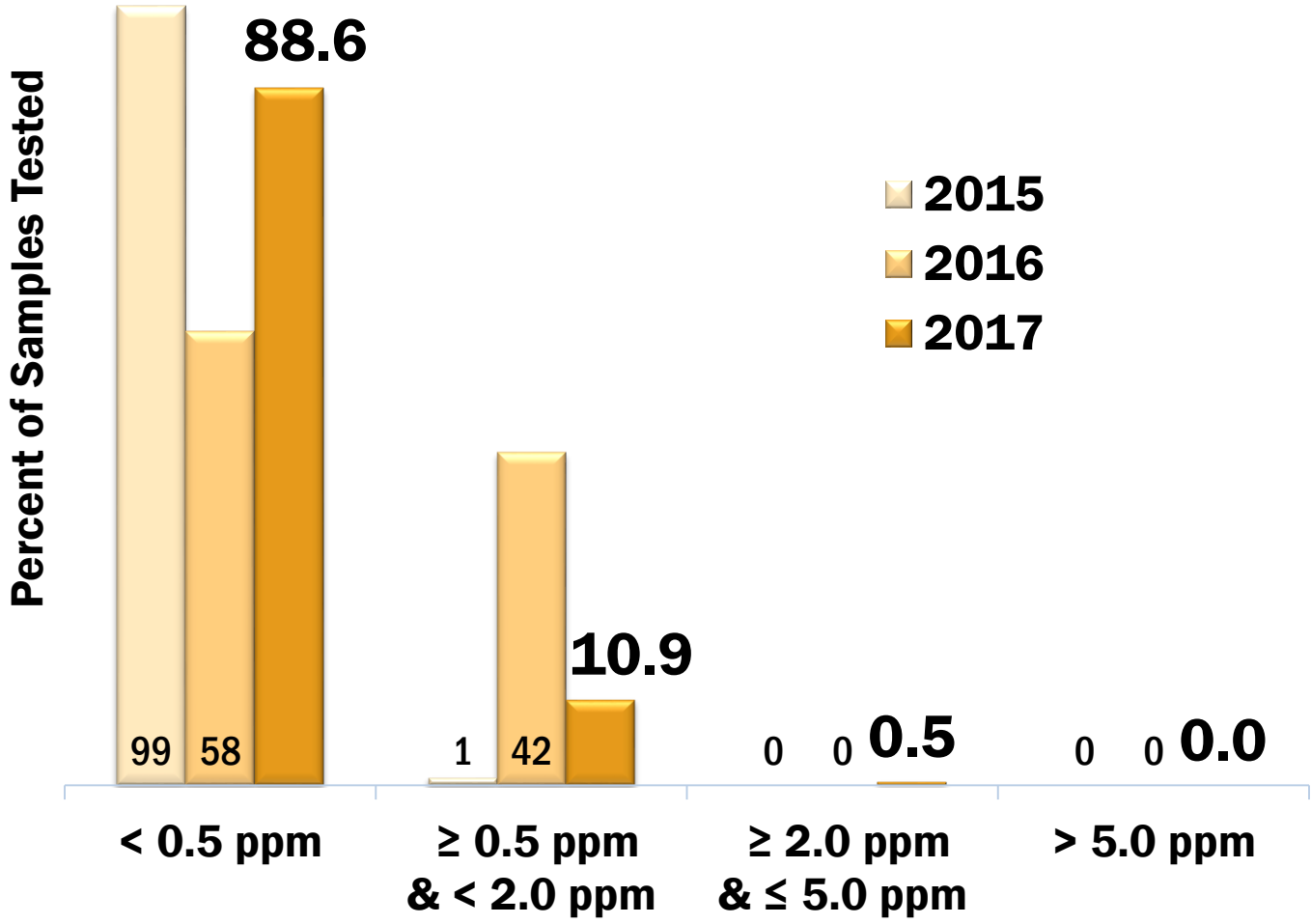
Deoxynivalenol (DON) or Vomitoxin Testing Results

A higher proportion of the export samples had no detectable levels of DON than 2016/2017

All samples were below the 5.0 ppm FDA advisory level



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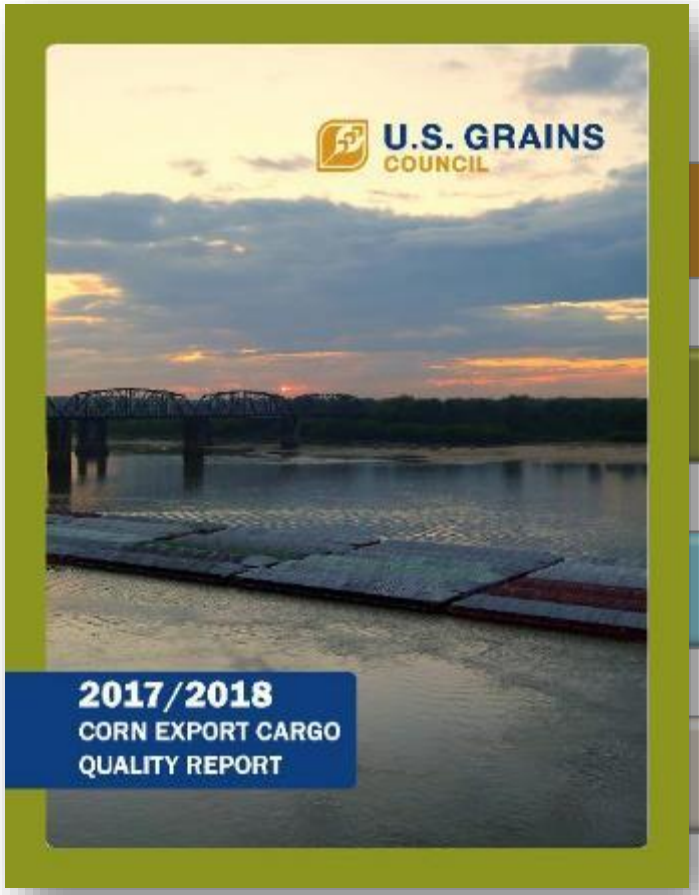
Other Components of the Report



- Quality Test Results
- U.S. Corn Export System
- Survey and Statistical Analysis Methods
- Testing Analysis Methods

Conclusions

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Export Cargo Report: Conclusions

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- Early 2017/2018 U.S. corn exports were, on average, better than or equal to U.S. No. 2 on all grade factors
- Lower total damage and the same test weight and BCFM as 2016/2017
- Same protein, slightly lower starch and higher oil concentrations compared with 2016/2017
- Slightly higher levels of stress cracks than 2016/2017 may be due, in part, to slightly higher 2017 harvest moisture

Export Cargo Report: Concl. (cont)

- Higher 100-k weight, kernel volume and true density than last year
- Higher average horneous endosperm than 2016/2017, indicating slightly harder corn in 2017/2018 than last year
- All samples' aflatoxin and DON levels were below the FDA action and advisory levels, respectively

Corn Quality Reports: Looking Ahead

U.S. GRAINS COUNCIL

- Hoping for a high quality corn crop in 2018
- Eighth year of Harvest and Export Cargo Reports will be released in December 2018 and early in 2019, respectively.
- Each year of these reports increases their value:
  - Several years of results using the same survey and testing methodology can be compared
  - Patterns in quality and factors that influence quality are surfacing

U.S. GRAINS COUNCIL

Building a Tradition:

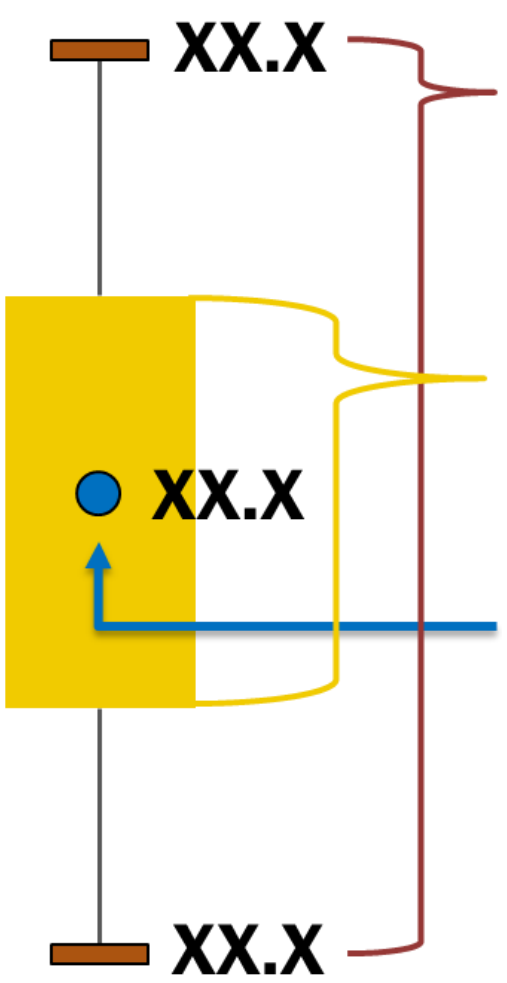
Thank You!

SUPPLEMENTAL SLIDES

U.S. Grains Council 2017/2018 Corn Export Cargo Quality Report

Corn Export Cargo Quality Report U.S. Aggregate Average and Range Comparison

Average and Range Comparison Legend



Range Contains Approximately 95.0% of Total Samples

Range Contains Approximately 66.7% of Total Samples

U.S. Aggregate Average

Average and Range Comparison

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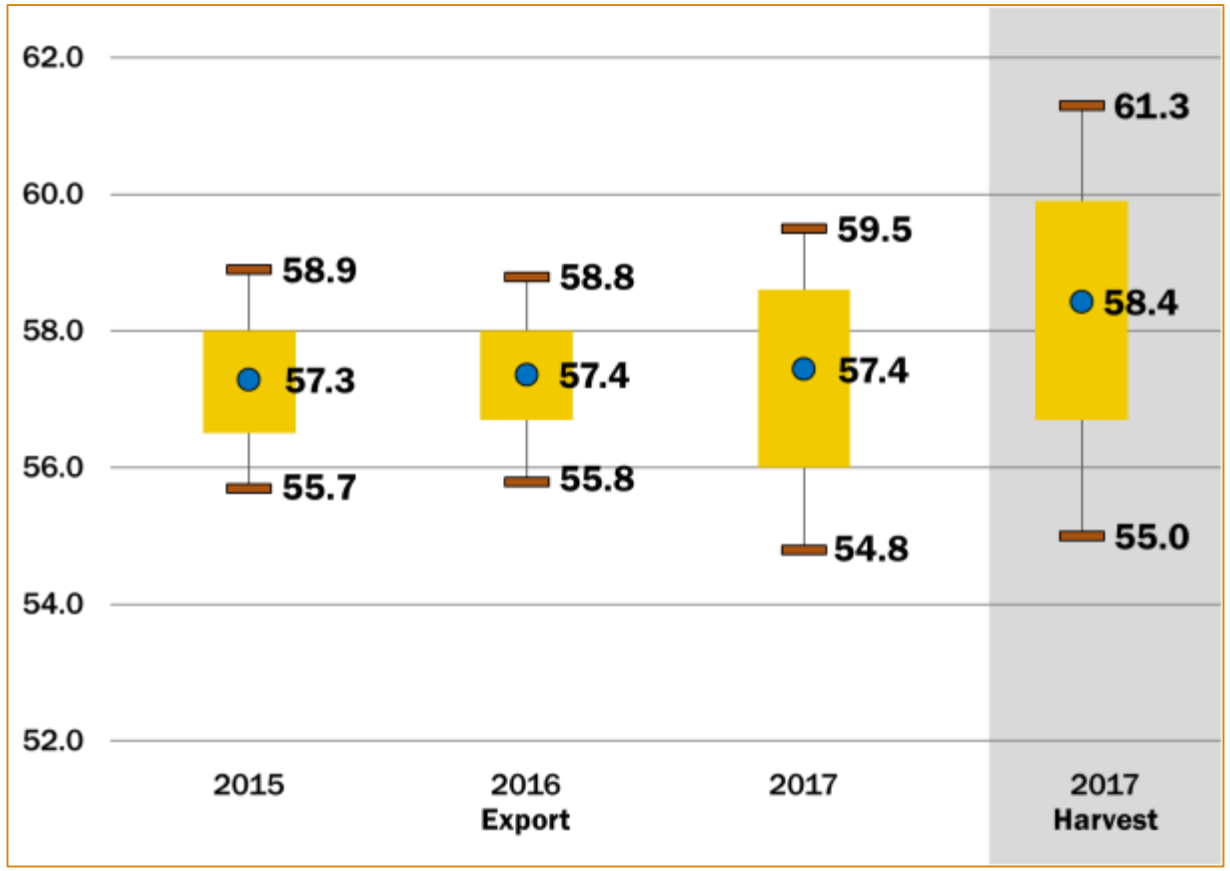
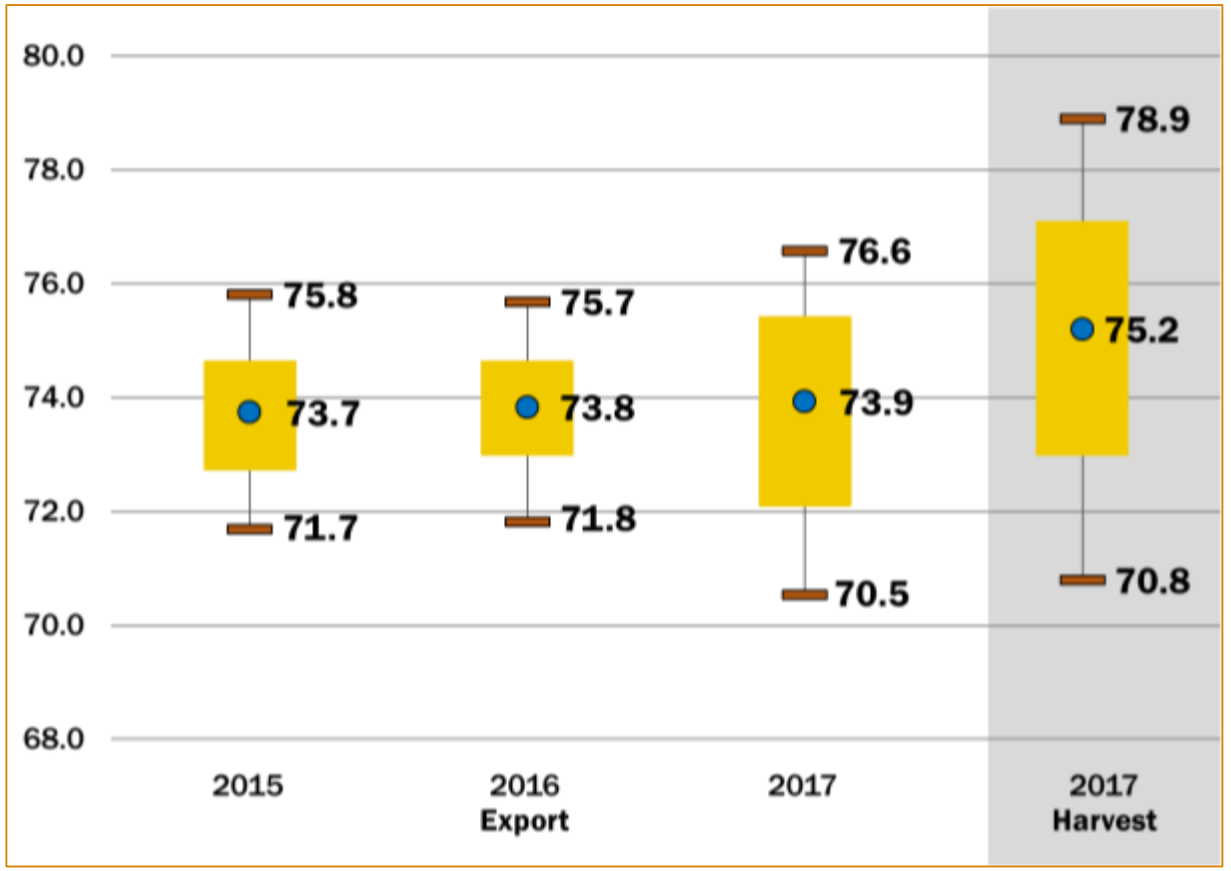
Test Weight (lb/bu)



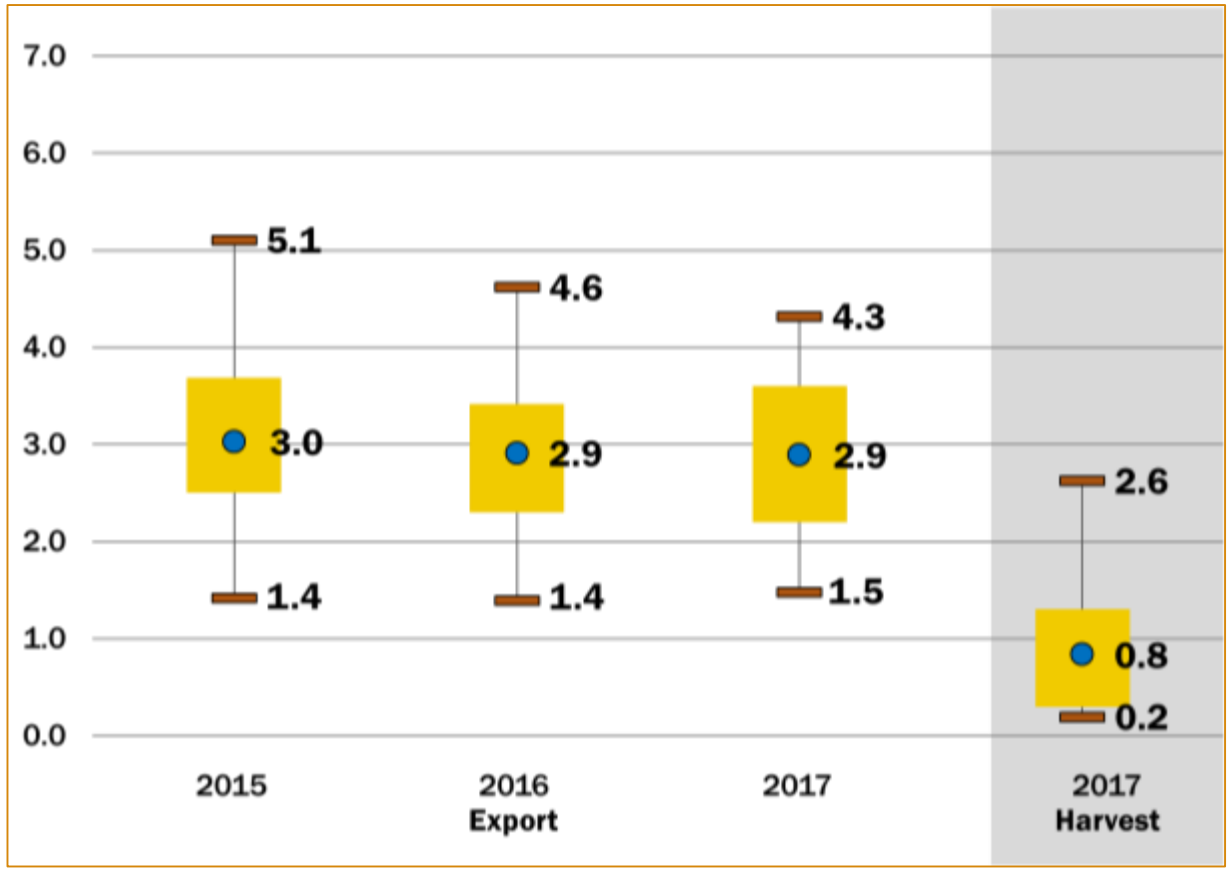
Test Weight (kg/hl)



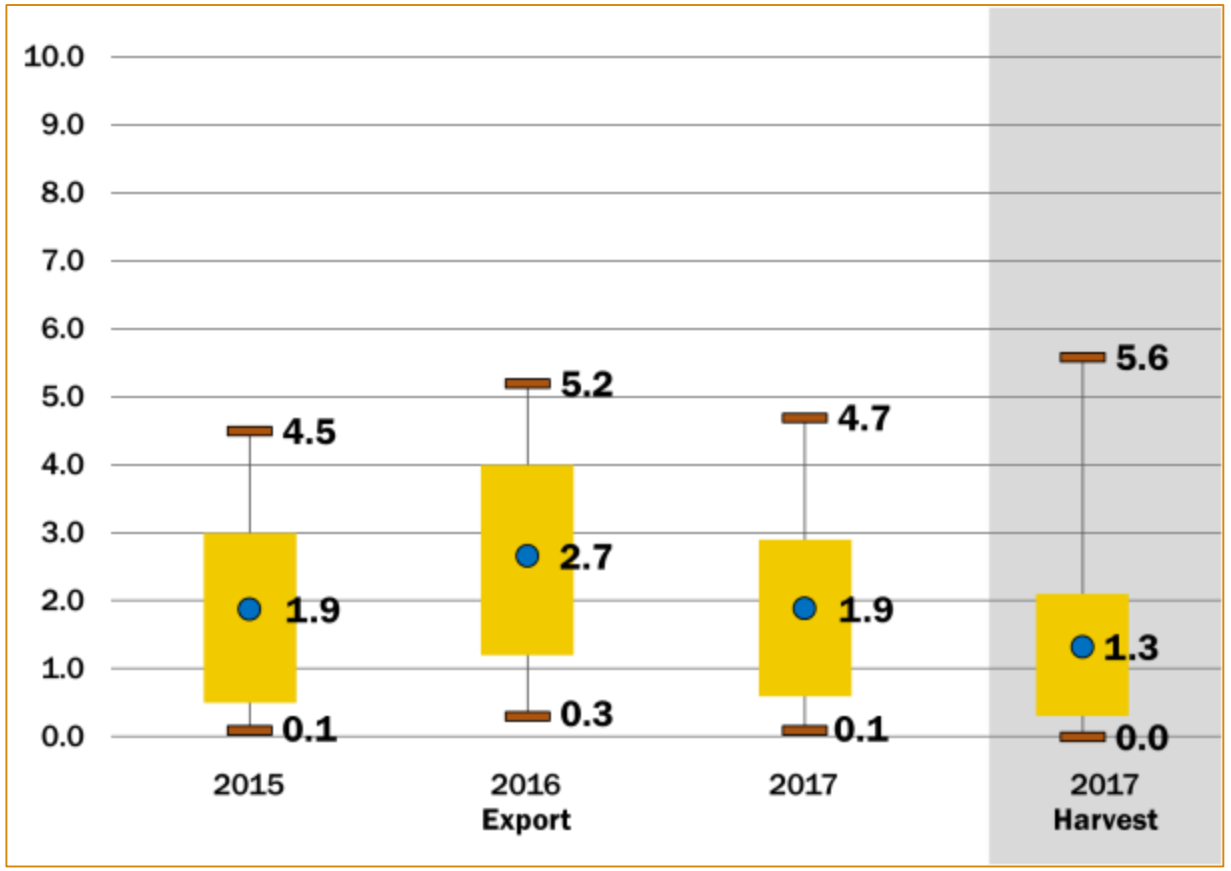
Average and Range Comparison (cont'd)

U.S. GRAINS COUNCIL

BCFM (%)



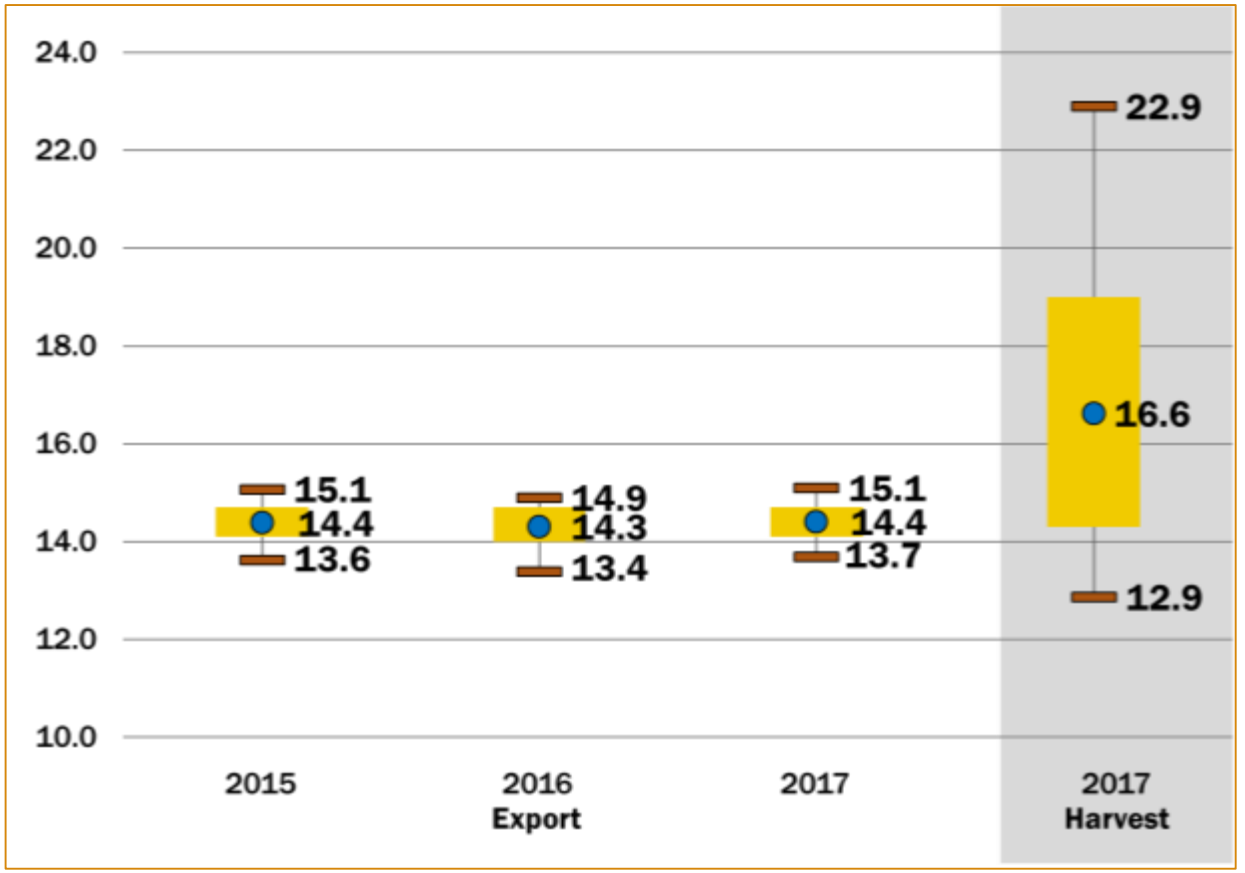
Total Damage (%)



Average and Range Comparison (cont'd)

U.S. GRAINS COUNCIL

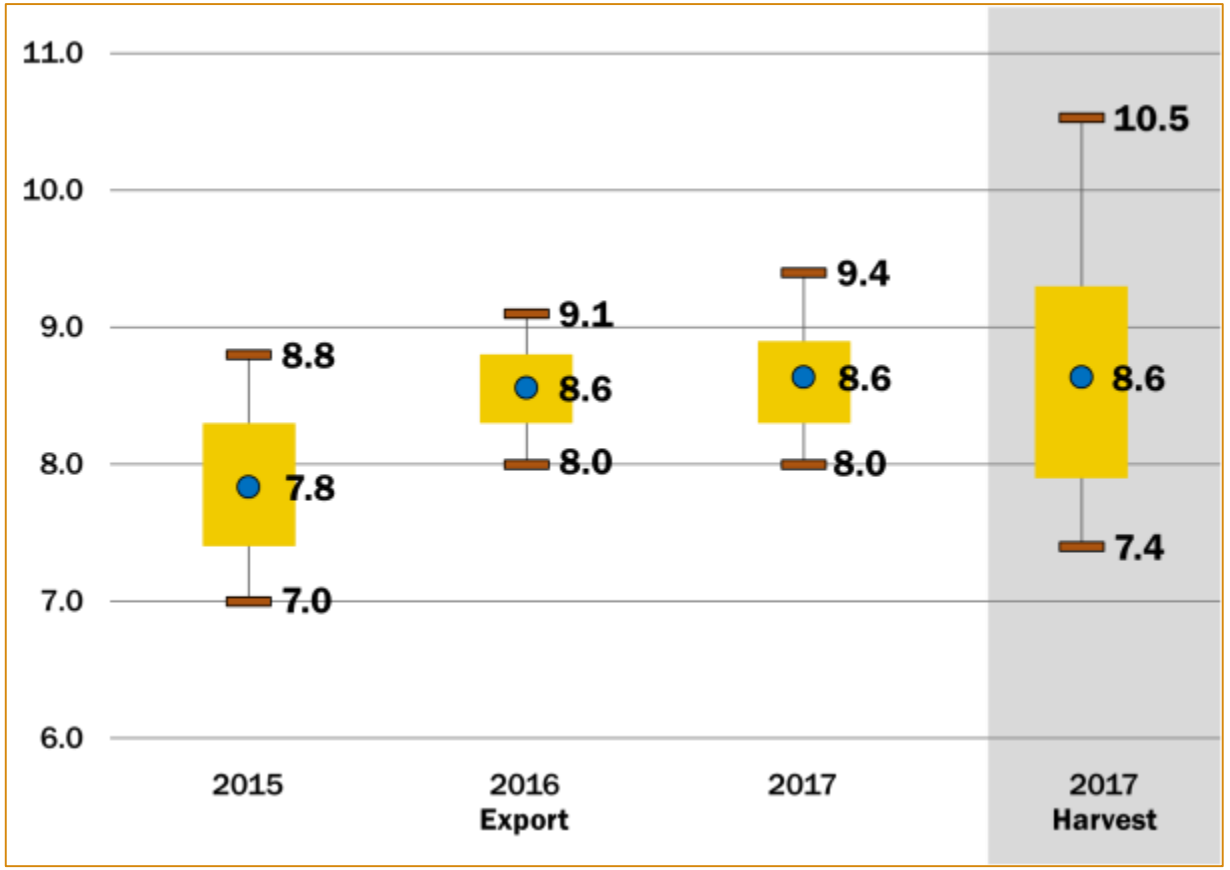
Moisture (%)



Average and Range Comparison (cont'd)

U.S. GRAINS COUNCIL

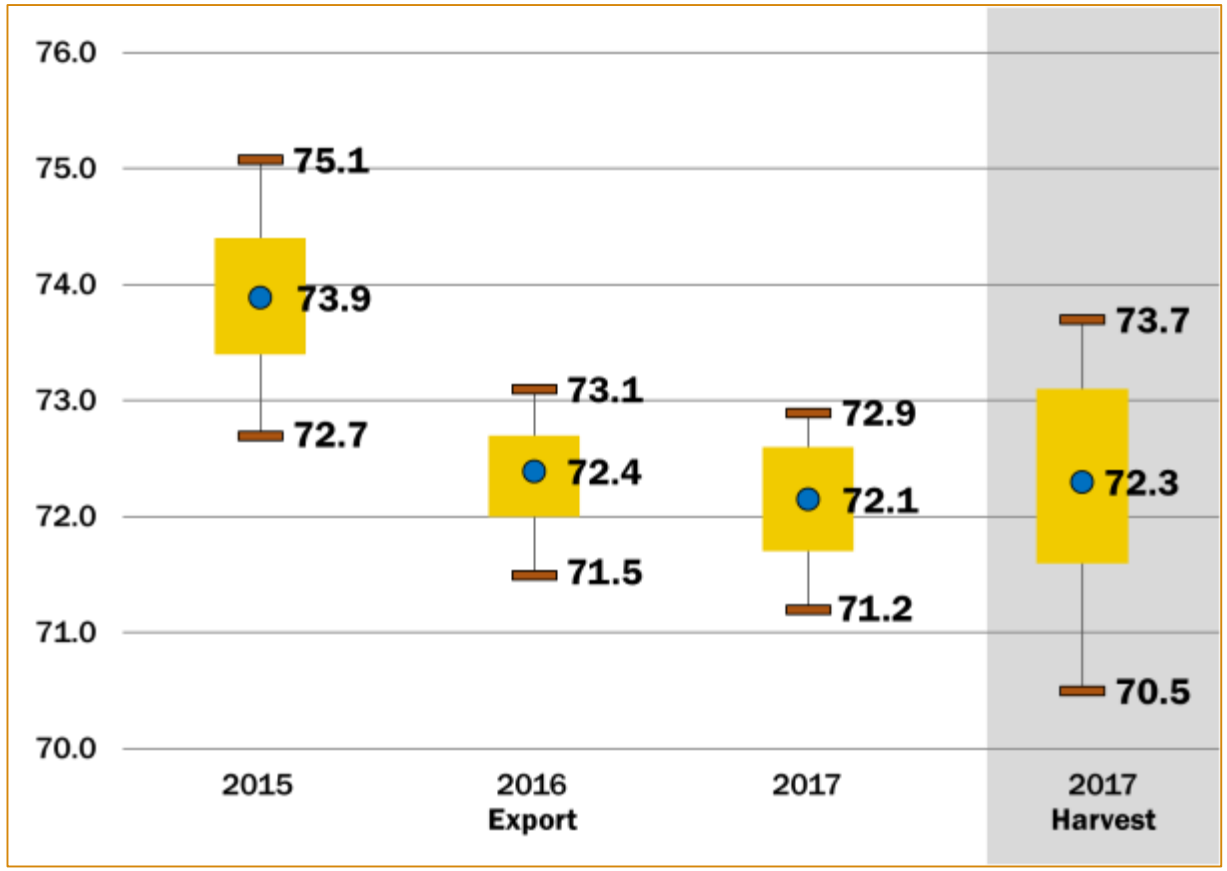
Protein (Dry Basis %)



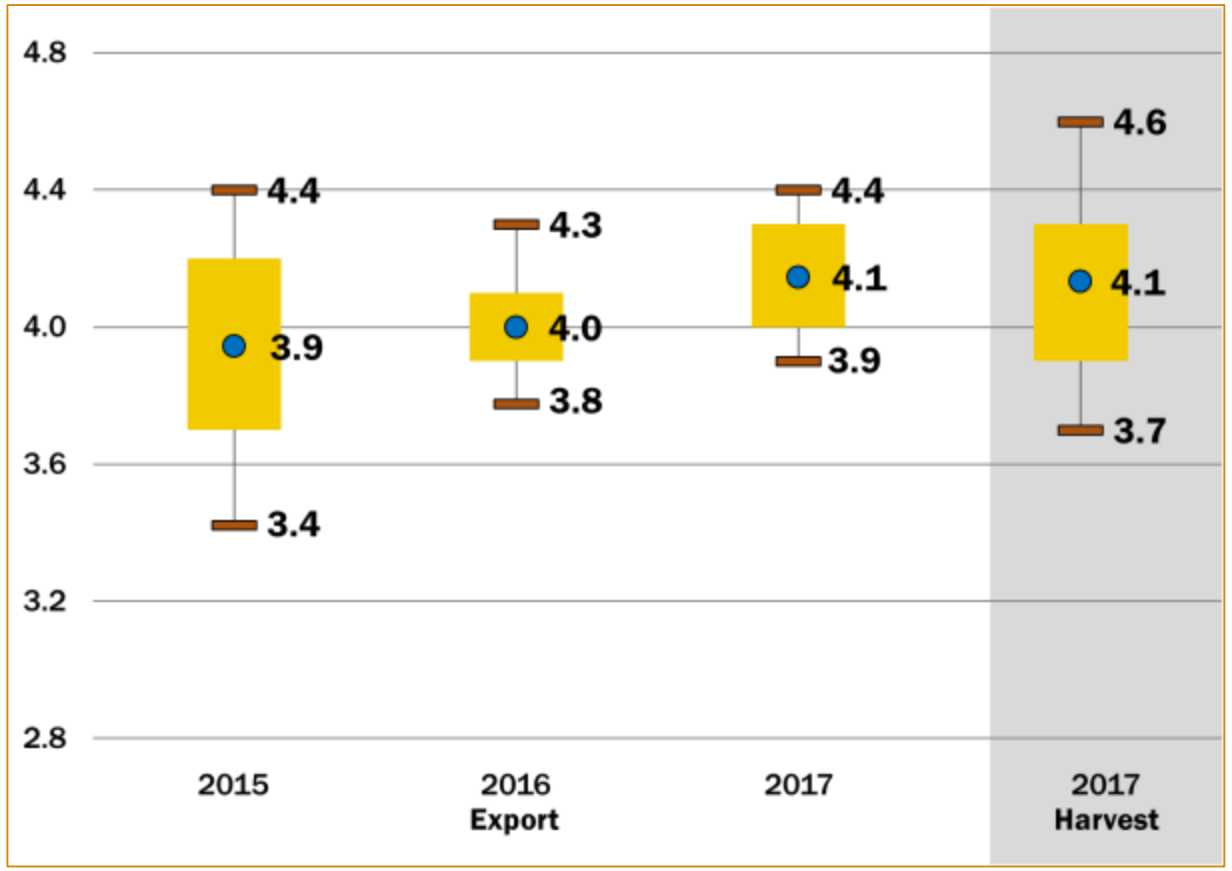
Average and Range Comparison (cont'd)

U.S. GRAINS COUNCIL

Starch (Dry Basis %)



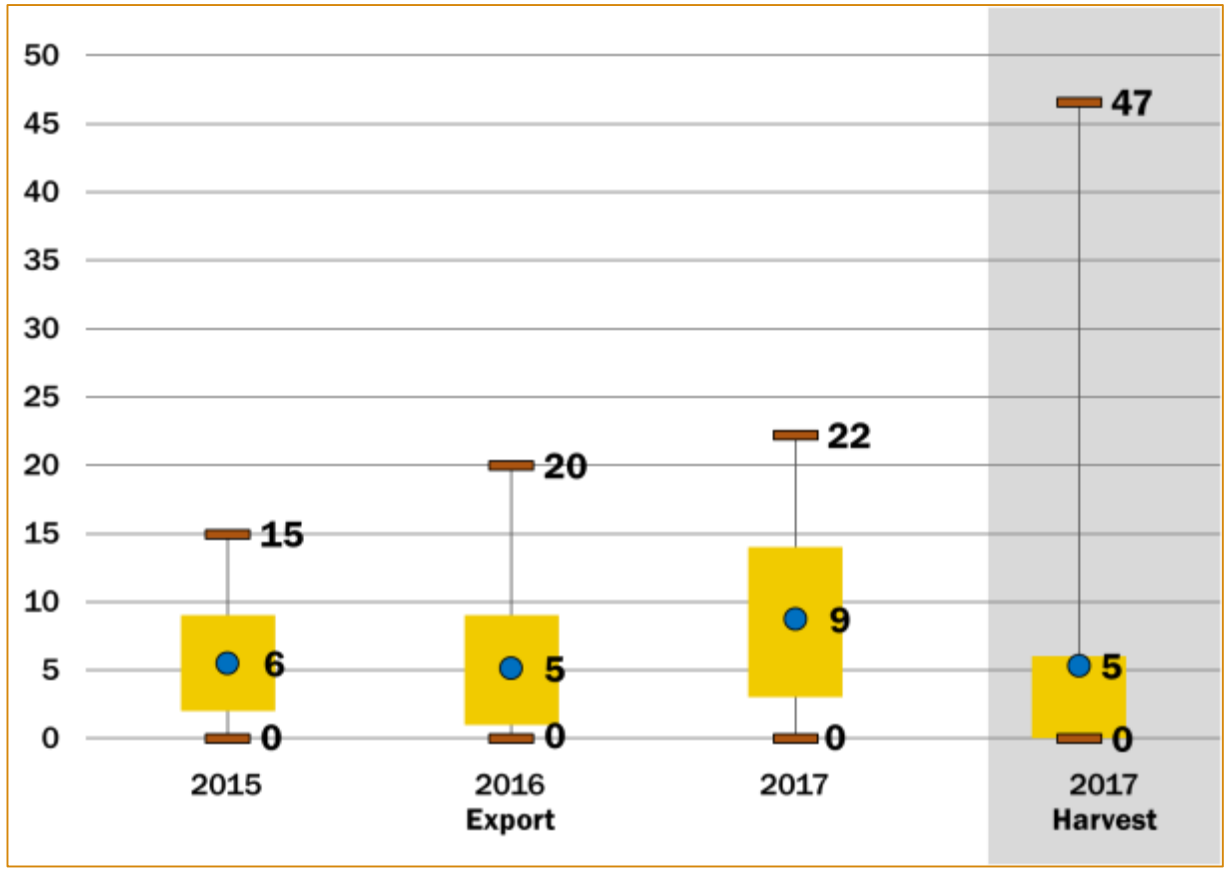
Oil (Dry Basis %)



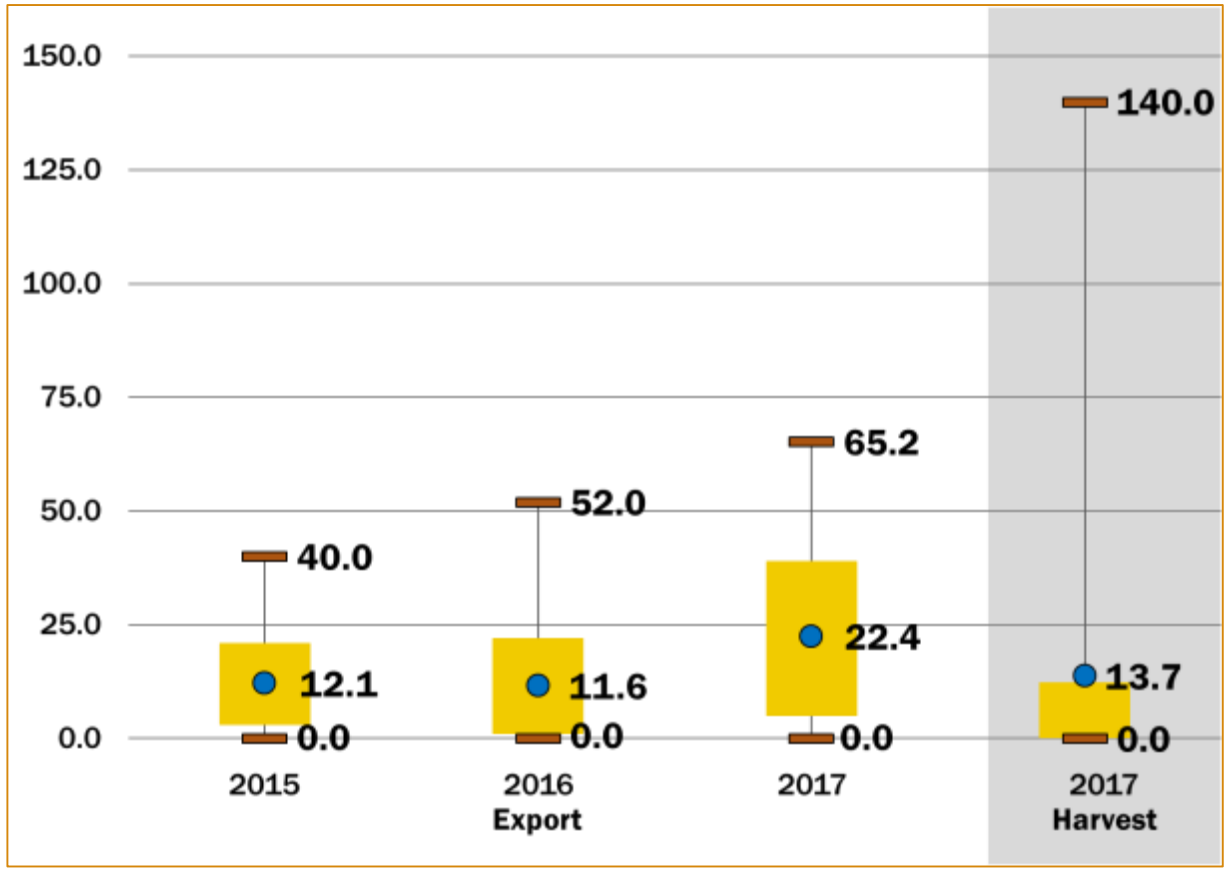
Average and Range Comparison (cont'd)

U.S. GRAINS COUNCIL

Stress Cracks (%)



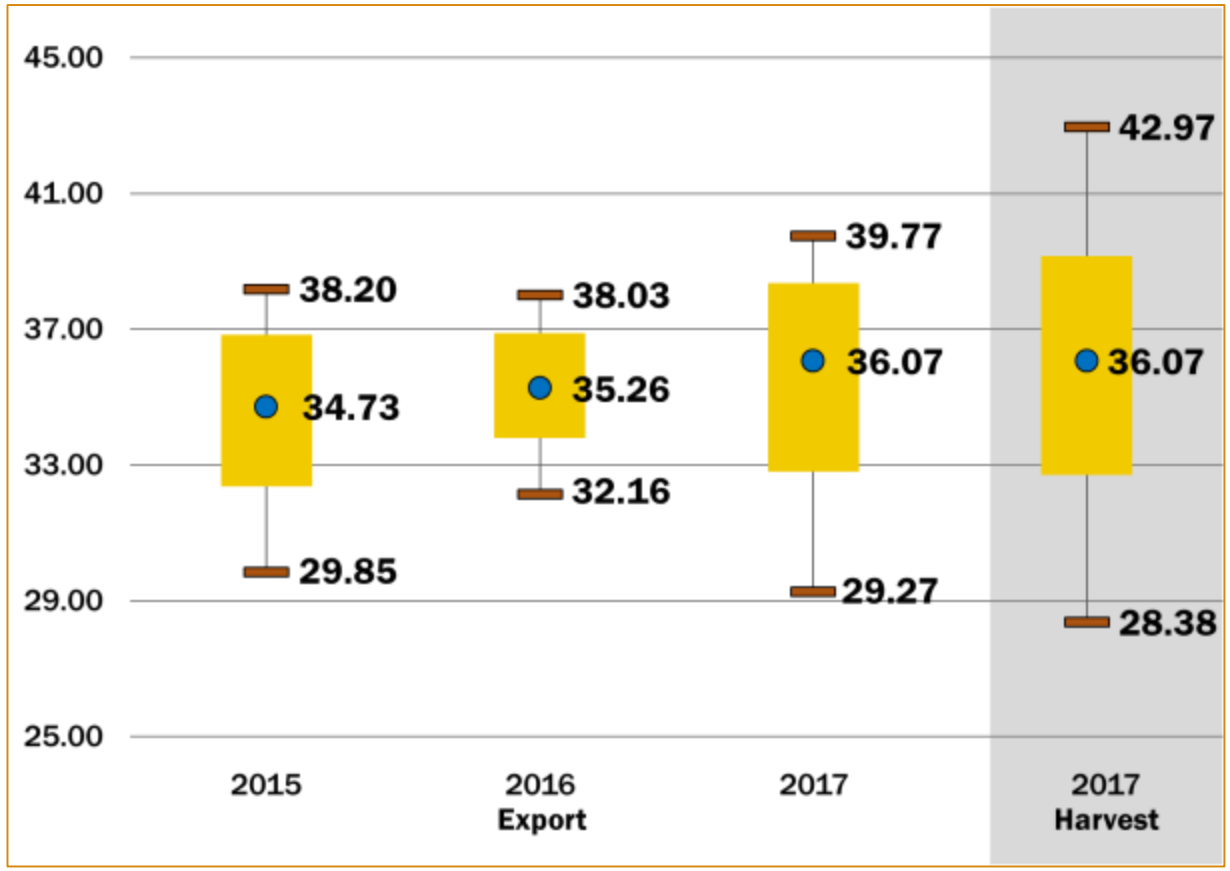
Stress Crack Index



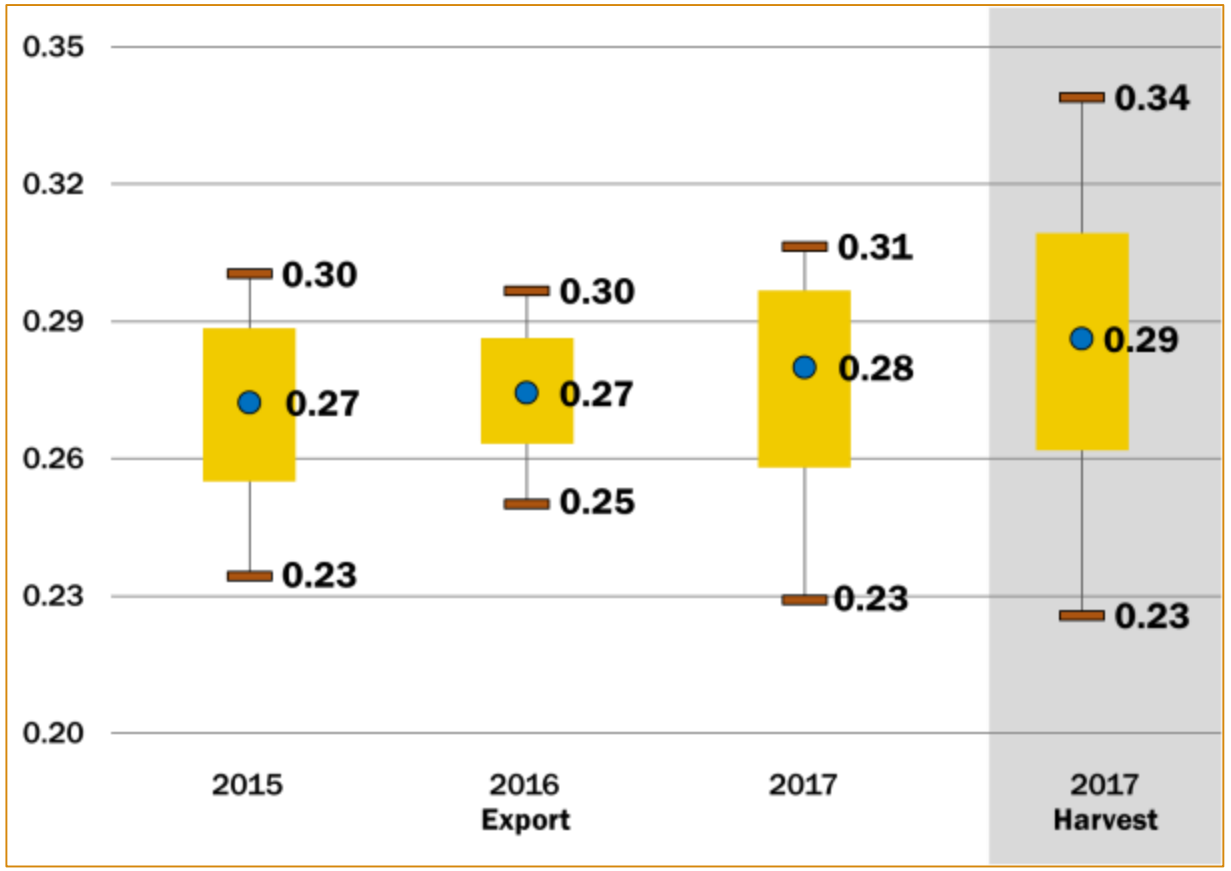
Average and Range Comparison (cont'd)

U.S. GRAINS COUNCIL

100-Kernel Weight (g)



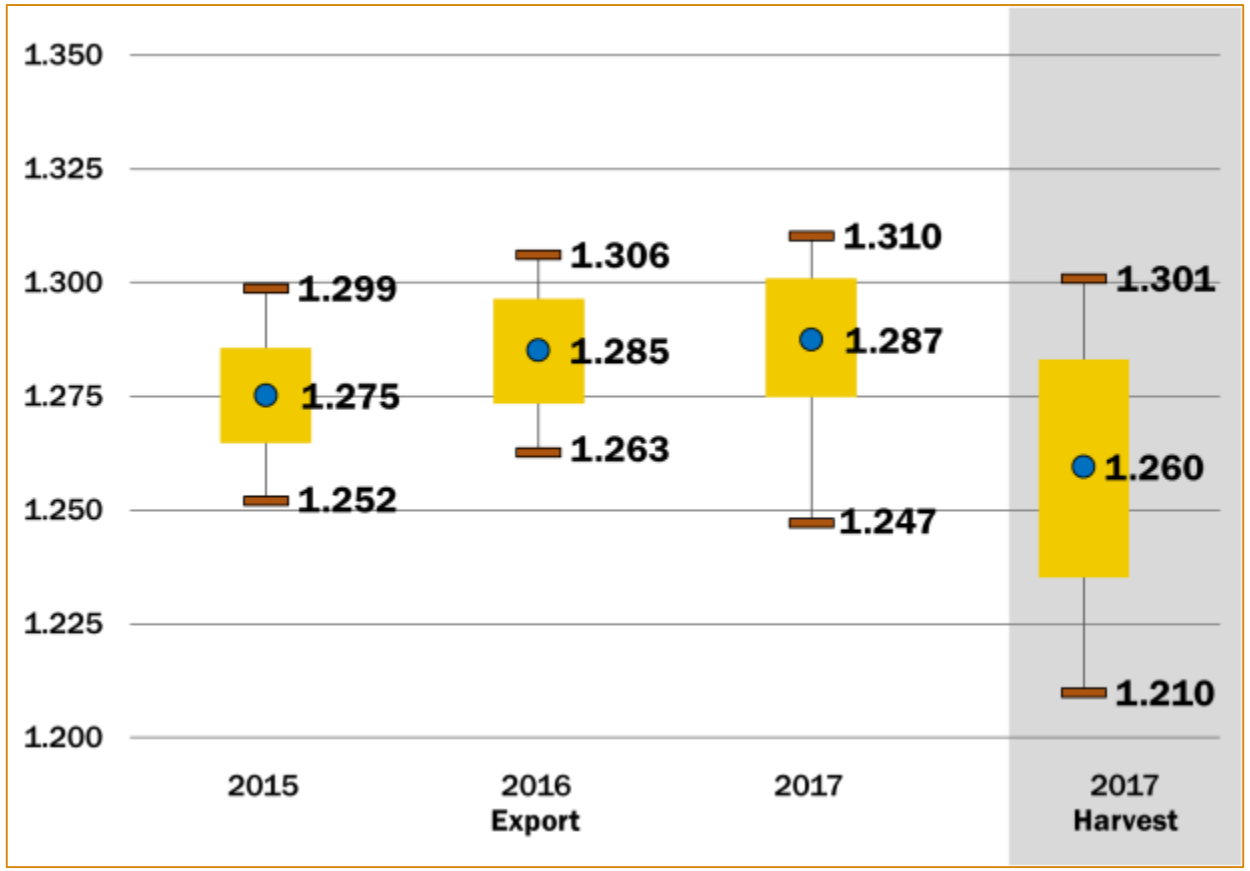
Kernel Volume (cm^3)



Average and Range Comparison (cont'd)

U.S. GRAINS COUNCIL

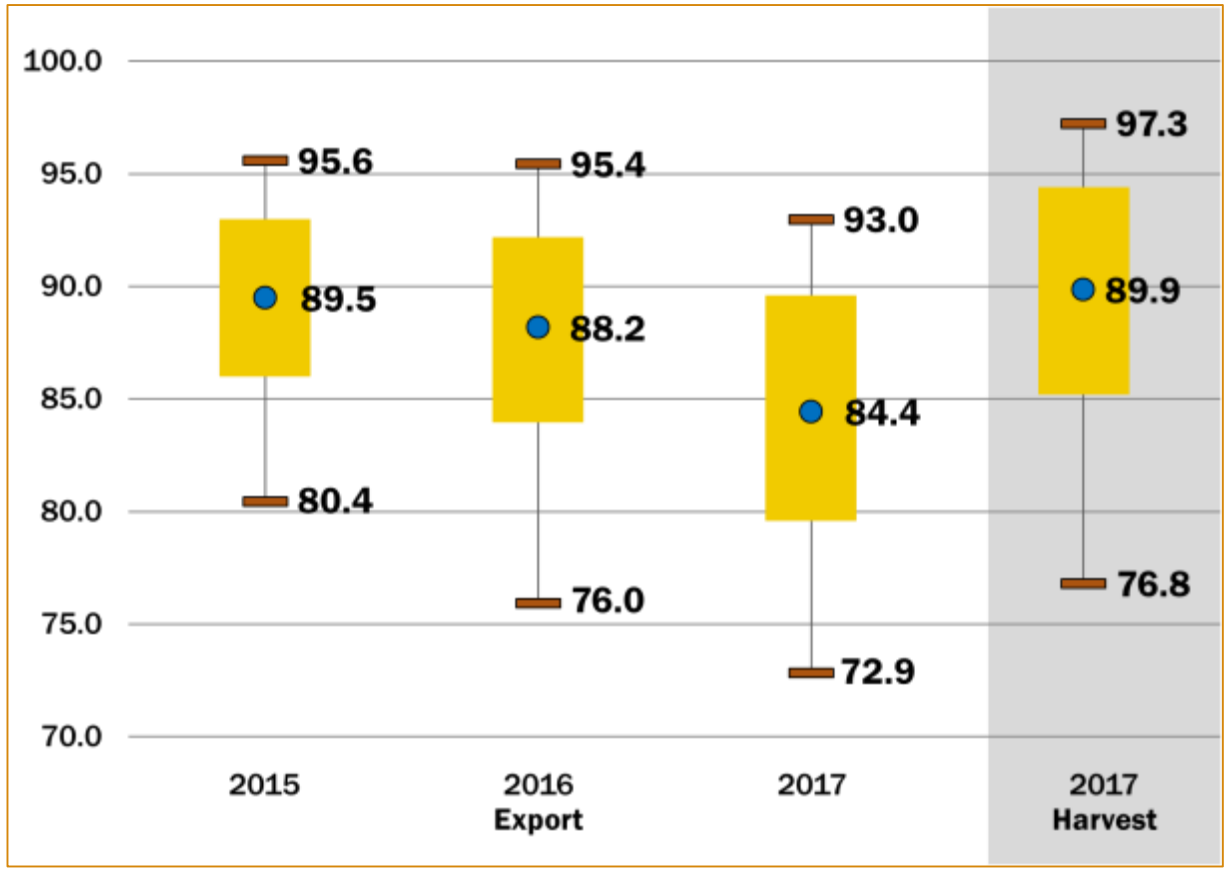
True Density (g/cm^3)



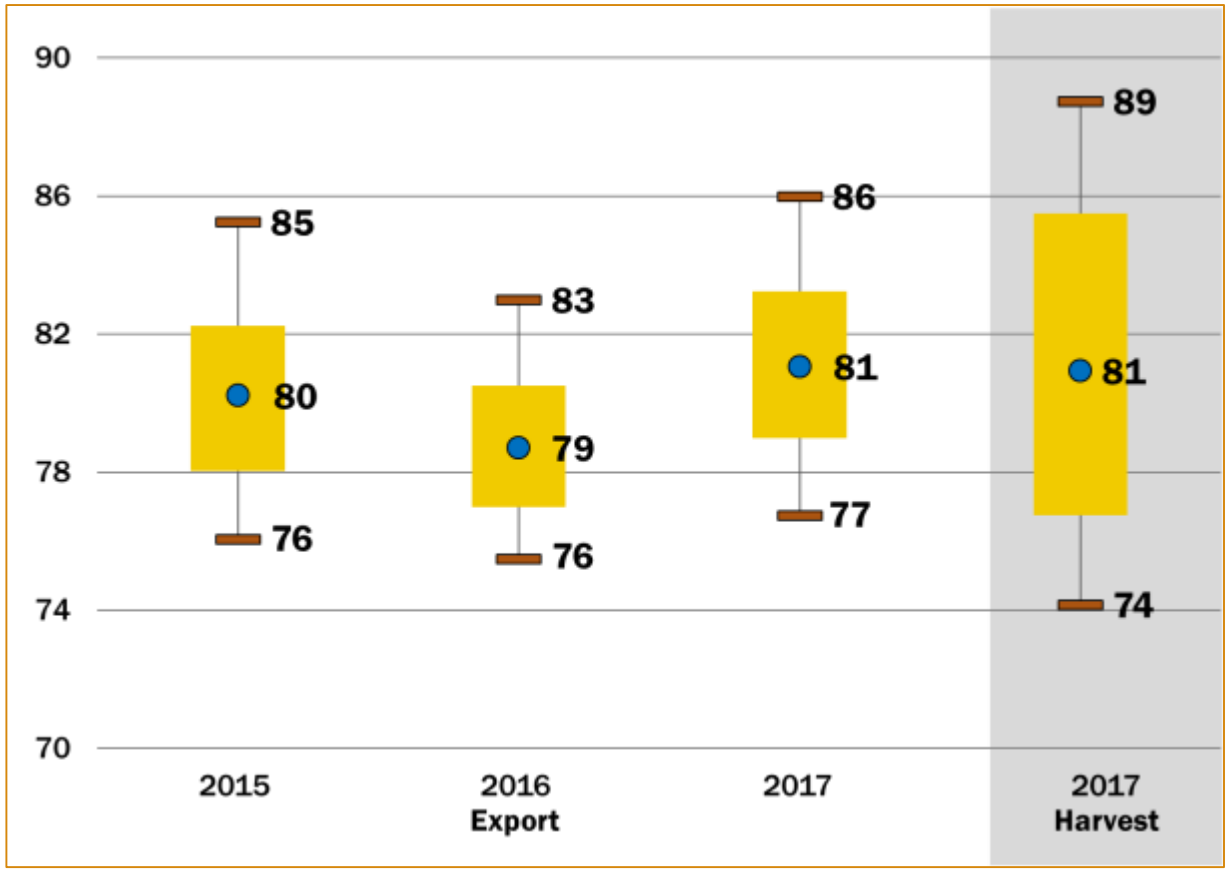
Average and Range Comparison (cont'd)

U.S. GRAINS COUNCIL

Whole Kernels (%)

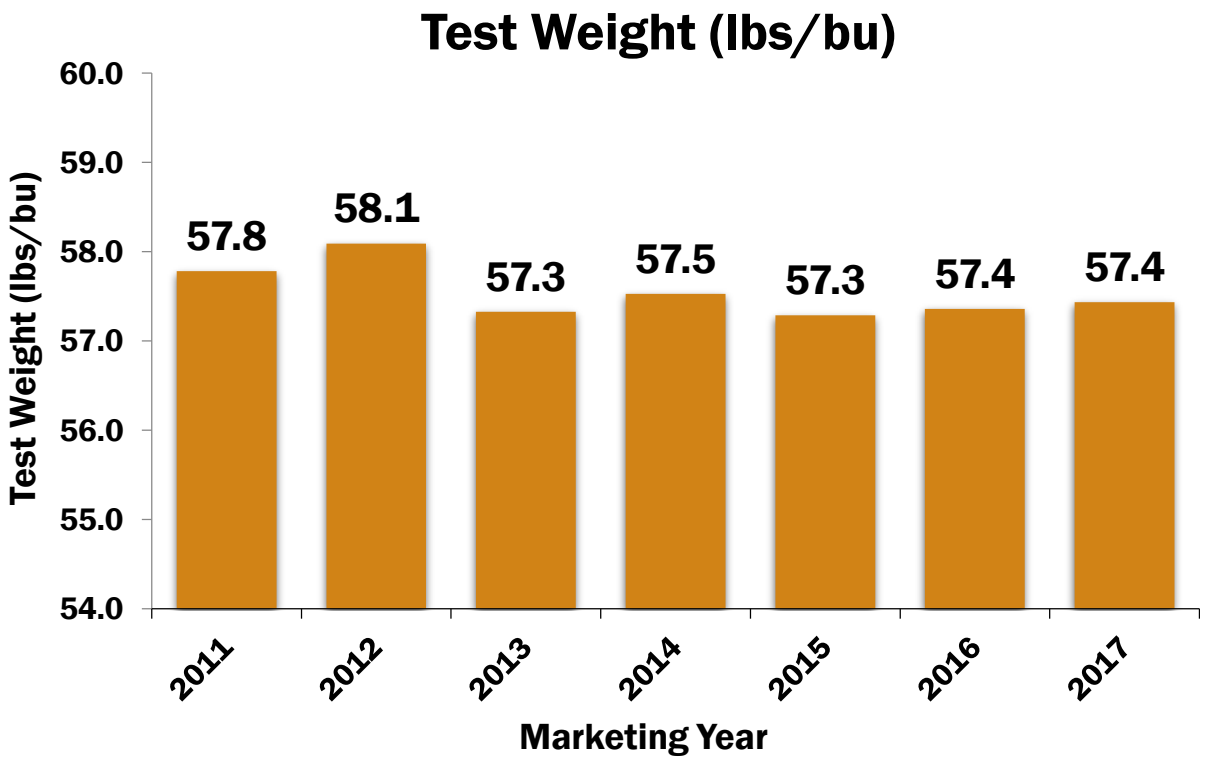


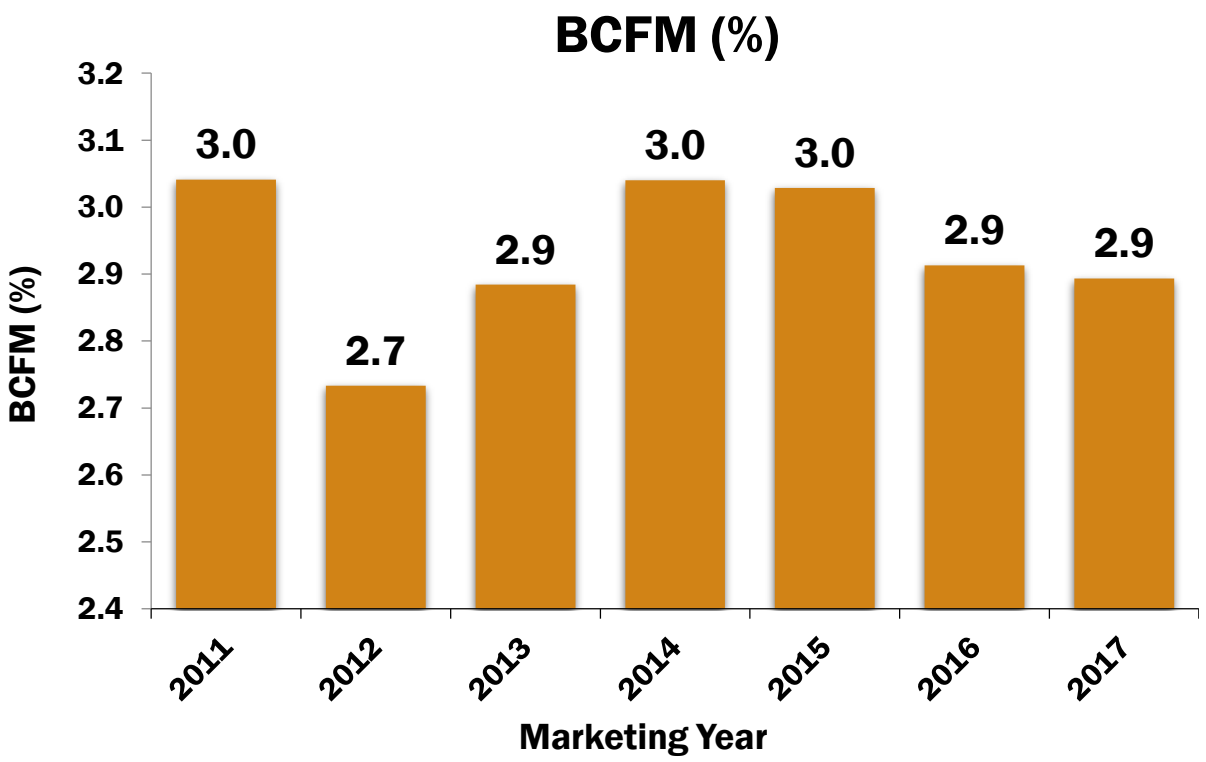
Horneous Endosperm (%)



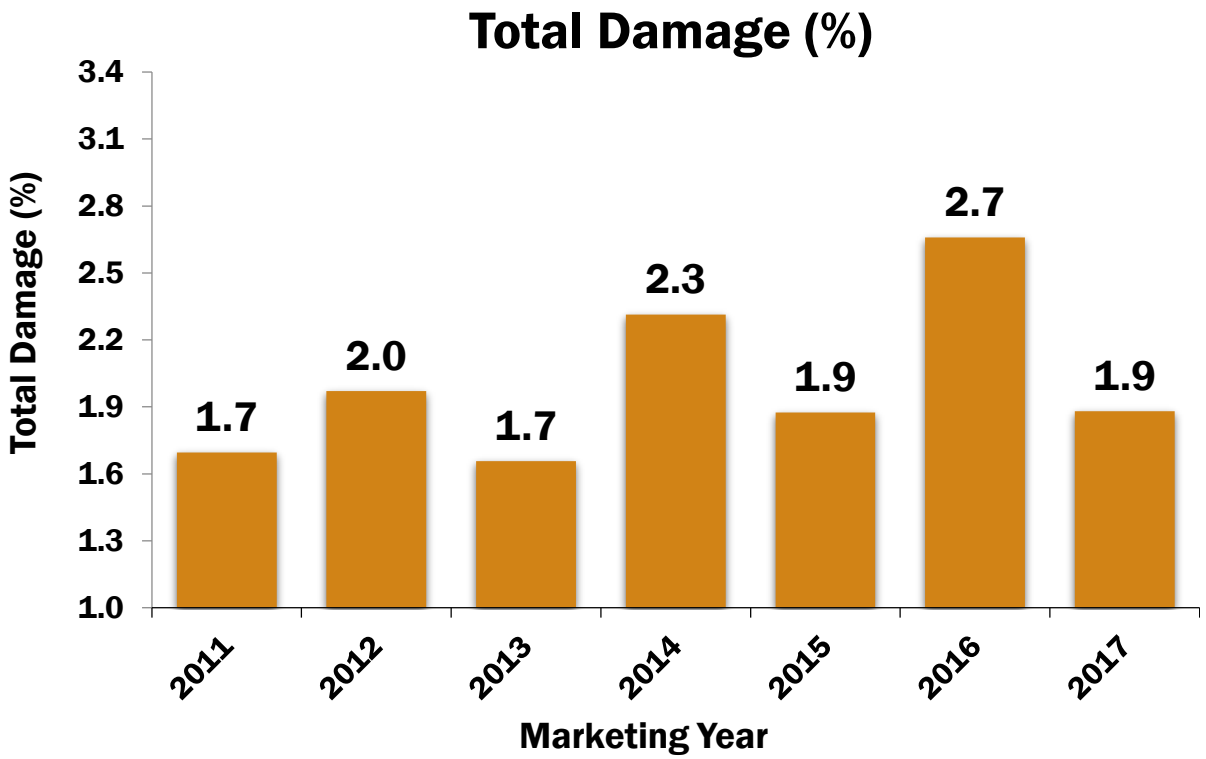
Corn Export Cargo Quality Report Historical U.S. Aggregate Averages

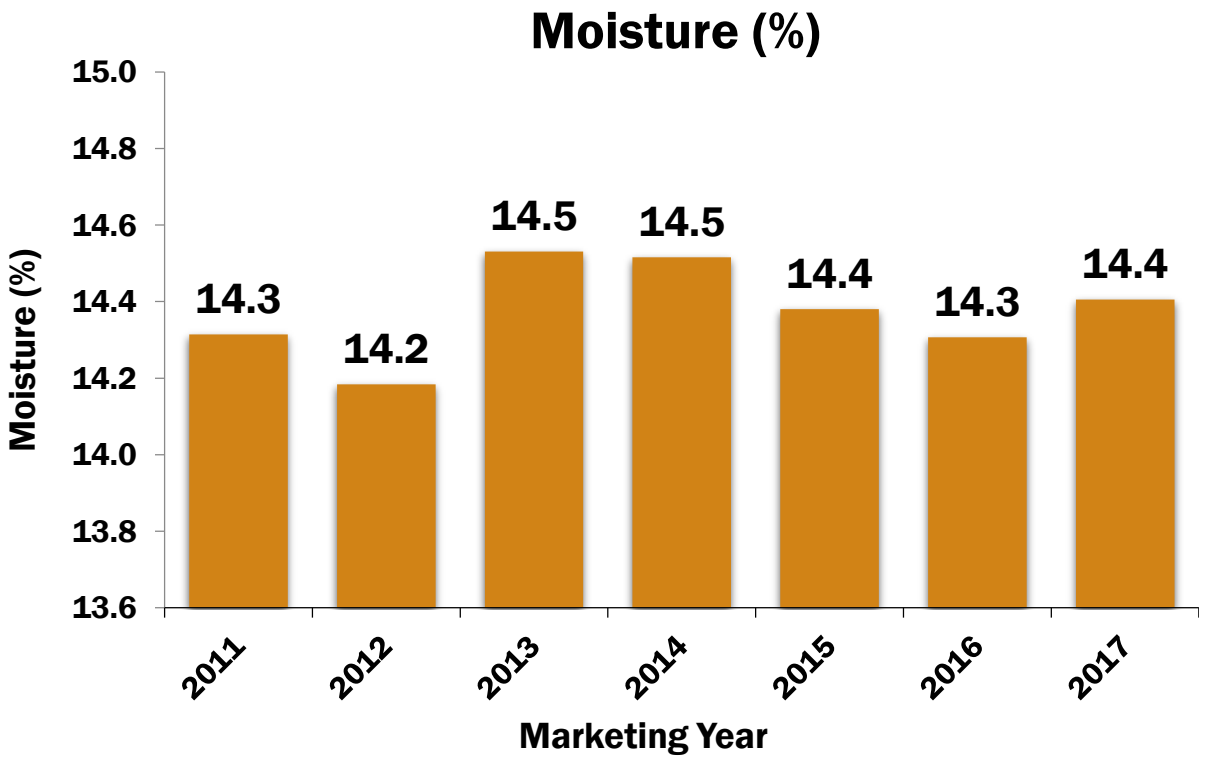
Historical U.S. Aggregate Averages: Grade Factors



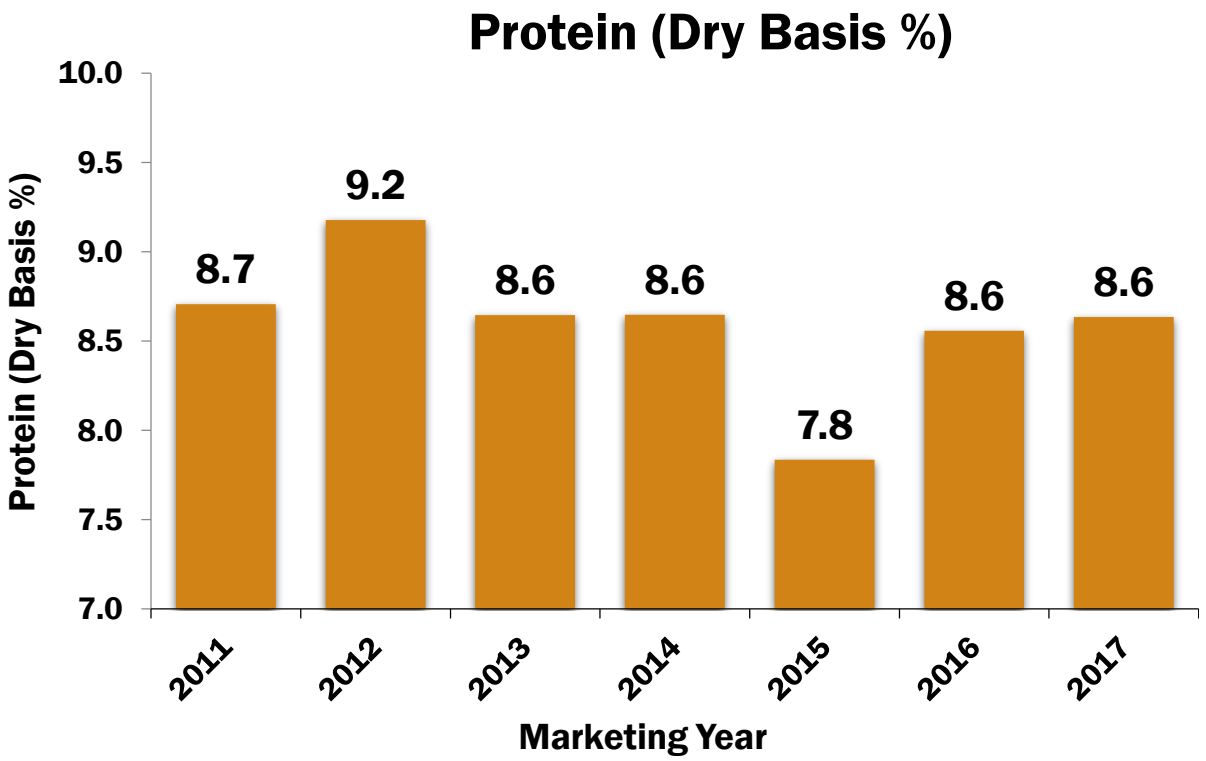


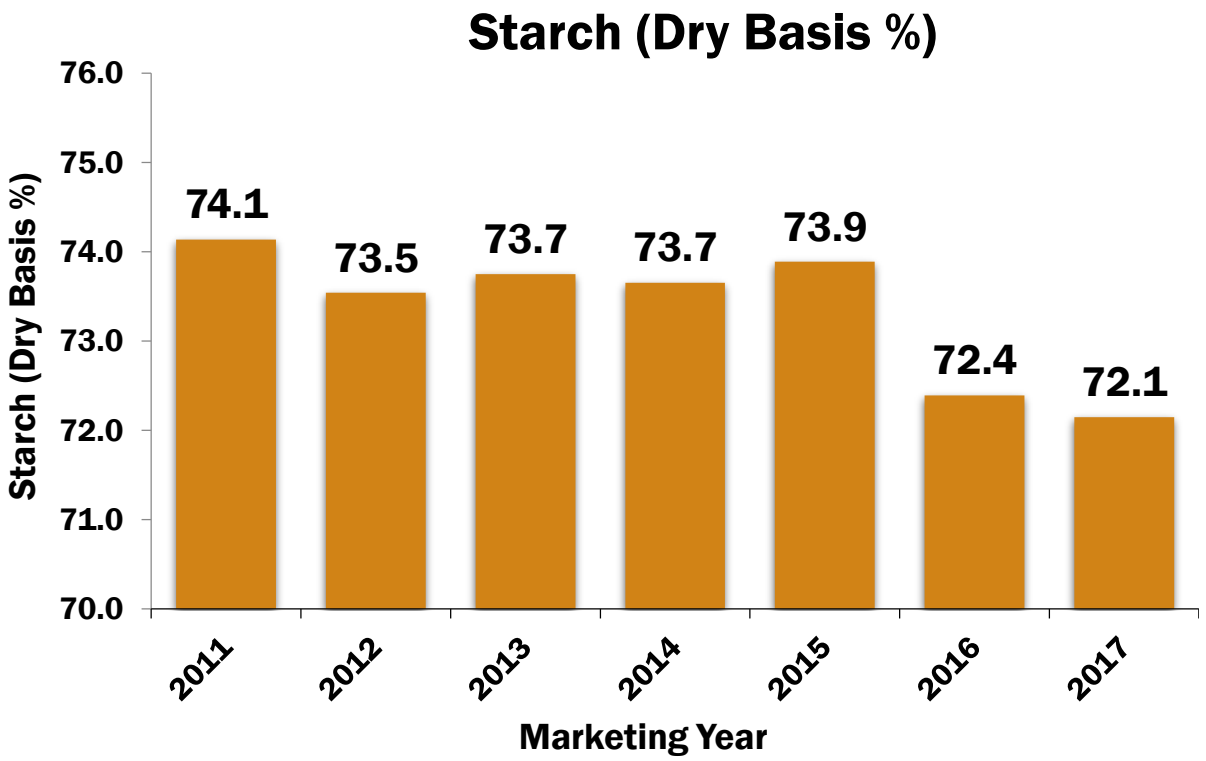
Historical U.S. Aggregate Averages: Grade Factors



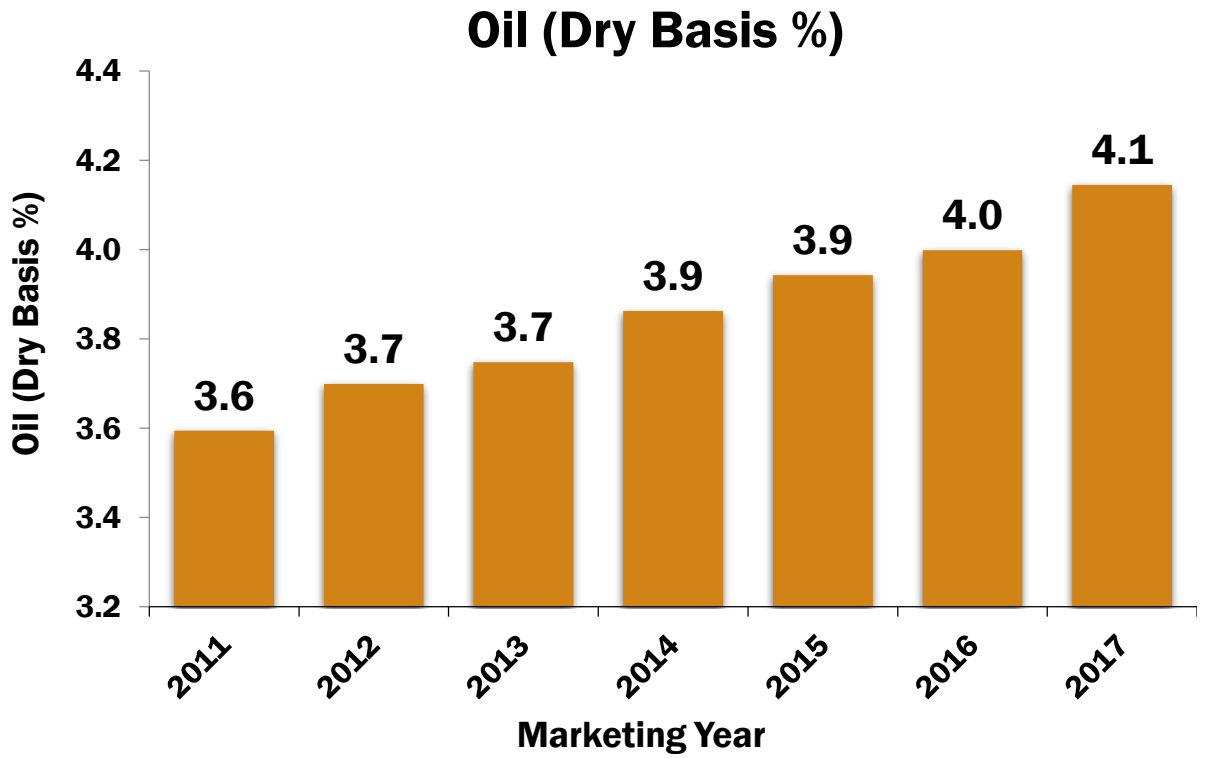


Historical U.S. Aggregate Averages: Chemical Composition

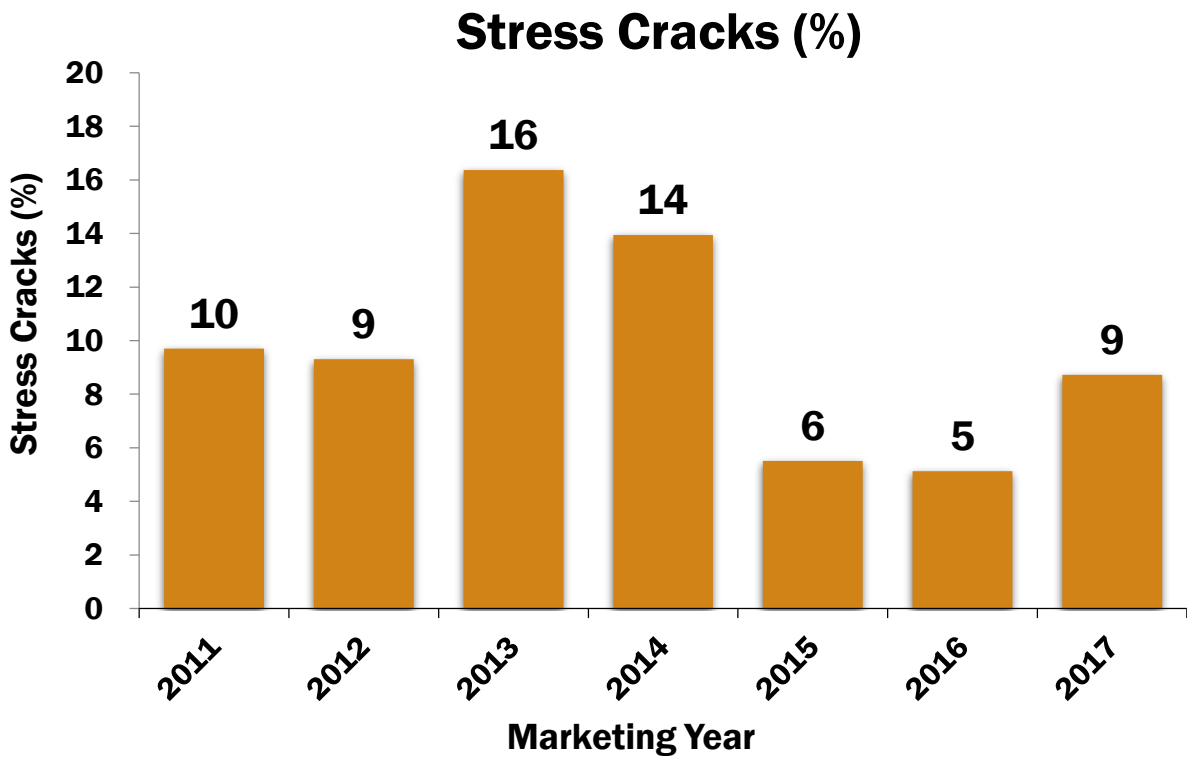


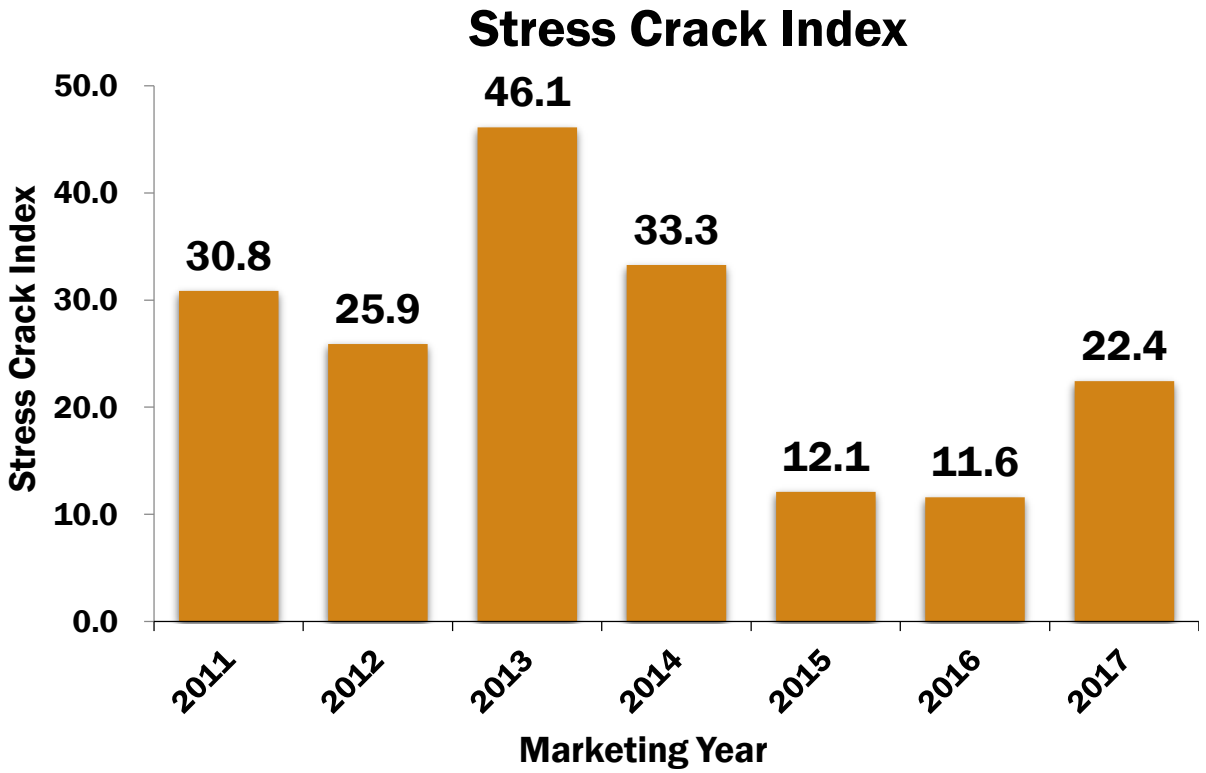


Historical U.S. Aggregate Averages: Chemical Composition

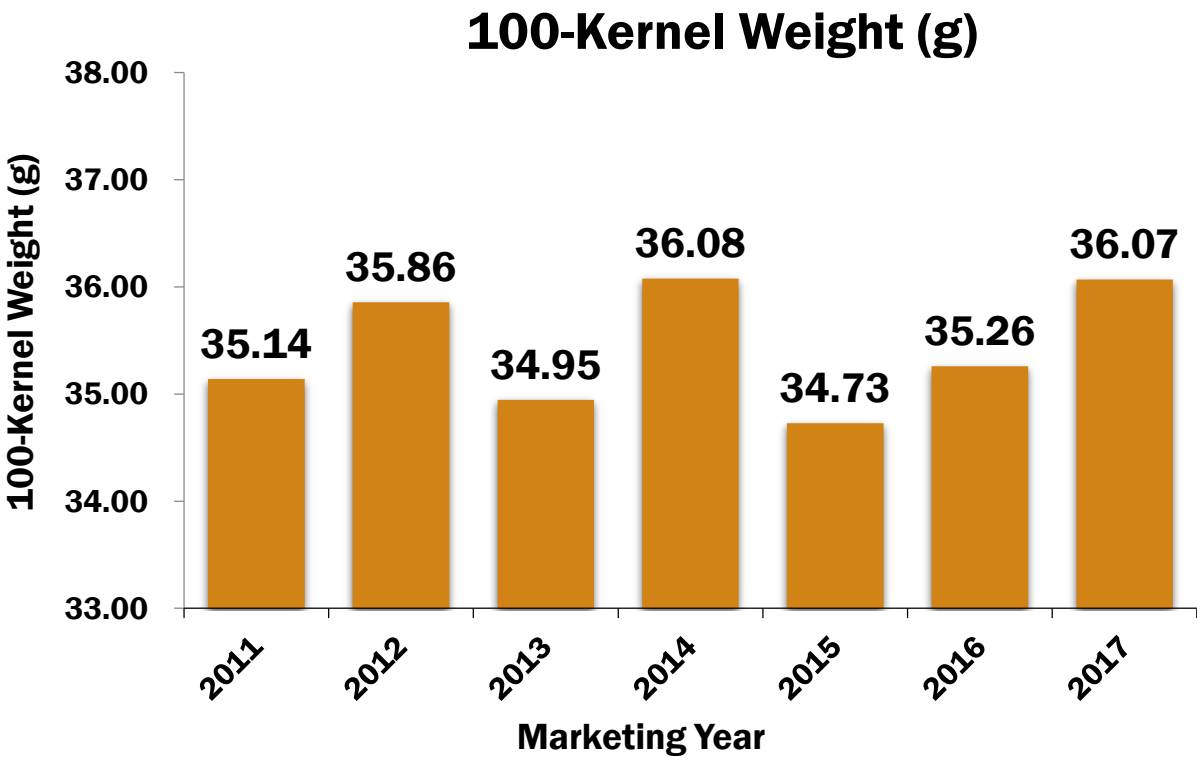


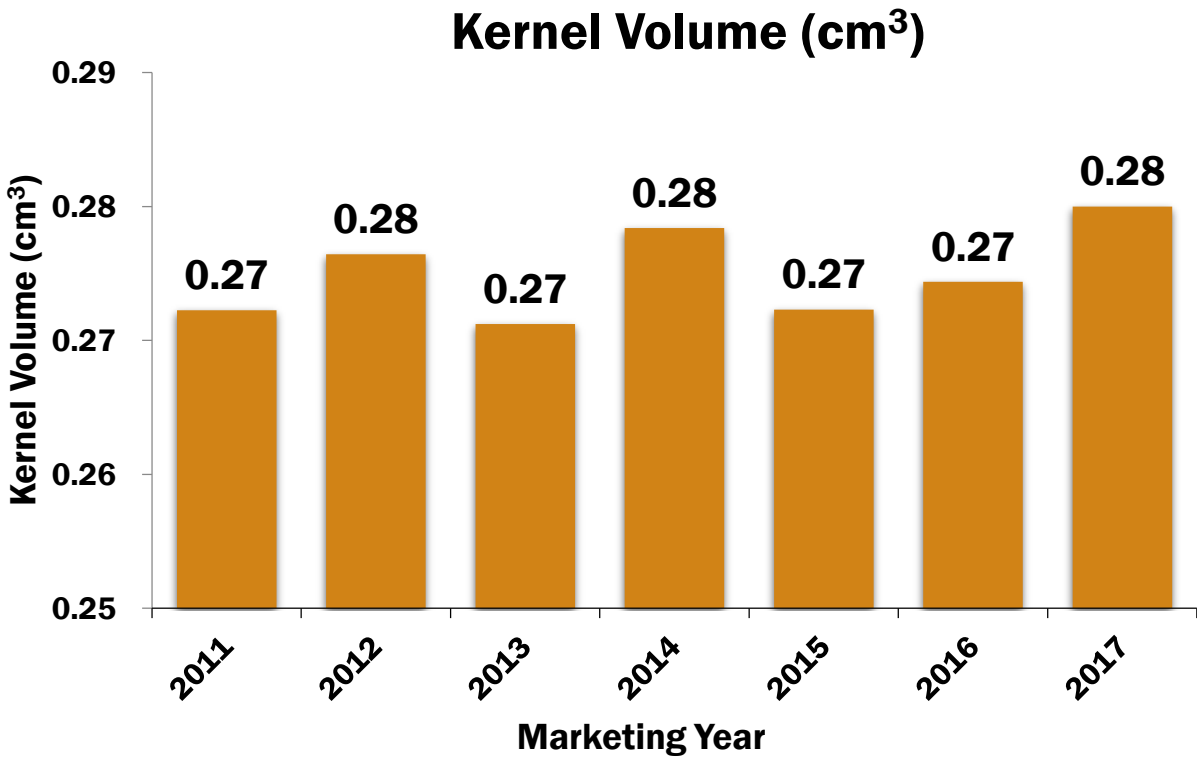
Historical U.S. Aggregate Averages: Physical Factors



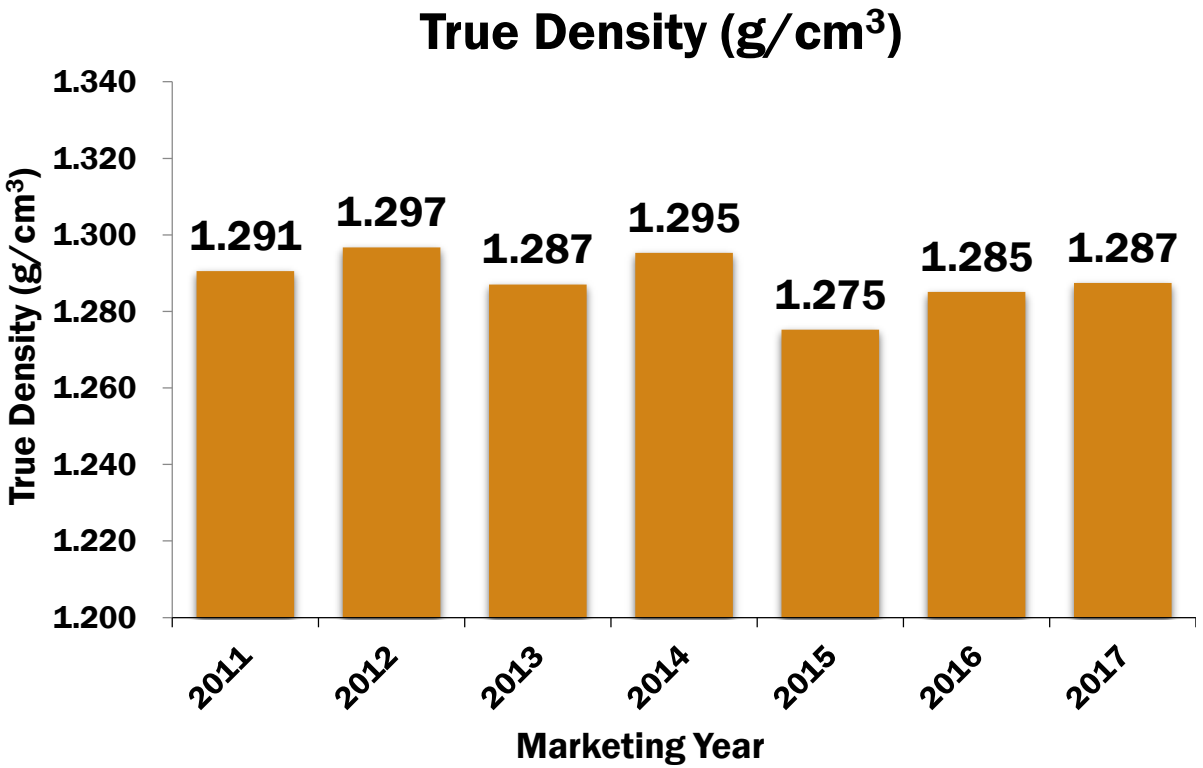


Historical U.S. Aggregate Averages: Physical Factors

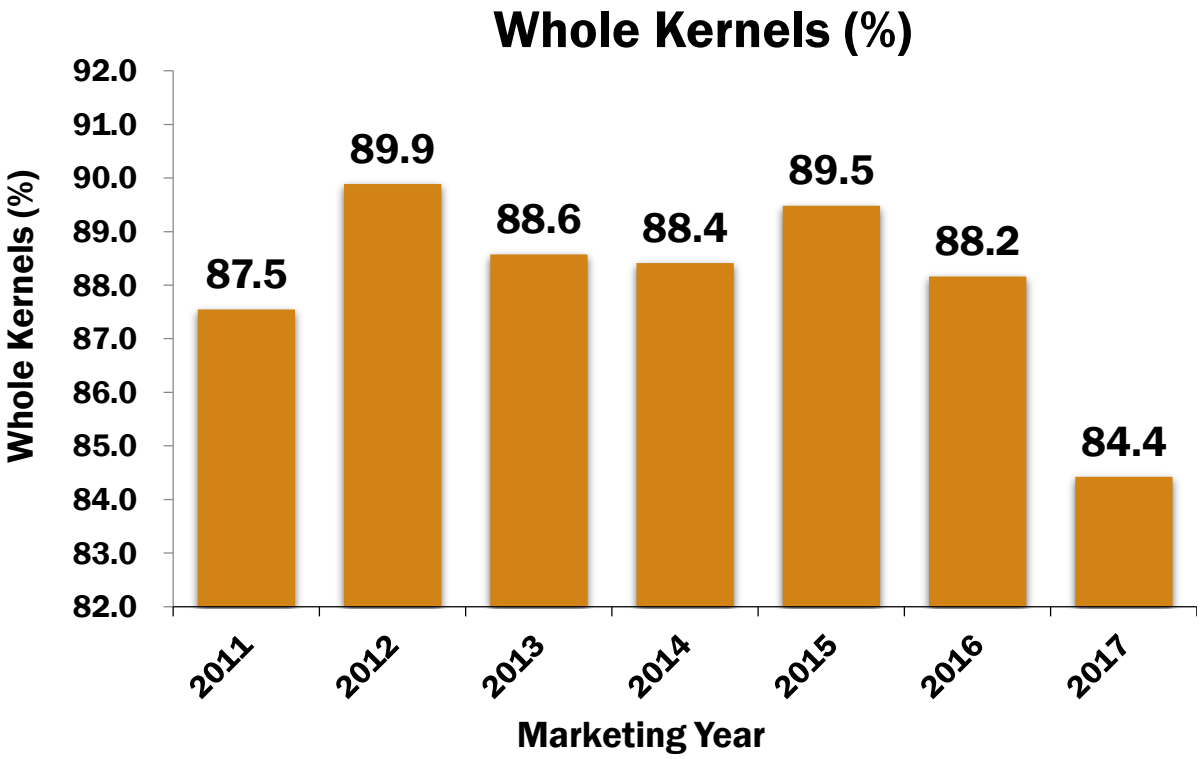


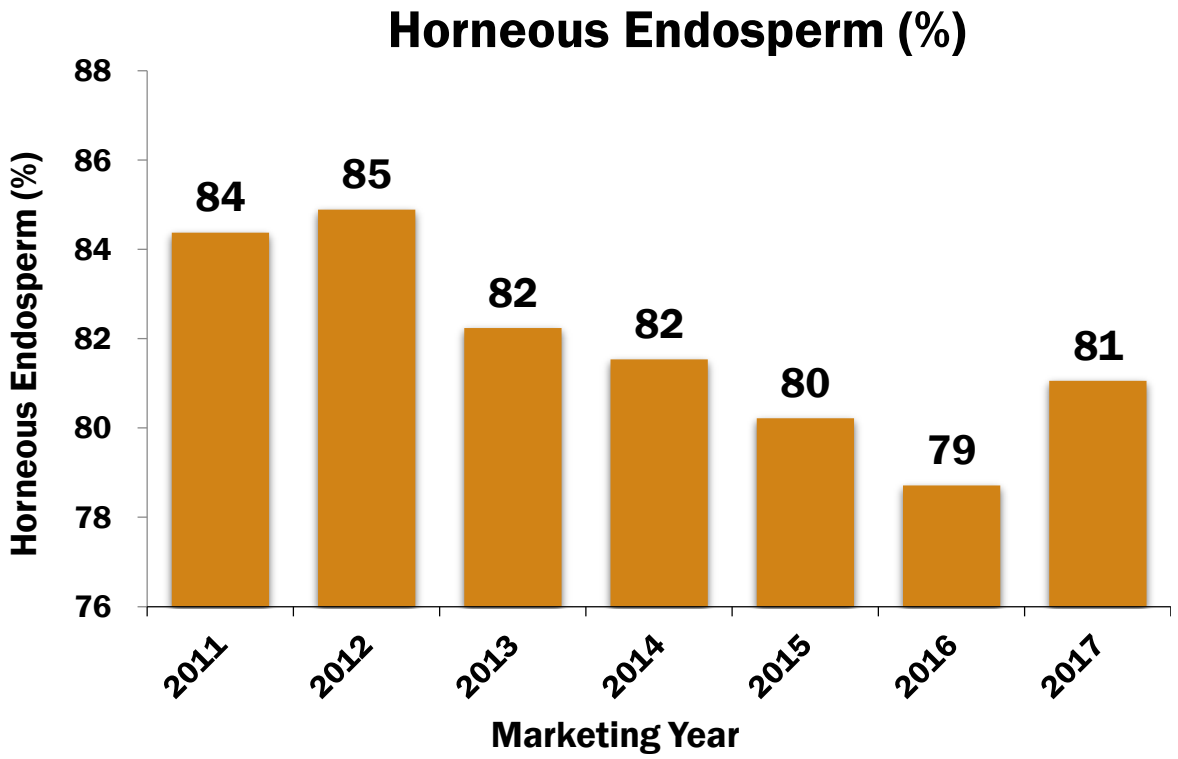


Historical U.S. Aggregate Averages: Physical Factors

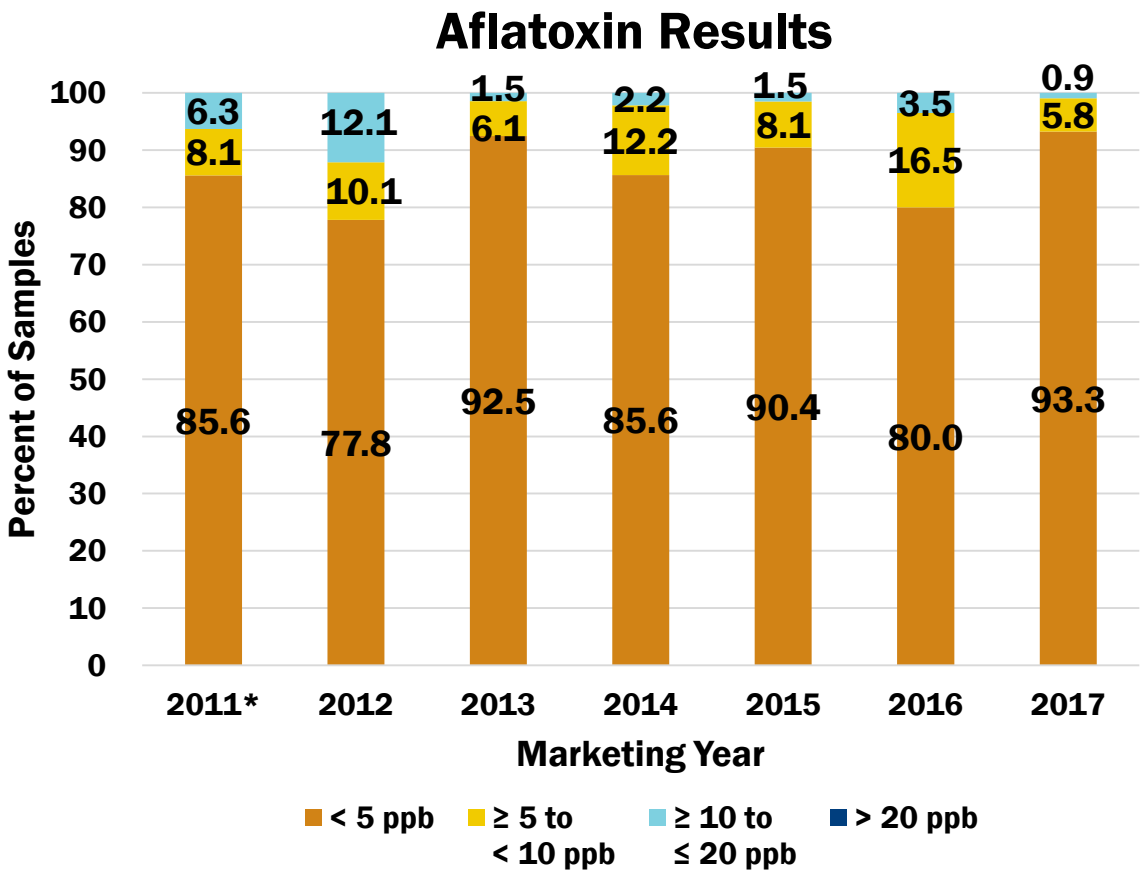


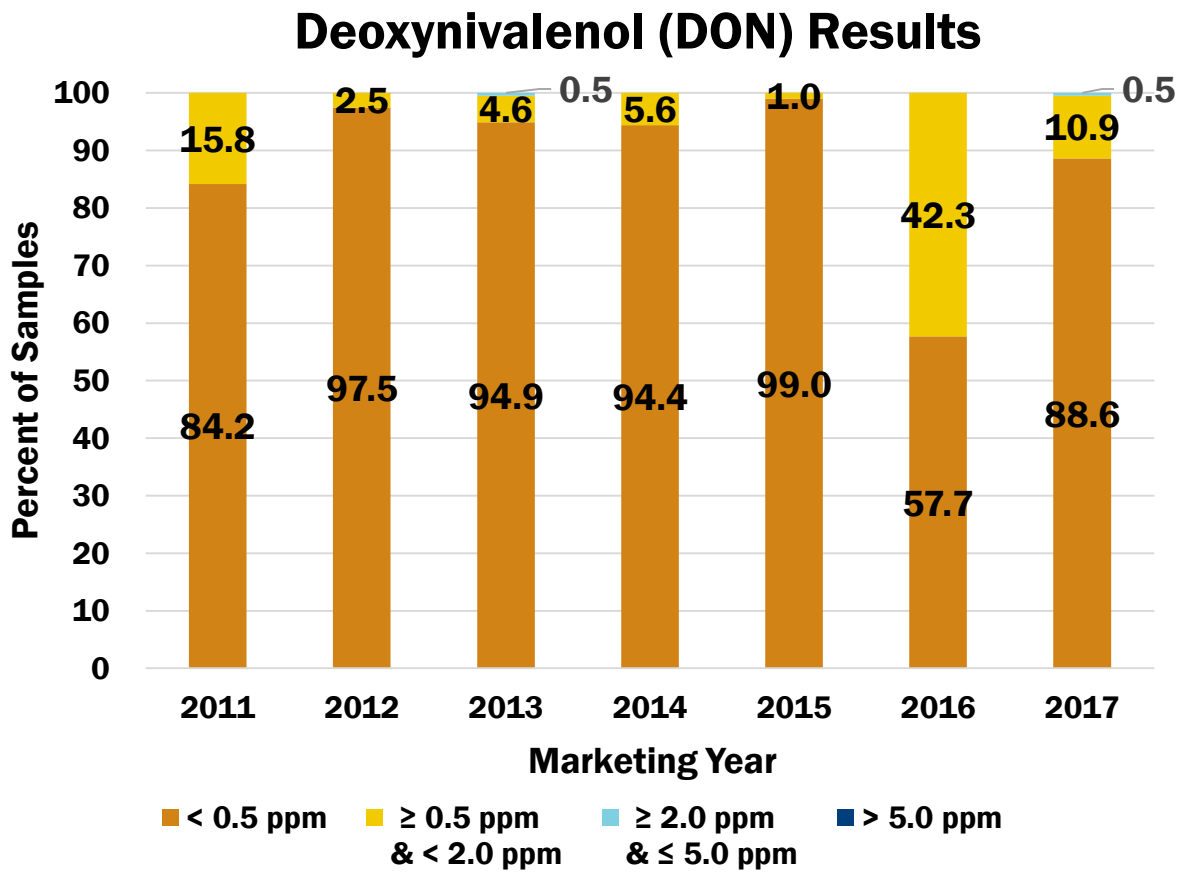
Historical U.S. Aggregate Averages: Physical Factors





Historical Mycotoxin Results





*Excludes the results of 46 samples that were tested using qualitative testing methods. The results of these 46 samples were all ≤ 20 ppb.