U.S. Grains Council
Corn Harvest Quality Report
2014/15

U.S. GRAINS COUNCIL

Developing markets. >> Enabling trade. >> Improving lives.

Quality, Reliability, Transparency

U.S. Grains Council:

- Building partnerships based on trust
- Bridge to world's largest, most reliable grain supply

Corn Harvest Quality Report:

- Reliable and comparable data
- Transparent and consistent methodology
- Early look at general harvest quality

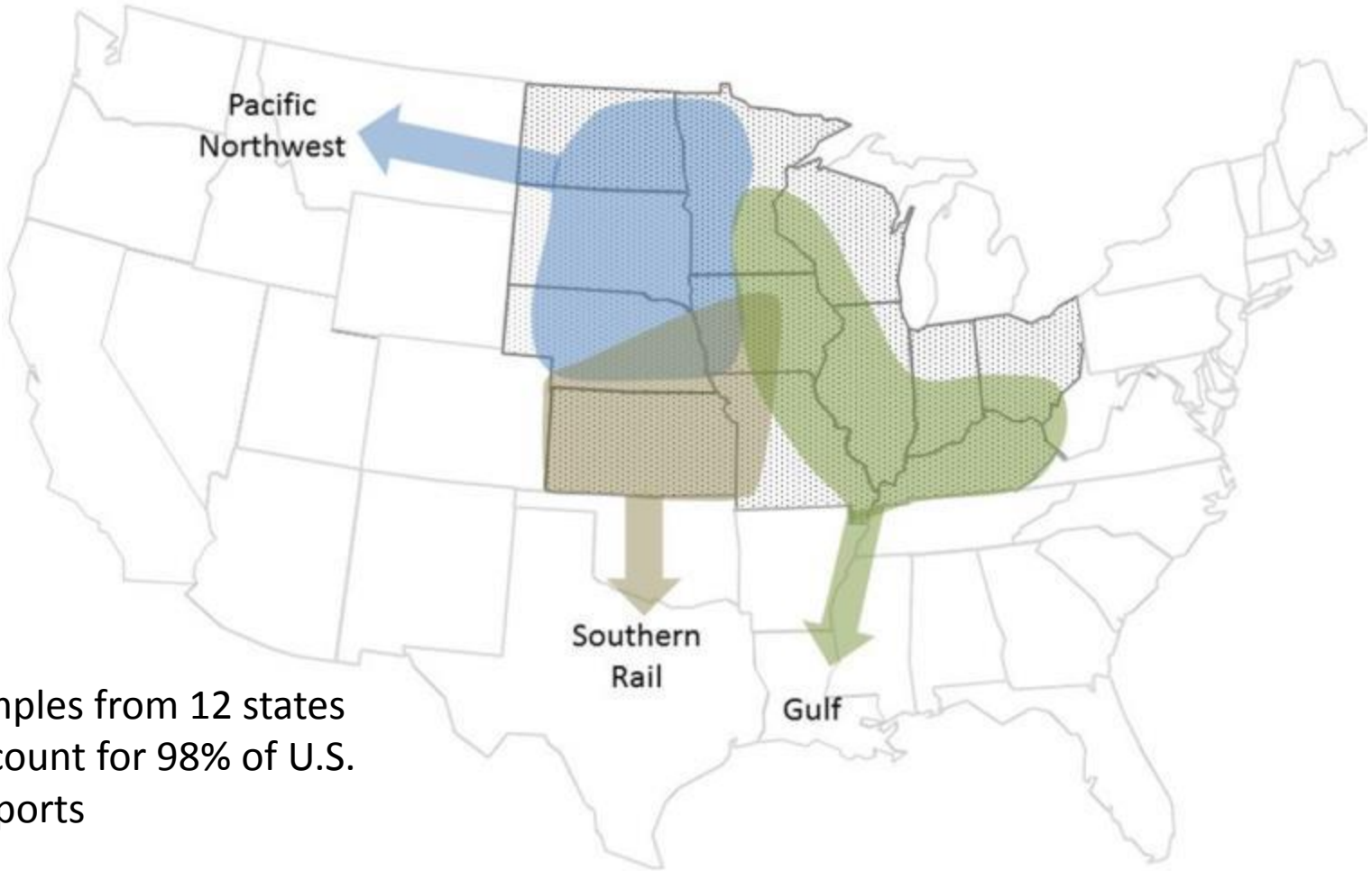
U.S. GRAINS COUNCIL

Tool for Better Decision Making

- 2014: Fourth year of this report
- Beginning to evaluate 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 2015 will report U.S. corn quality from samples at export points

“Export Catchment Areas” (ECAs)

Corn Harvest Quality Report 2014/15



629 samples from 12 states that account for 98% of U.S. corn exports

U.S. GRAINS COUNCIL

Quality Factors Tested

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

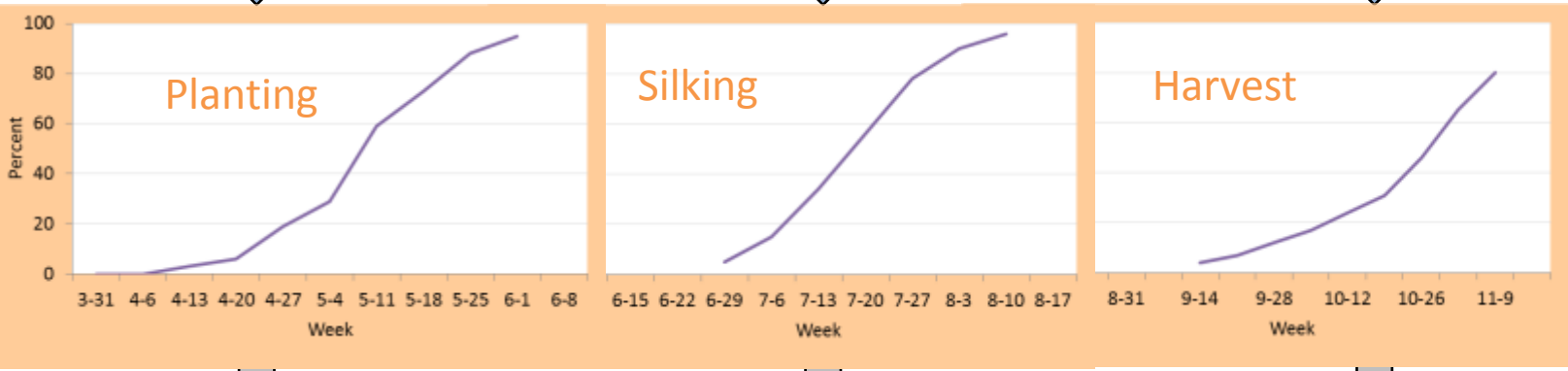
2014 Growing Conditions and Impact on Crop Development

Corn Harvest Quality Report 2014/15

Cool, wet April followed by a warm, dry May

Cool temperatures, dry July with ample soil moisture

Cool temperatures with large swings; extreme moisture in some areas



Little early planting; Quick, uniform emergence; Rapid early growth

Excellent pollination conditions, setting stage for high yields

Delayed dry down and harvest in most areas

COUNCIL

Harvest 2014/15 Highlights

Corn Harvest Quality Report 2014/15

Grade factors

- Test weight: slightly lower than 2013 and 3YA*, yet still indicates good kernel filling and maturation
- BCFM: levels remained low, average well below the limit for No. 1 grade
- Total damage: higher levels than in previous years with greater variance; however, average still well below the limit for No. 1 grade

Moisture

- Lower than 2013, but higher than 3YA

Chemical composition

- Lower protein, accompanied by high starch and slightly higher oil concentration

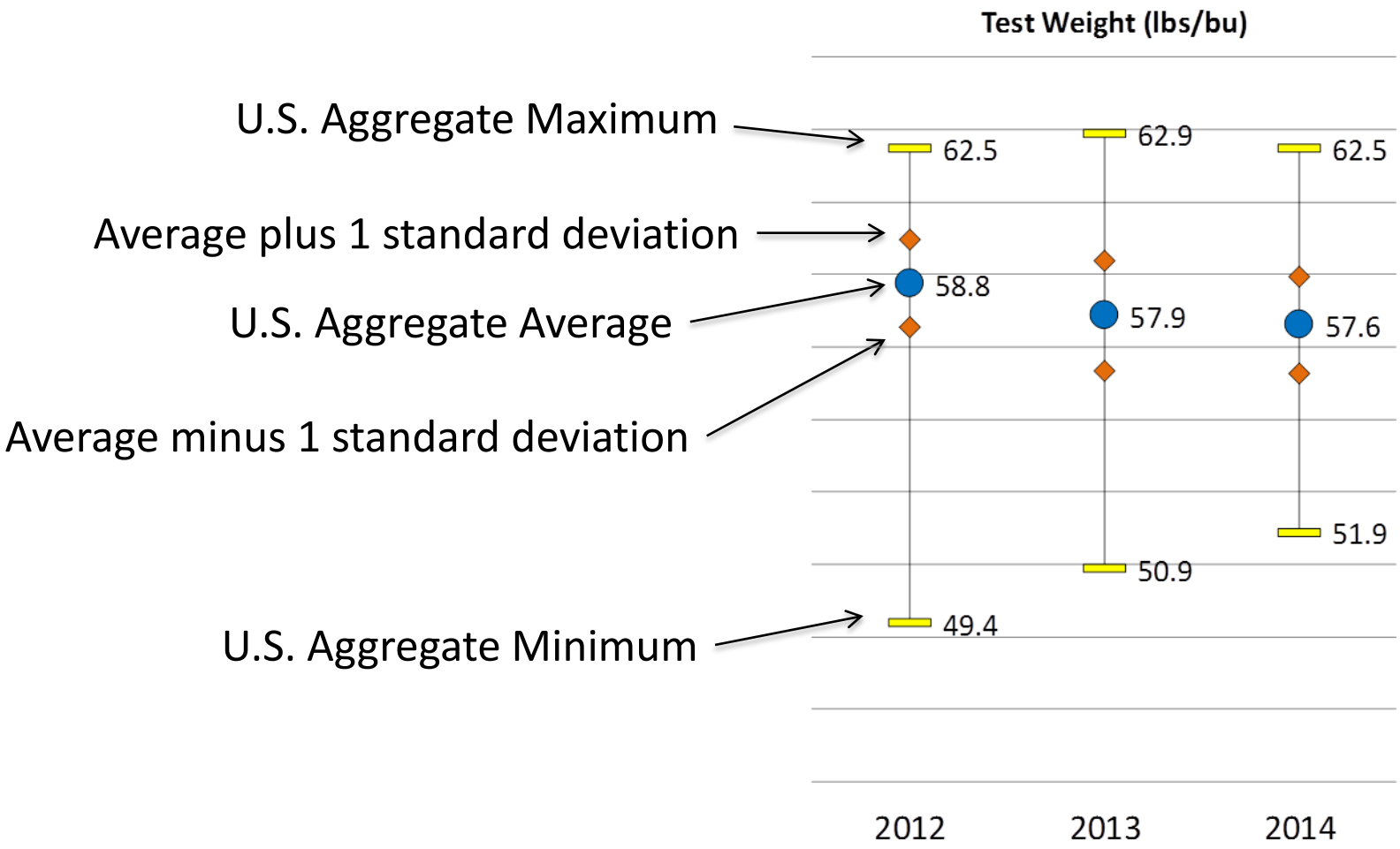
Physical Factors

- Stress cracks and SCI: lower levels than 2013, yet higher than 3YA; susceptibility to breakage may be slightly less than last year
- True density and horneous endosperm: similar to 2013 but lower than 3YA
- Whole kernel percent: higher than 2013 but similar to 3YA

**3YA: simple average of U.S. Aggregate average quality factor in 2011, 2012 and 2013*

Test Results: Comparison

Corn Harvest Quality Report 2014/15

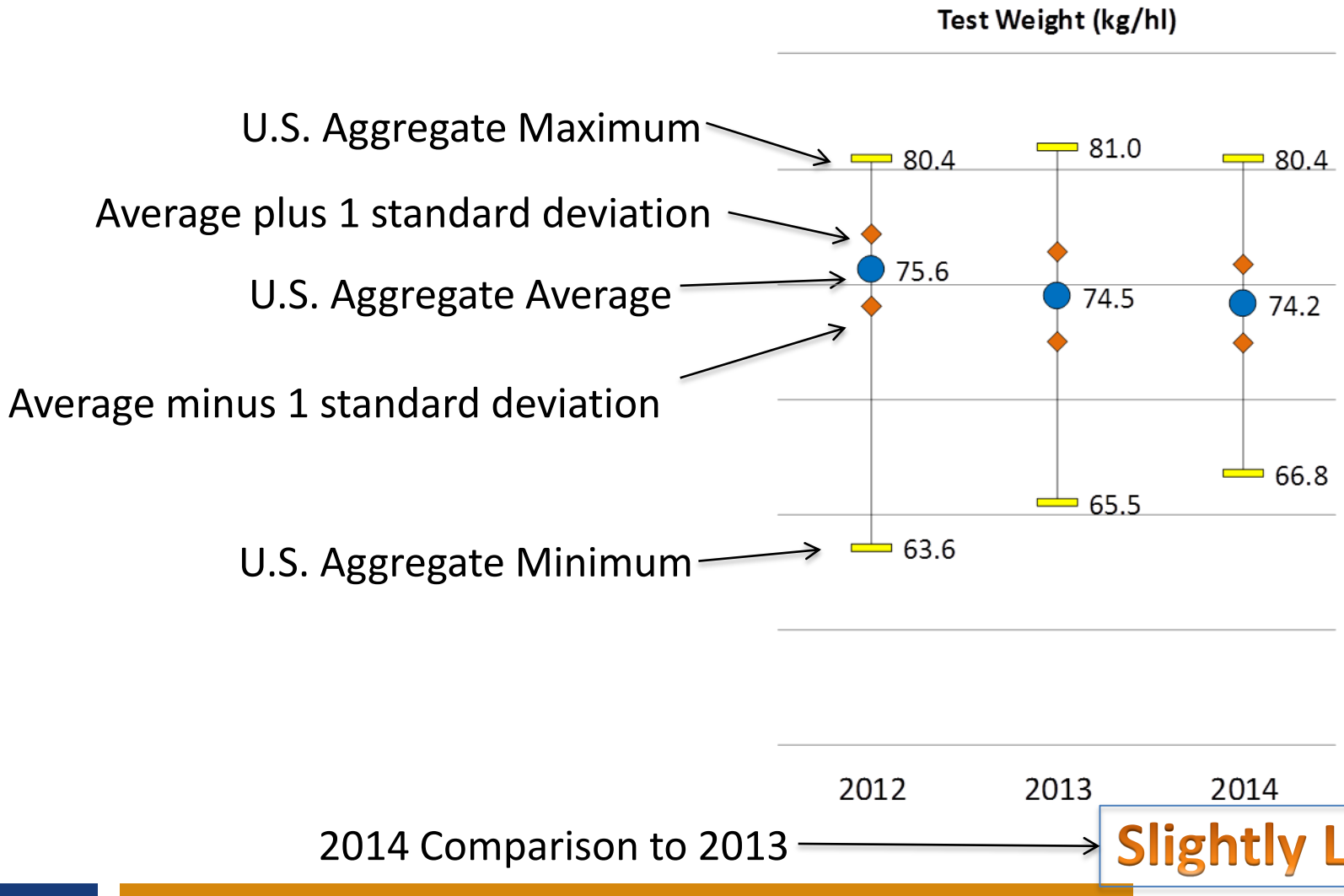


2014 Comparison to 2013 → **Slightly Lower**

U.S. GRAINS COUNCIL

Test Results: Comparison

Corn Harvest Quality Report 2014/15

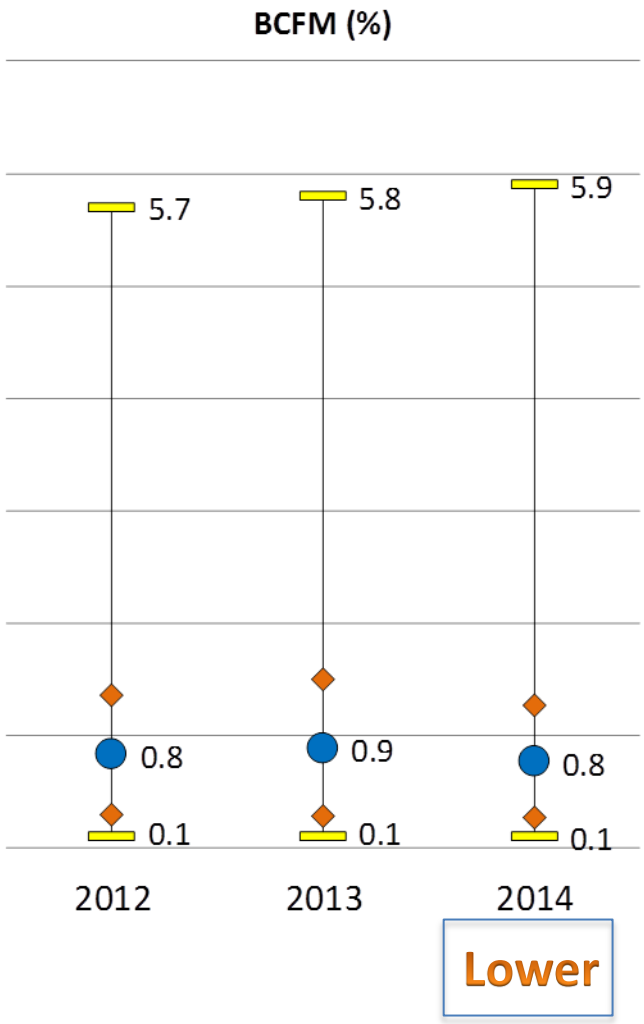


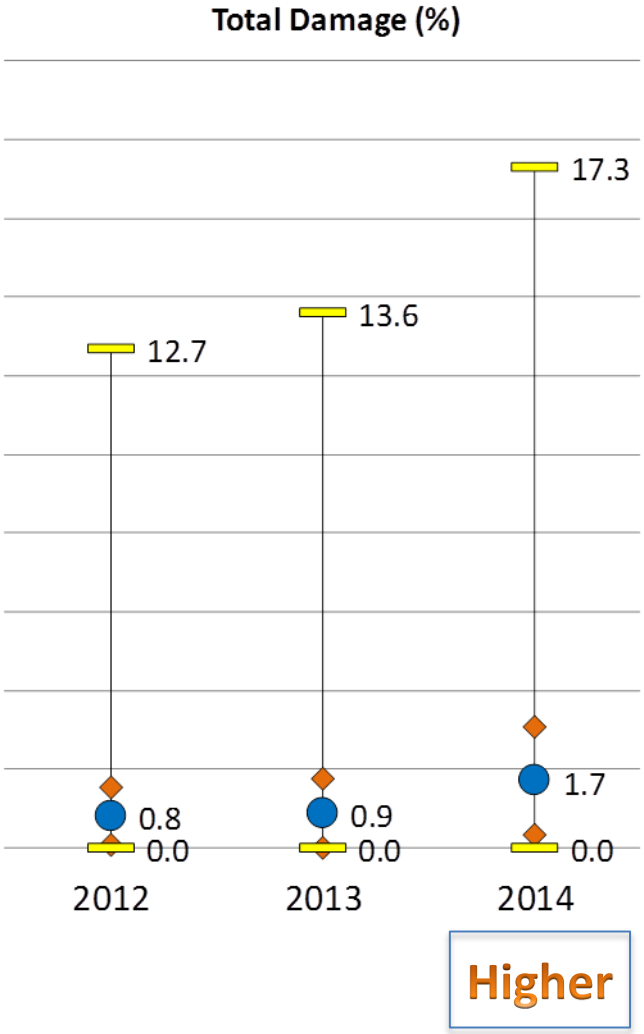
2014 Comparison to 2013 → **Slightly Lower**

U.S. GRAINS COUNCIL

Test Results: Comparison (cont'd)

Corn Harvest Quality Report 2014/15

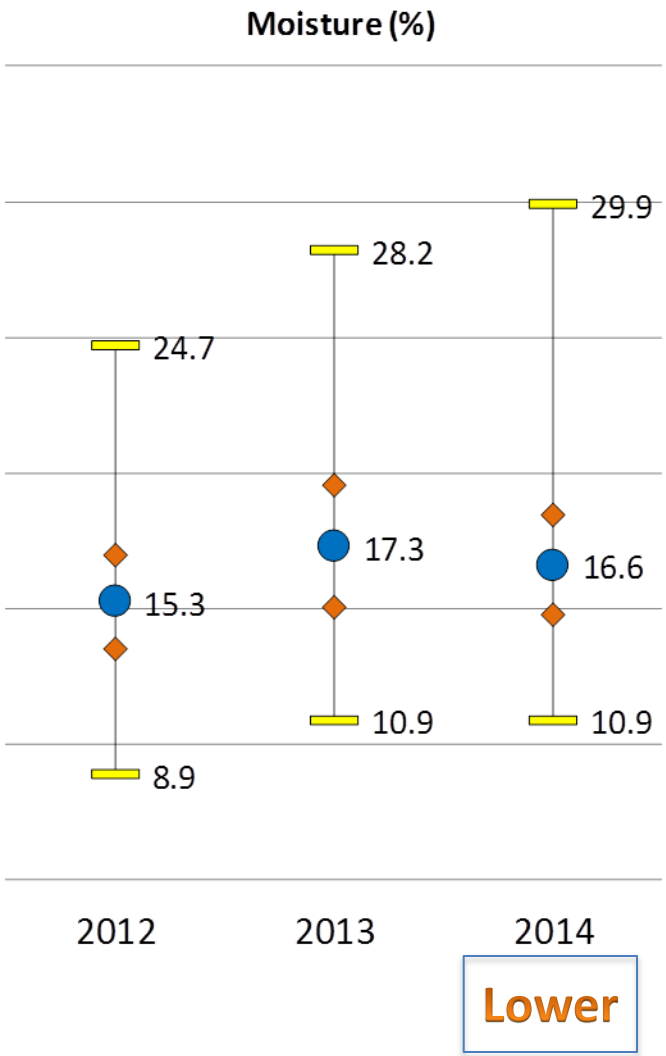




U.S. GRAINS COUNCIL

Test Results: Comparison (cont'd)

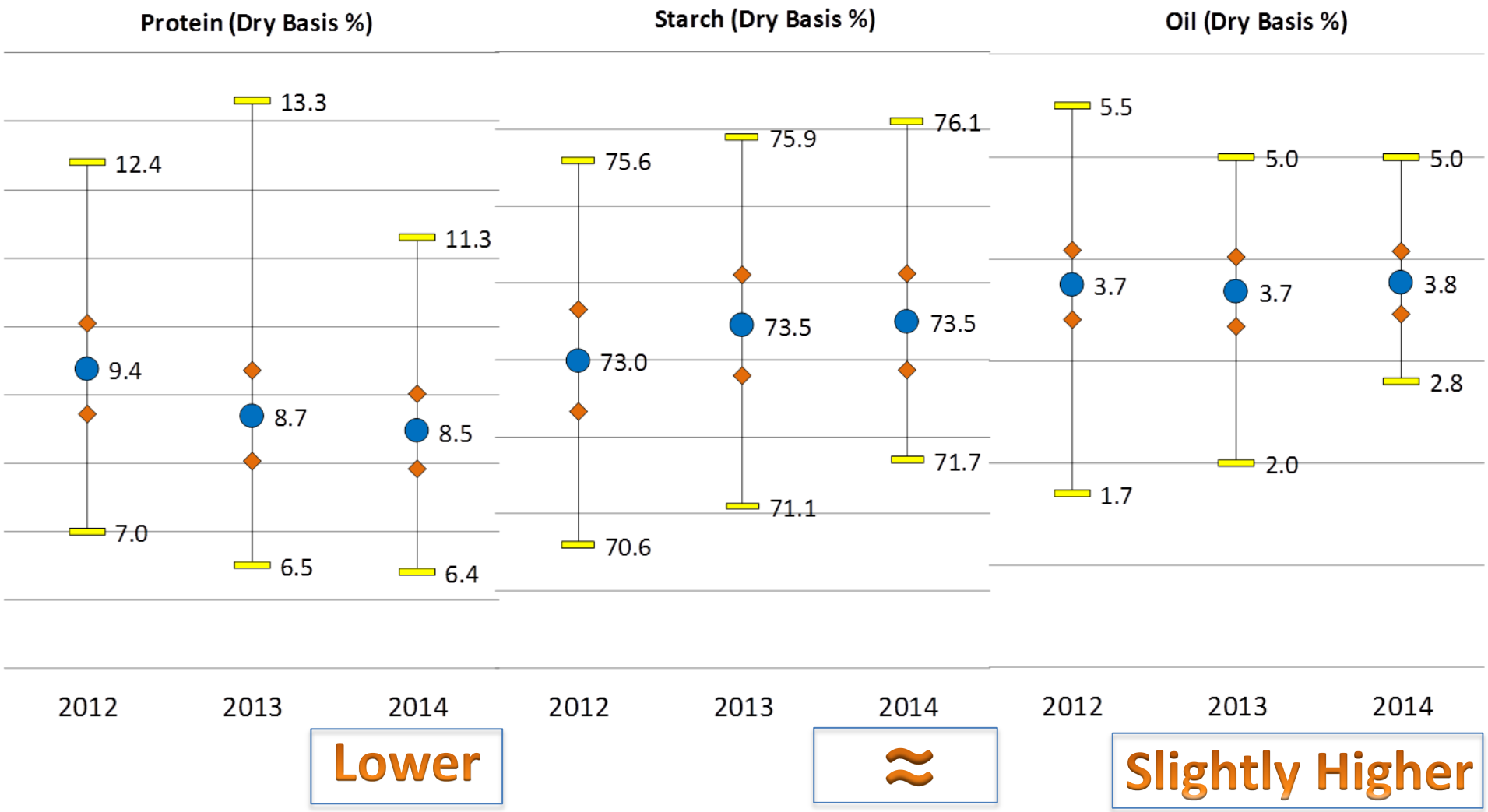
Corn Harvest Quality Report 2014/15



U.S. GRAINS COUNCIL

Test Results: Comparison (cont'd)

Corn Harvest Quality Report 2014/15



Lower

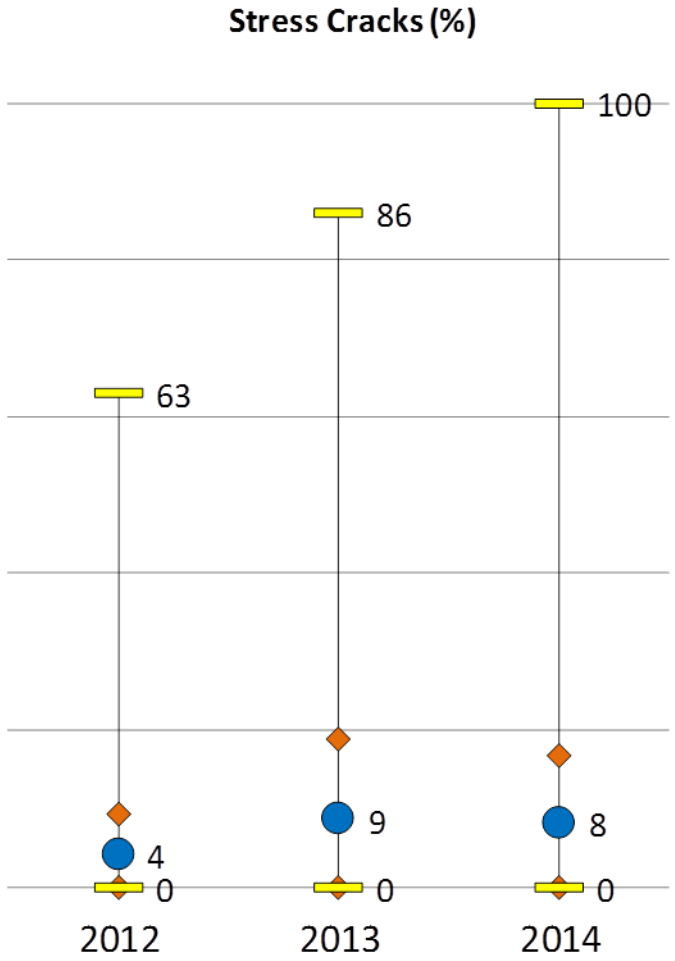
≈

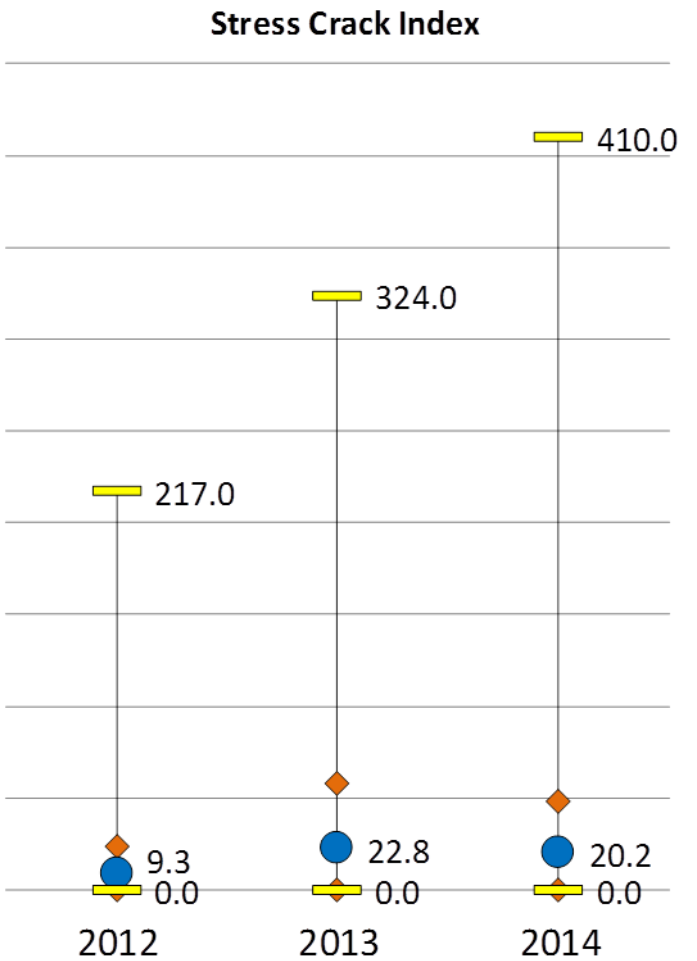
Slightly Higher

U.S. GRAINS COUNCIL

Test Results: Comparison (cont'd)

Corn Harvest Quality Report 2014/15





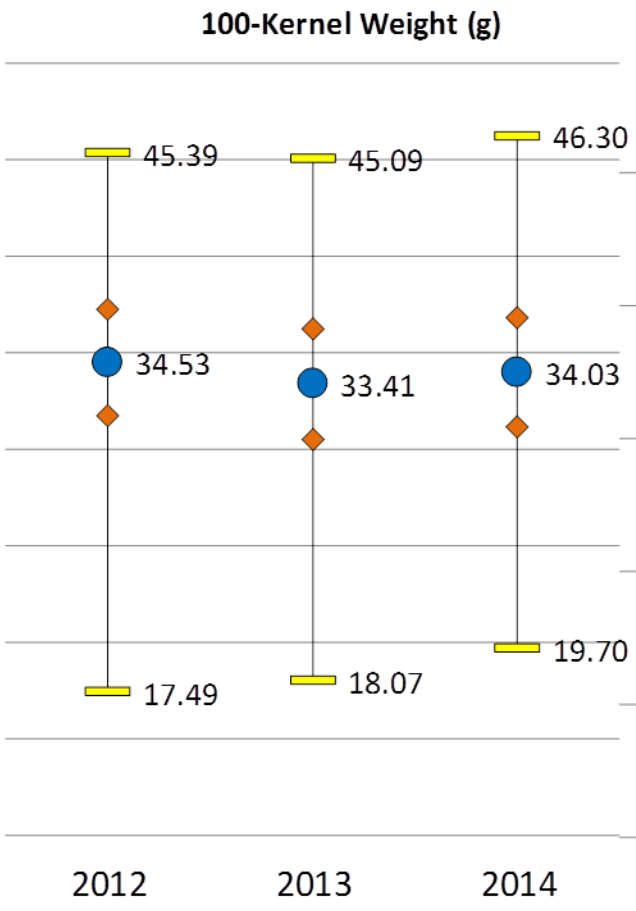
Lower

Lower

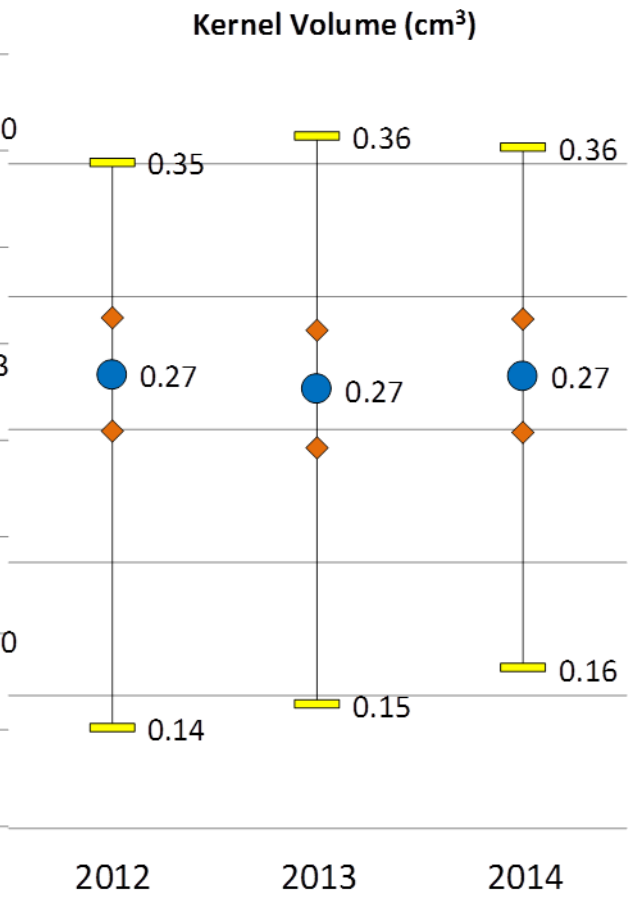
U.S. GRAINS COUNCIL

Test Results: Comparison (cont'd)

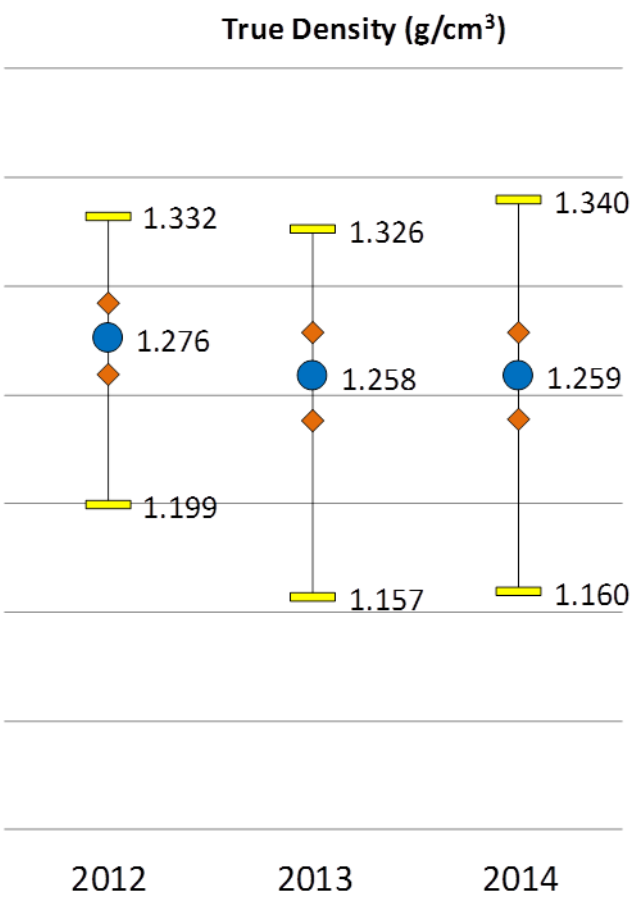
Corn Harvest Quality Report 2014/15



Higher



≈

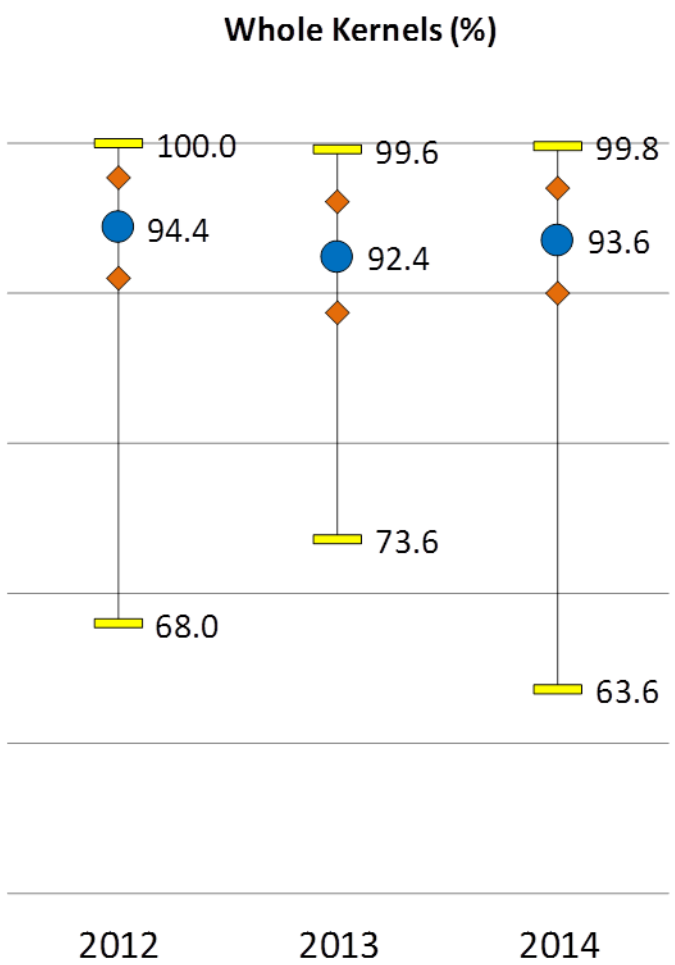


Slightly Higher

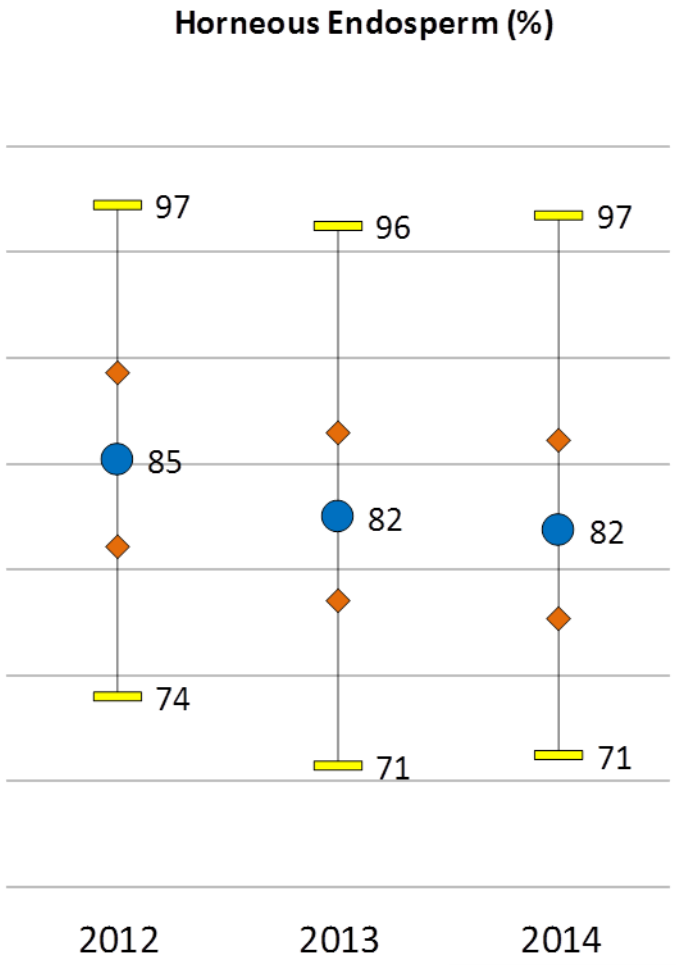
U.S. GRAINS COUNCIL

Test Results: Comparison (cont'd)

Corn Harvest Quality Report 2014/15



Higher



≈

U.S. GRAINS COUNCIL

Test Results: Comparison (cont'd)

Aflatoxins

- 100% of the samples tested below the FDA action level

DON

- While greater incidences of DON were detected in the 2014 crop than in the 2013 and 2012 crops, all samples tested below the FDA advisory levels

Grade Factors and Moisture

U.S. GRAINS COUNCIL

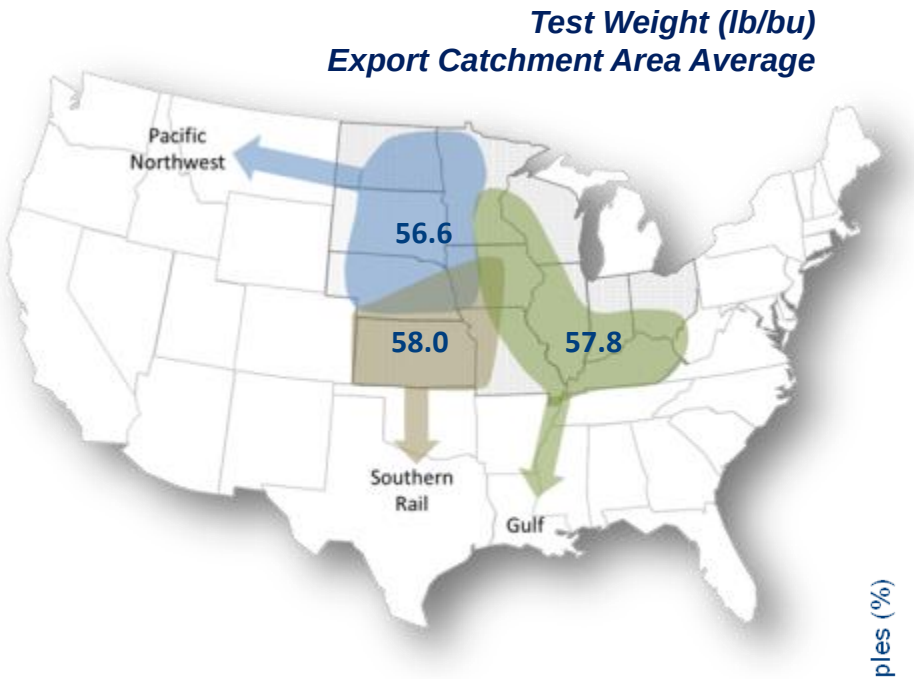
U.S. Corn Grades & Grade Requirements

Corn Harvest Quality Report 2014/15

Grade	Test Weight (lb/bu)	Heat Damage (%)	Total Damage (%)	BCFM (%)
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

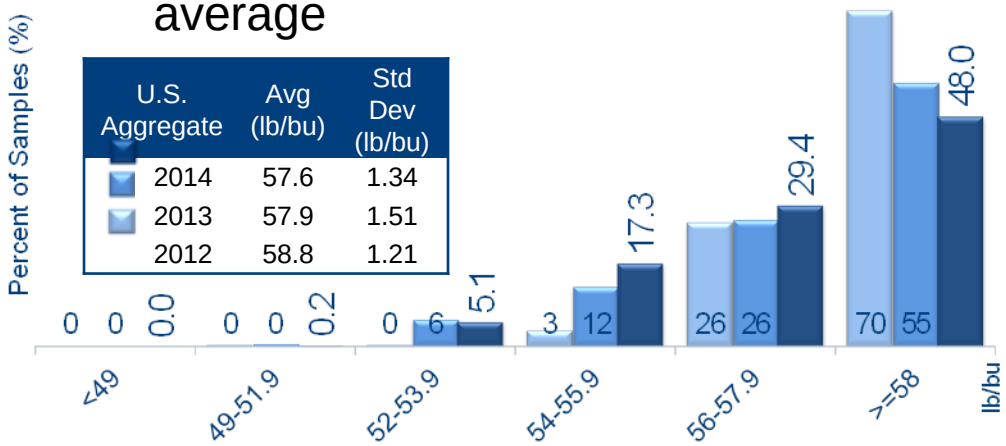
Source: USDA Federal Grain Inspection Service (FGIS)

Test Weight – U.S. Units



U.S. Aggregate: 57.6 lb/bu

- Slightly lower average but less variability than 2013
- Still indicates good kernel filling and maturation
- 94.7% above No. 2 grade minimum
- Southern Rail ECA had highest average



U.S. GRAINS COUNCIL

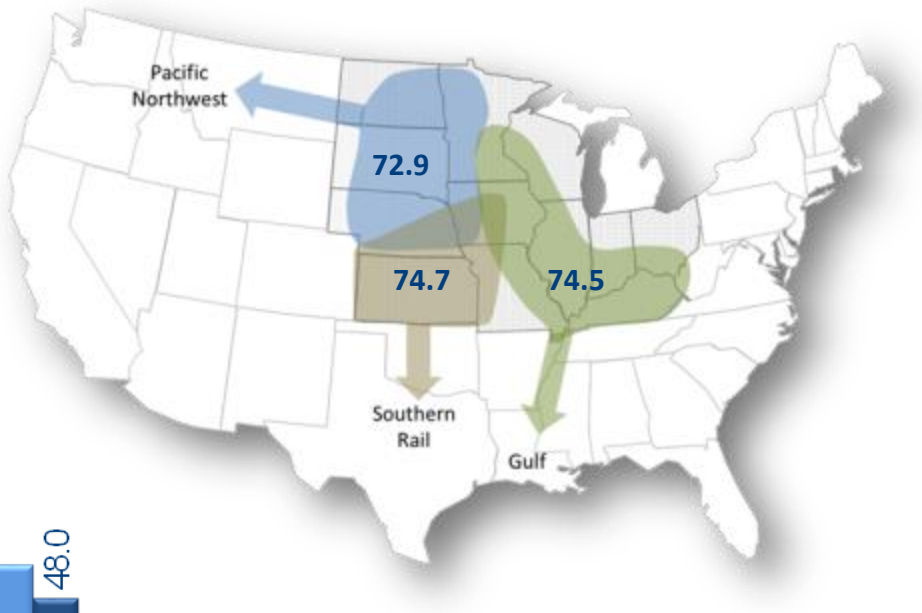
Test Weight - Metric

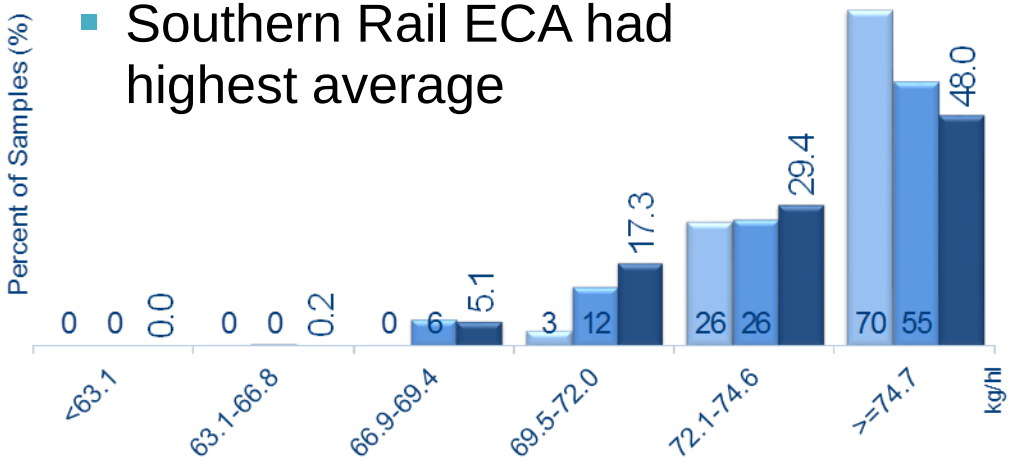
Corn Harvest Quality Report 2014/15

U.S. Aggregate: 74.2 kg/hl

- Slightly lower average but less variability than 2013
- Still indicates good kernel filling and maturation
- 94.7% above No. 2 grade minimum
- Southern Rail ECA had highest average

Test Weight (kg/hl)
Export Catchment Area Average





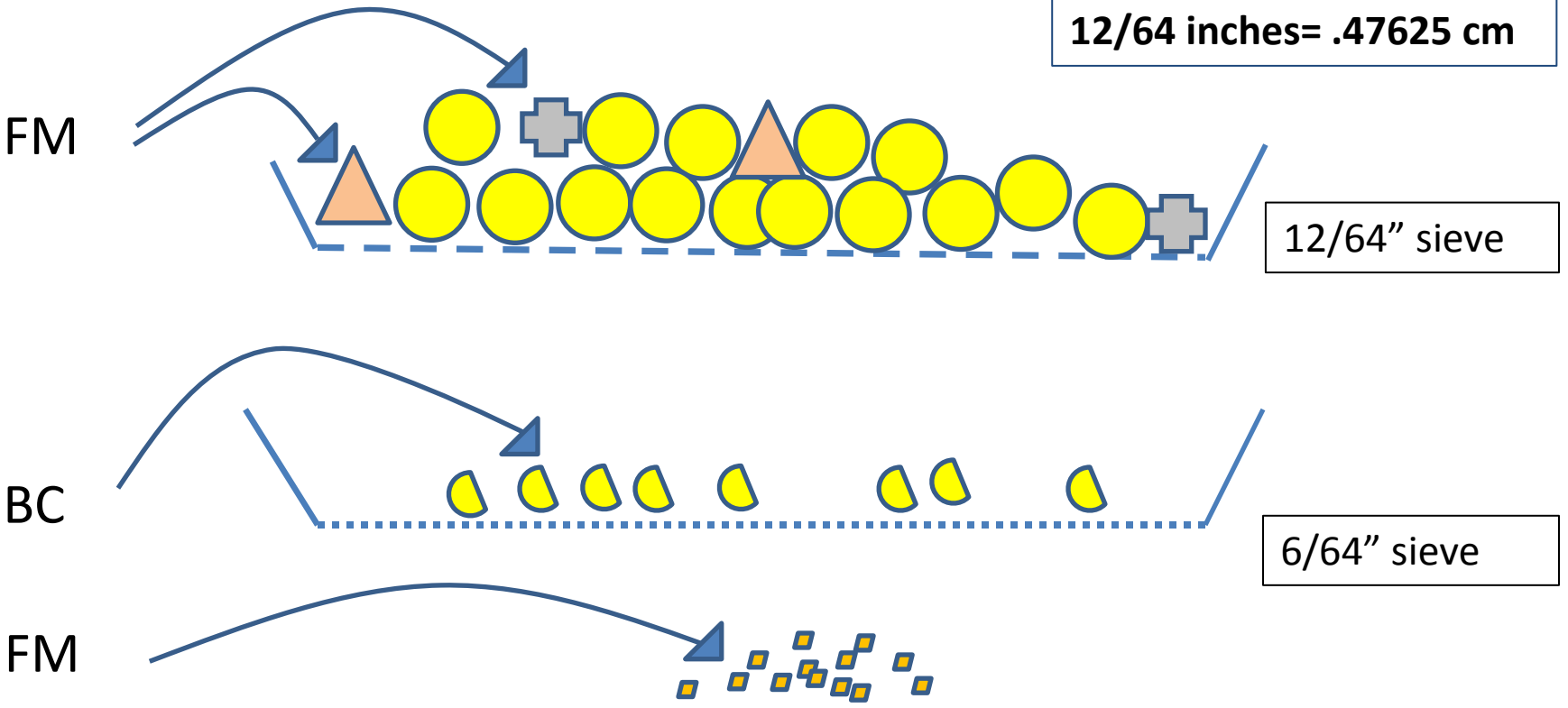
U.S. Aggregate	Avg (kg/hl)	Std Dev (kg/hl)
2014	74.2	1.72
2013	74.5	1.95
2012	75.6	1.56

U.S. GRAINS COUNCIL

Broken Corn/Foreign Material
Measured as % by weight

Corn Harvest Quality Report 2014/15

6/64 inches= .238125 cm
12/64 inches= .47625 cm

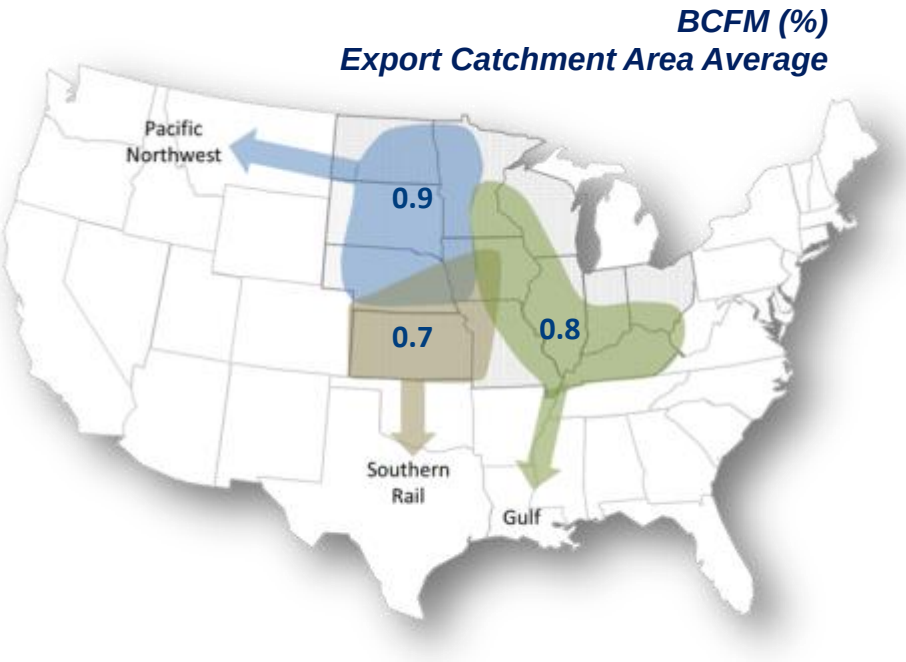


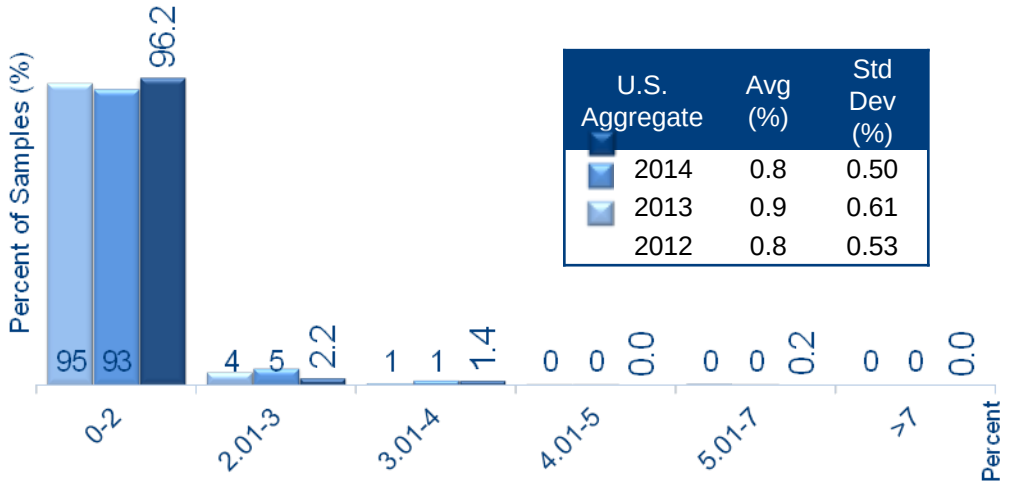
U.S. GRAINS COUNCIL

Broken Corn and Foreign Material (BCFM) (%)

U.S. Aggregate: 0.8%

- Average well below limit for No. 1 grade
- Average less than and more uniform than 2013 and 3YA
- Southern Rail ECA had the lowest average in 2014





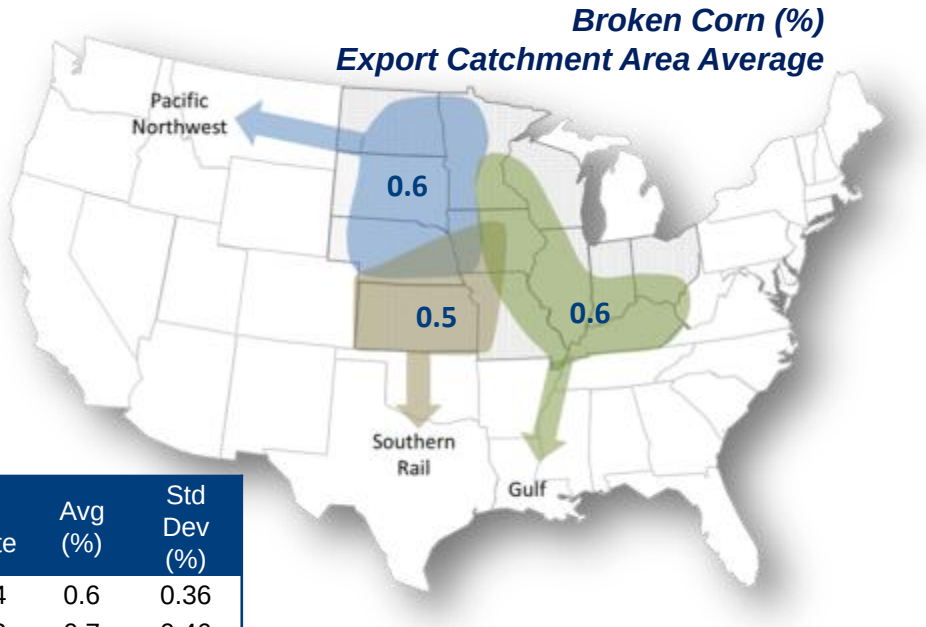
U.S. Aggregate	Avg (%)	Std Dev (%)
2014	0.8	0.50
2013	0.9	0.61
2012	0.8	0.53

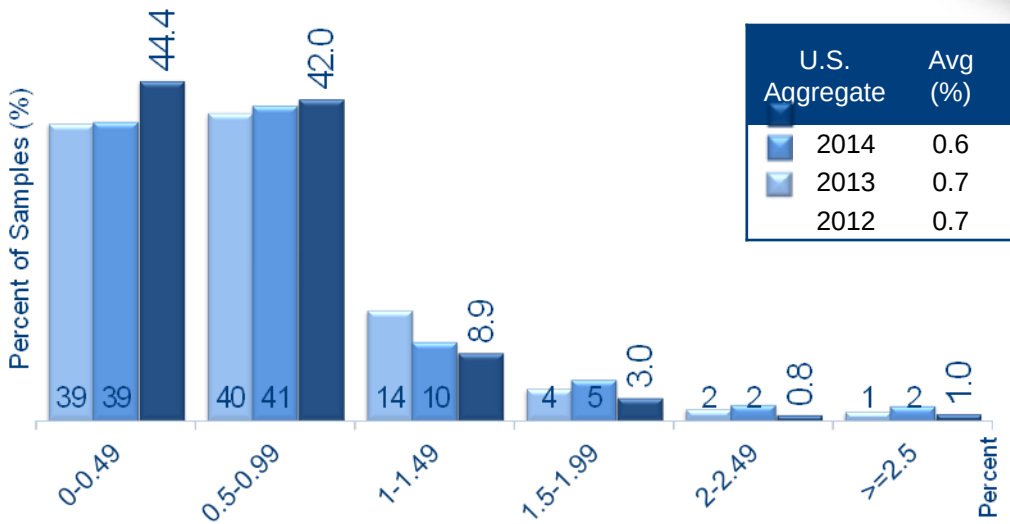
U.S. GRAINS COUNCIL

Broken Corn (BC) (%)

U.S. Aggregate: 0.6%

- In nearly all samples, BCFM consisted mostly of BC, similar to previous years
- Average slightly lower than previous years





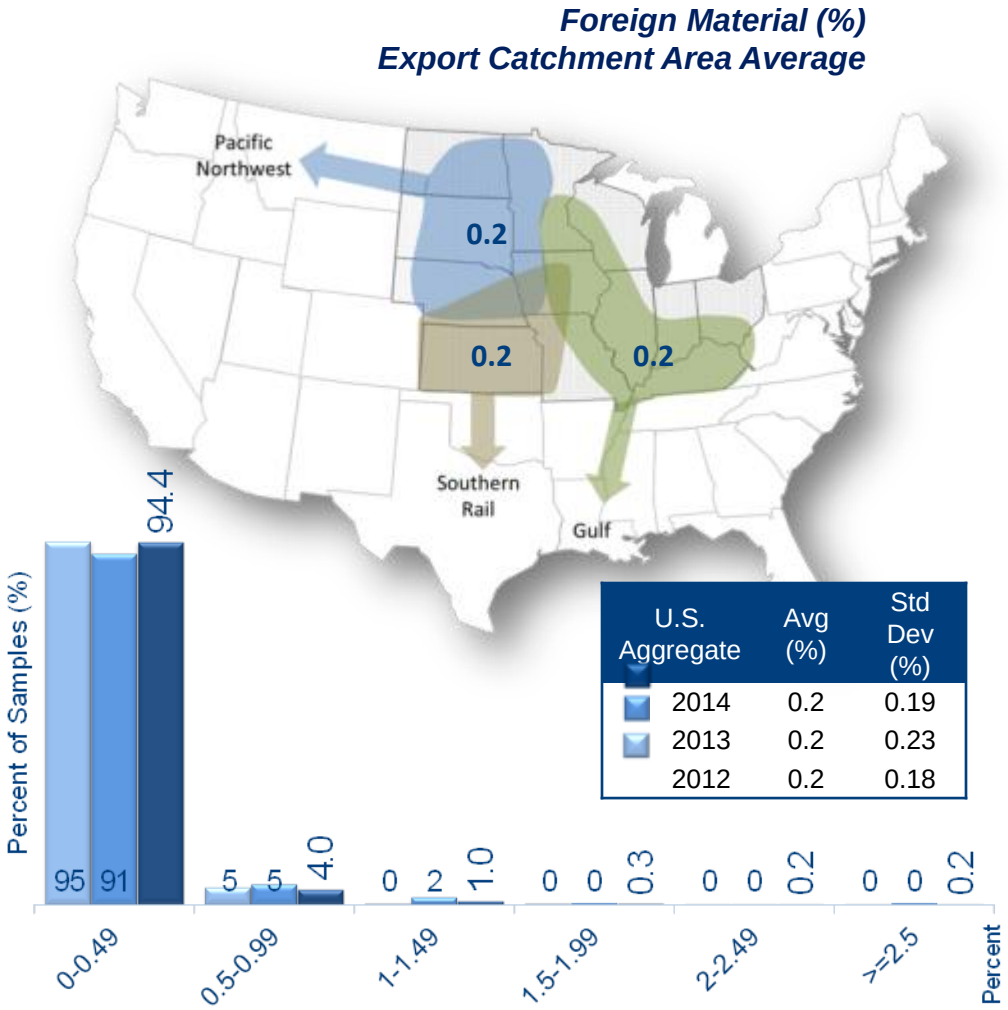
U.S. Aggregate	Avg (%)	Std Dev (%)
2014	0.6	0.36
2013	0.7	0.46
2012	0.7	0.42

U.S. GRAINS COUNCIL

Foreign Material (FM) (%)

U.S. Aggregate: 0.2%

- Low levels indicate minimal cleaning required as corn is entering the market channel
- FM has varied little across ECAs or over the years



U.S. GRAINS COUNCIL

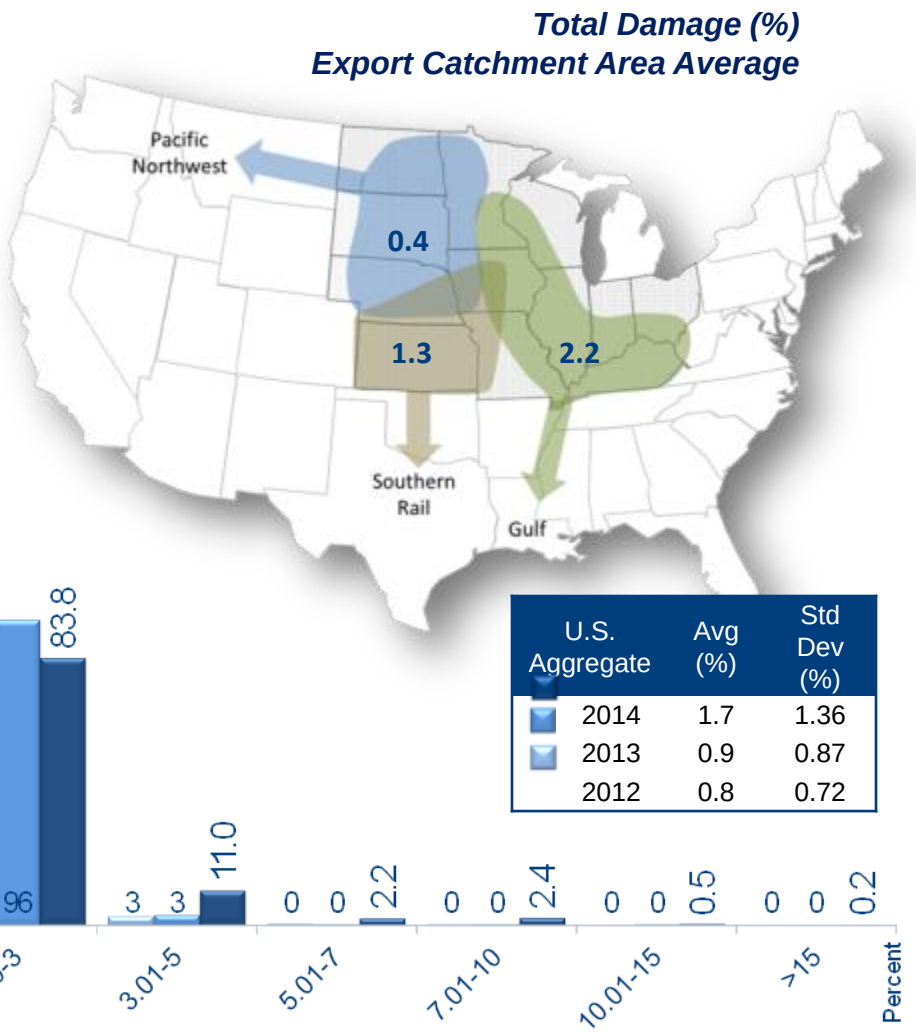
Total Damage and Heat Damage (%)

Total Damage U.S. Aggregate: 1.7%

- 83.8% of samples meet standard for No. 1 grade
- Samples at upper end of range may require special attention to prevent further deterioration
- Pacific Northwest ECA had lowest average of 0.4%

Heat Damage: Zero

- Same as previous years



U.S. GRAINS COUNCIL

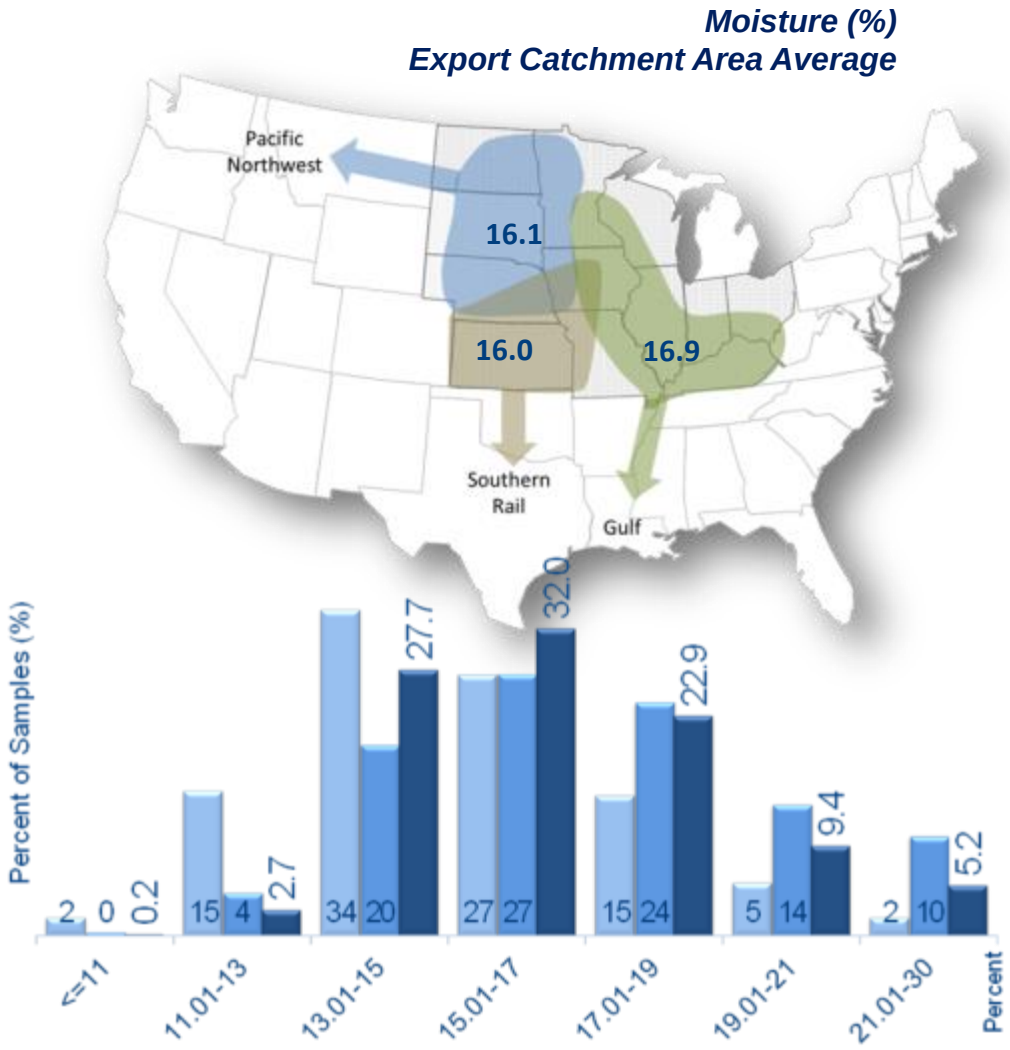
Moisture (%)

Not a grade factor

U.S. Aggregate: 16.6%

- Lower average and variability than 2013, yet higher than 2012
- Average moisture in the Gulf ECA has been consistently higher than the other 2 ECAs for all 3 years

U.S. Aggregate	Avg (%)	Std Dev (%)
2014	16.6	1.84
2013	17.3	2.24
2012	15.3	1.72



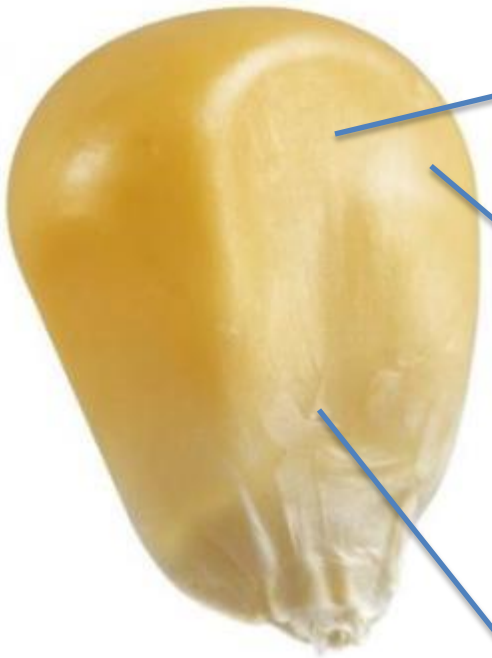
U.S. GRAINS COUNCIL

Chemical Composition

U.S. GRAINS COUNCIL

Chemical Composition

Corn Harvest Quality Report 2014/15



Protein
- Important for poultry and livestock feeding
- Supplies essential amino acids

Influenced by genetics, crop yields and available nitrogen during the growing season

Starch
- Important for wet millers and dry-grind ethanol manufacturers

Oil
- Important by-product of wet and dry milling
- Essential feed component

Influenced by genetics and crop yields

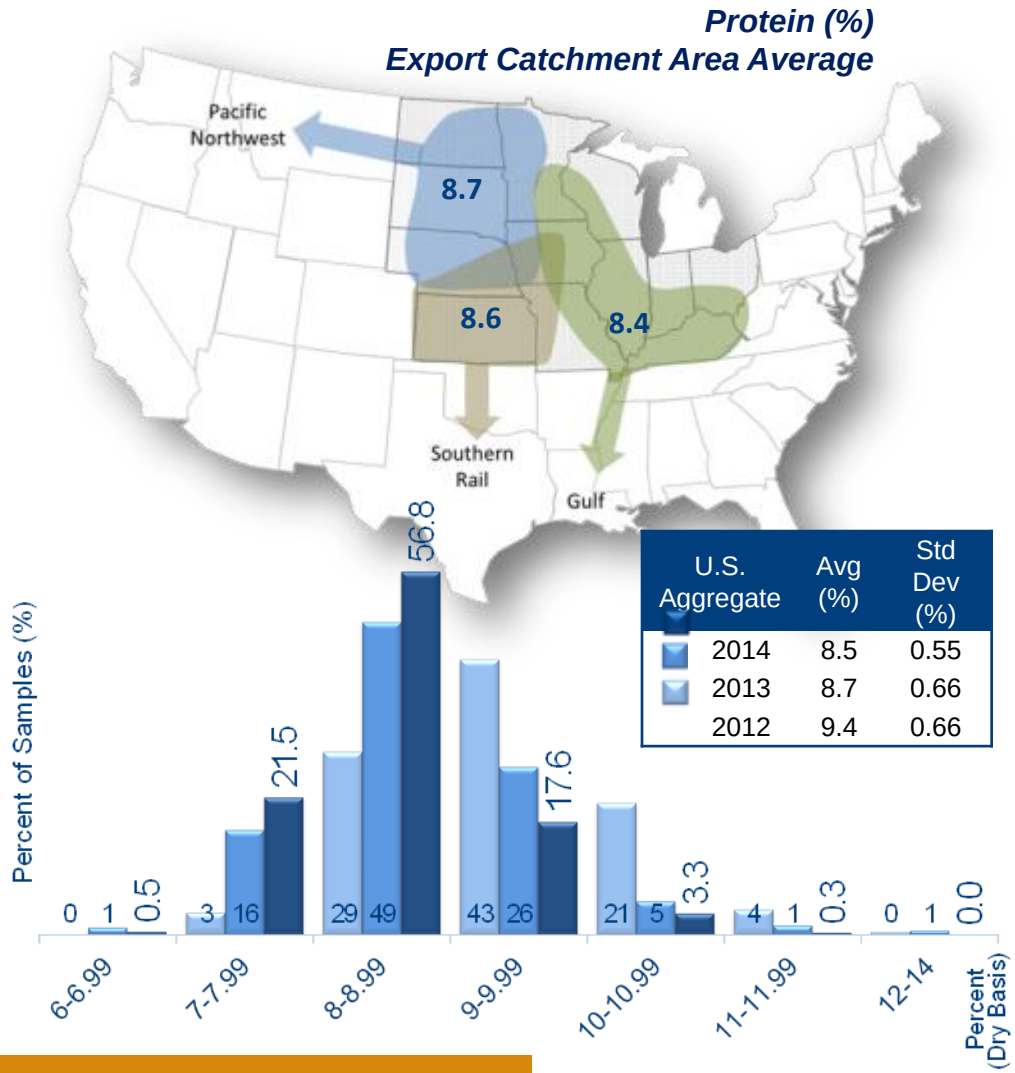
U.S. GRAINS COUNCIL

Protein (Dry basis %)

Corn Harvest Quality Report 2014/15

U.S. Aggregate: 8.5%

- Lower levels in 2014 likely attributable to higher yields
  - For 11 of the 12 surveyed states, when their average yields increased, their average protein concentration decreased



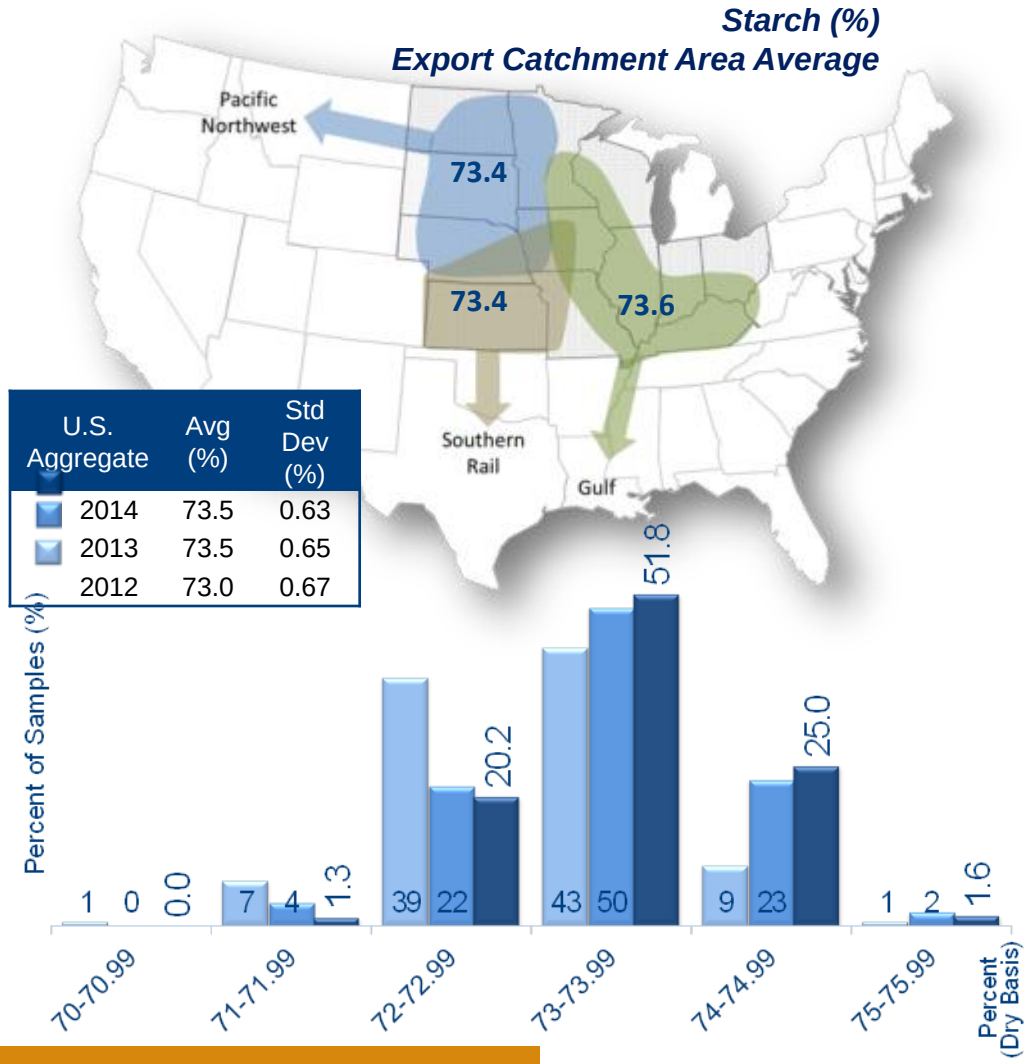
U.S. GRAINS COUNCIL

Starch (Dry basis %)

Corn Harvest Quality Report 2014/15

U.S. Aggregate: 73.5%

- Comparable concentration to 2013 but higher than 2012
- Gulf ECA tends to have higher average starch and lower protein concentration than the Pacific Northwest and Southern Rail ECAs



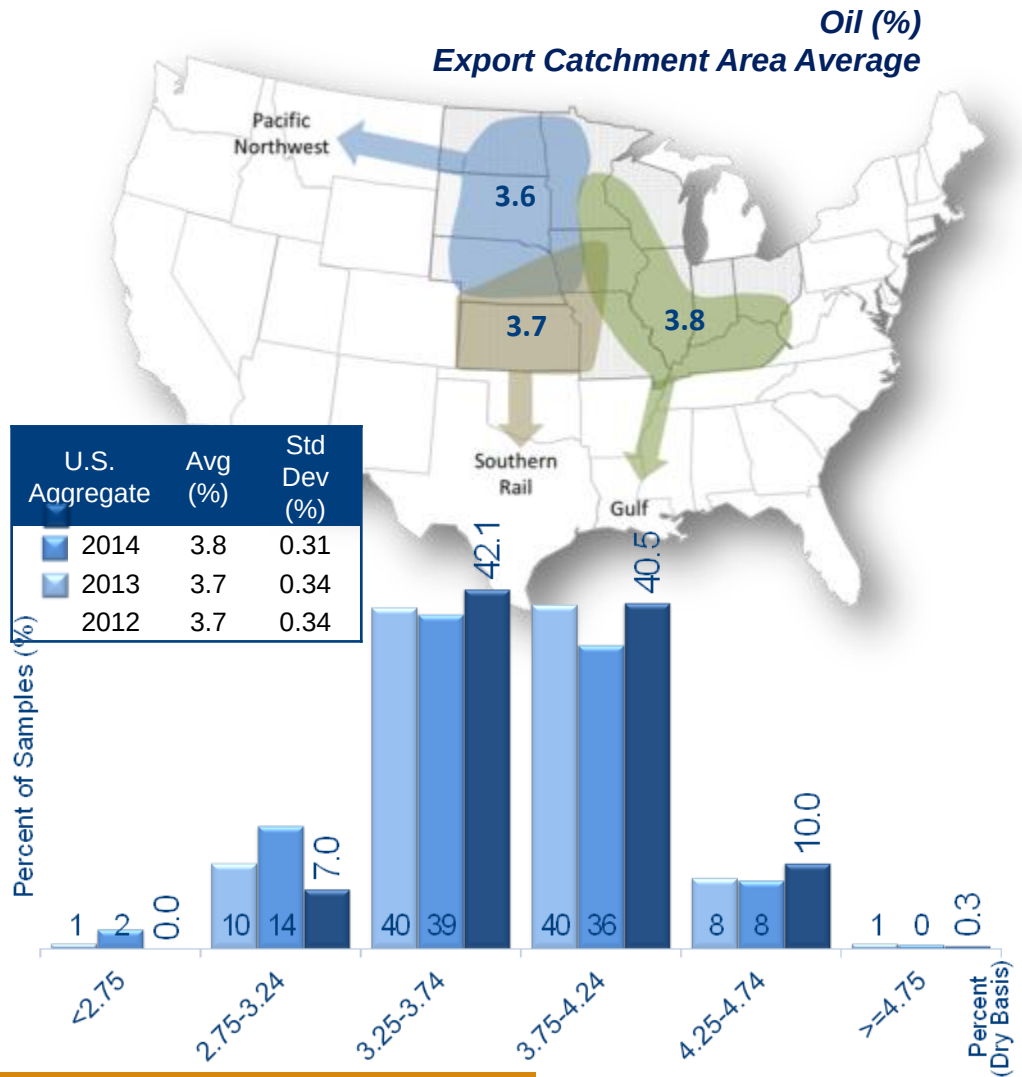
U.S. GRAINS COUNCIL

Oil (Dry basis %)

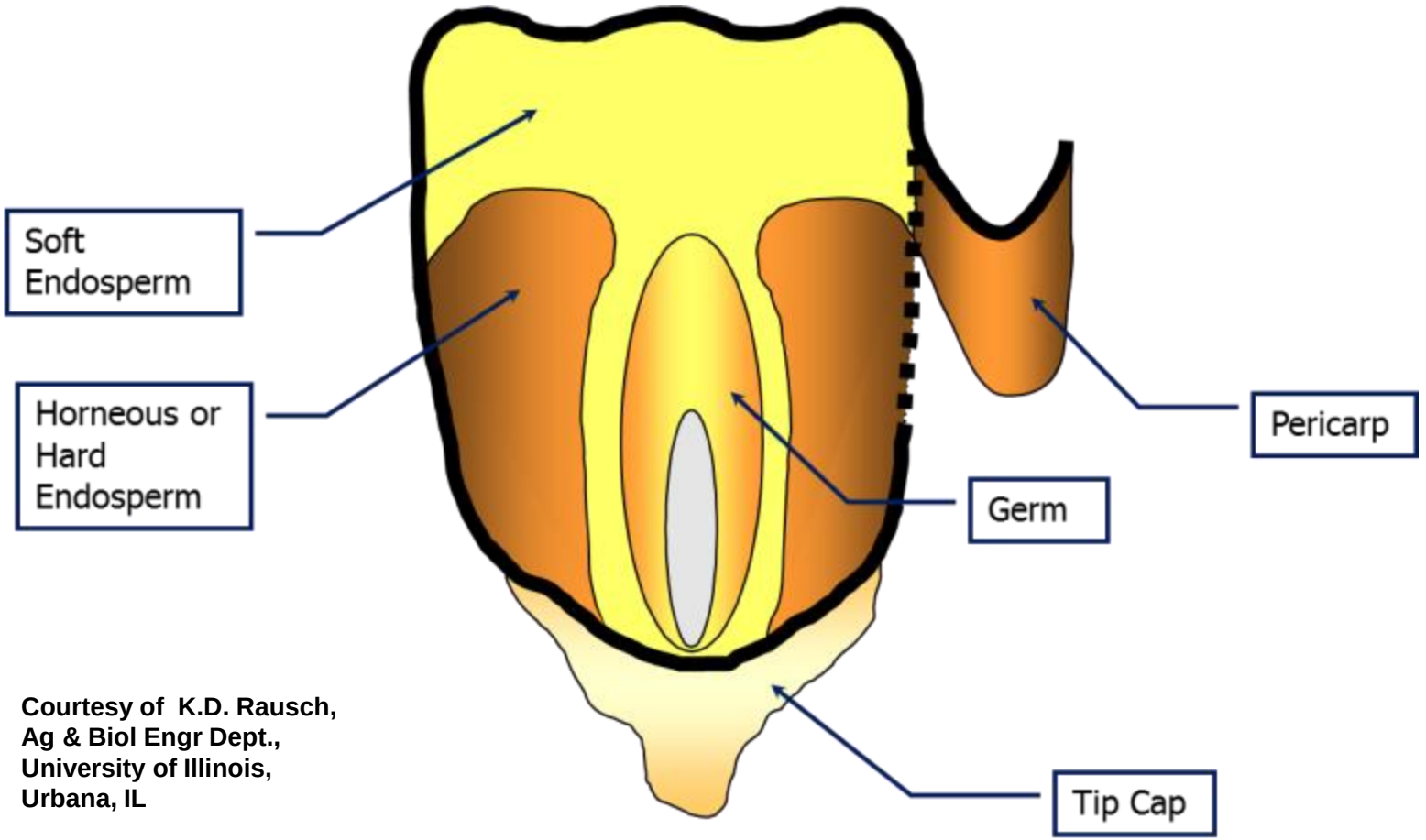
Corn Harvest Quality Report 2014/15

U.S. Aggregate: 3.8%

- Slightly higher concentration than in 2013 and 2012
- Gulf and Southern Rail ECAs had higher average oil concentration than Pacific Northwest ECA in 2014 and 2013



U.S. GRAINS COUNCIL



Courtesy of K.D. Rausch, Ag & Biol Engr Dept., University of Illinois, Urbana, IL

Physical Factors

Physical Factors – Overview

Related to processing characteristics, storability and potential for breakage

- Stress cracks
- Stress cracks index
- Kernel weight, volume and density
- Whole kernels
- Horneous (hard) endosperm

Stress Cracks

- **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)

% kernels with 1 stress crack

X 1

+

% kernels with 2 stress cracks

X 3

+

% kernels with >2 stress cracks

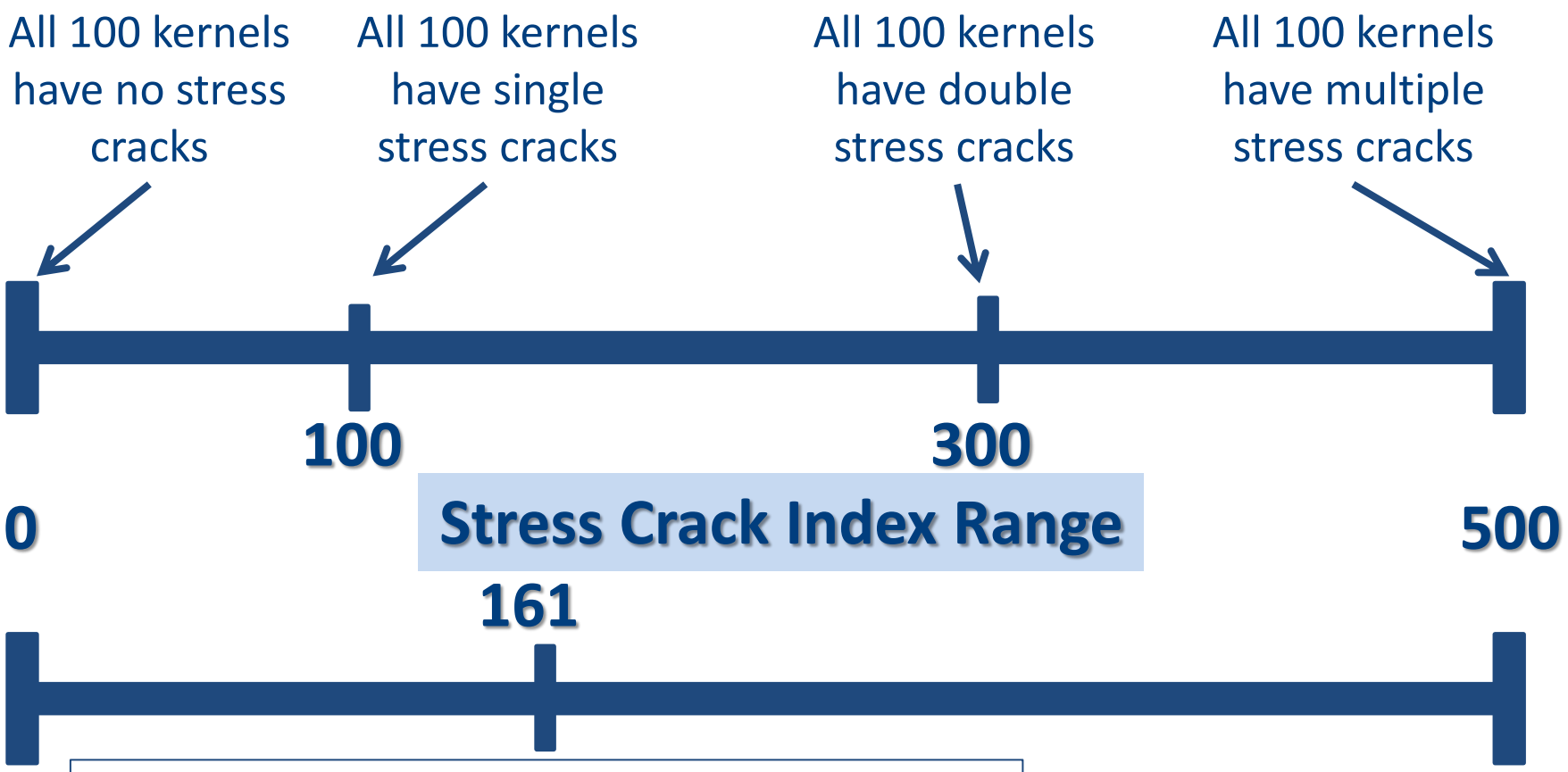
X 5

= SCI

U.S. GRAINS COUNCIL

Magnitude of SCI

Corn Harvest Quality Report 2014/15



Example **SC% = 43%**

SCI Calculation:

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

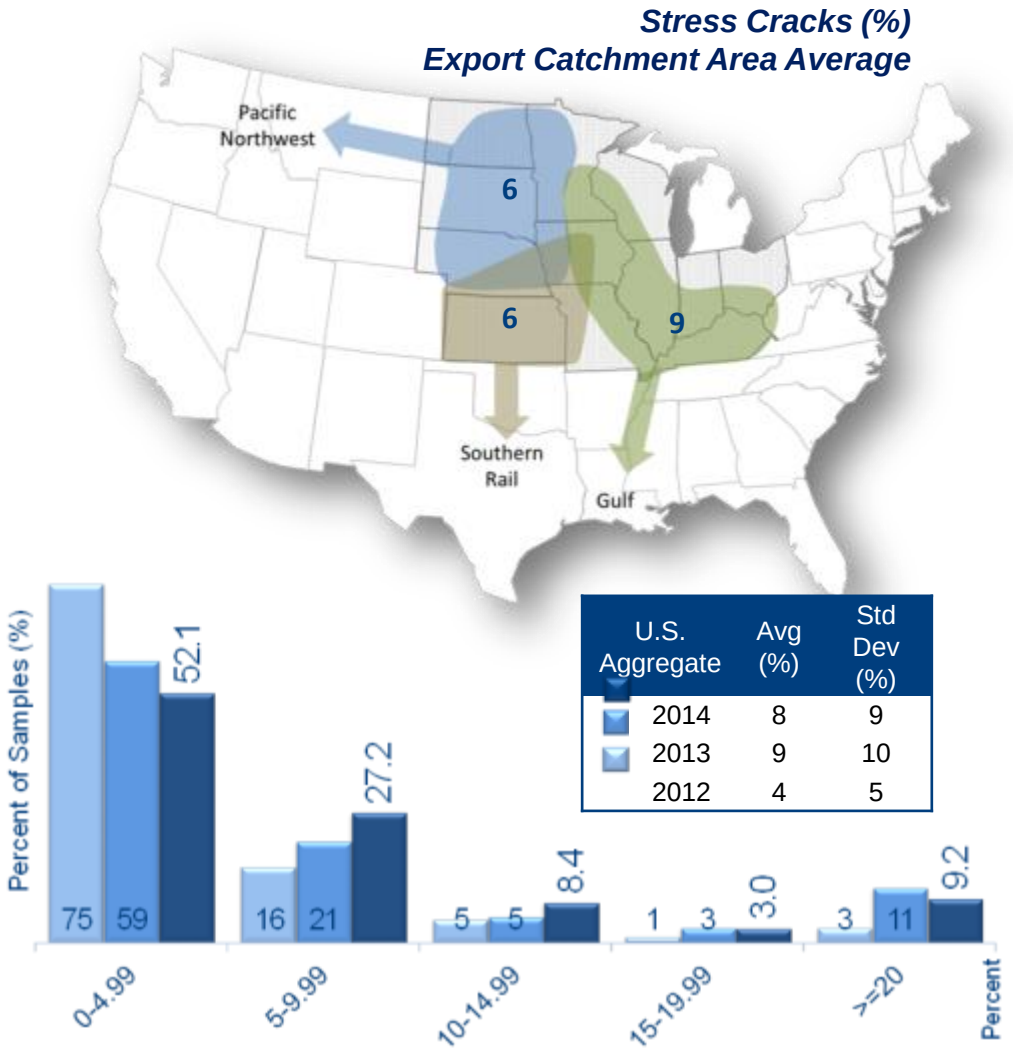
a: 4 kernels
b: 19 kernels
c: 20 kernels

U.S. GRAINS COUNCIL

Stress Cracks (%)

U.S. Aggregate: 8%

- Somewhat lower than 2013 but higher than 3YA
- Southern Rail ECA has had lower stress cracks than Gulf and Pacific Northwest ECAs

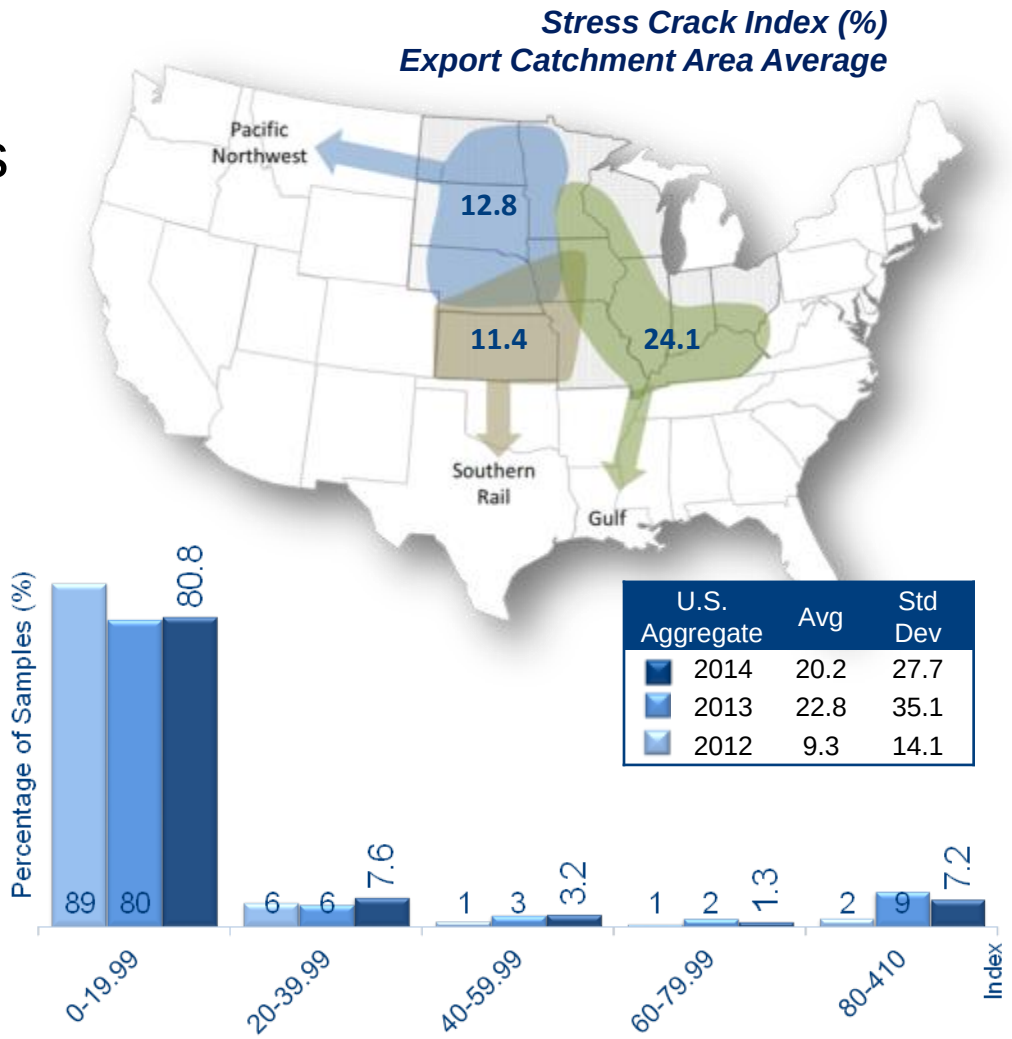


U.S. GRAINS COUNCIL

Stress Crack Index (SCI)

U.S. Aggregate: 20.2

- Similar numbers of kernels with multiple stress cracks to 2013 but more than 2012
- Southern Rail ECA has had the lowest average SCI of the 3 ECAs



U.S. GRAINS COUNCIL

Kernel Weight, Volume, Density

Corn Harvest Quality Report 2014/15

- Measure the size and composition of corn kernels
- Kernel volume is indicative of growing conditions and genetics

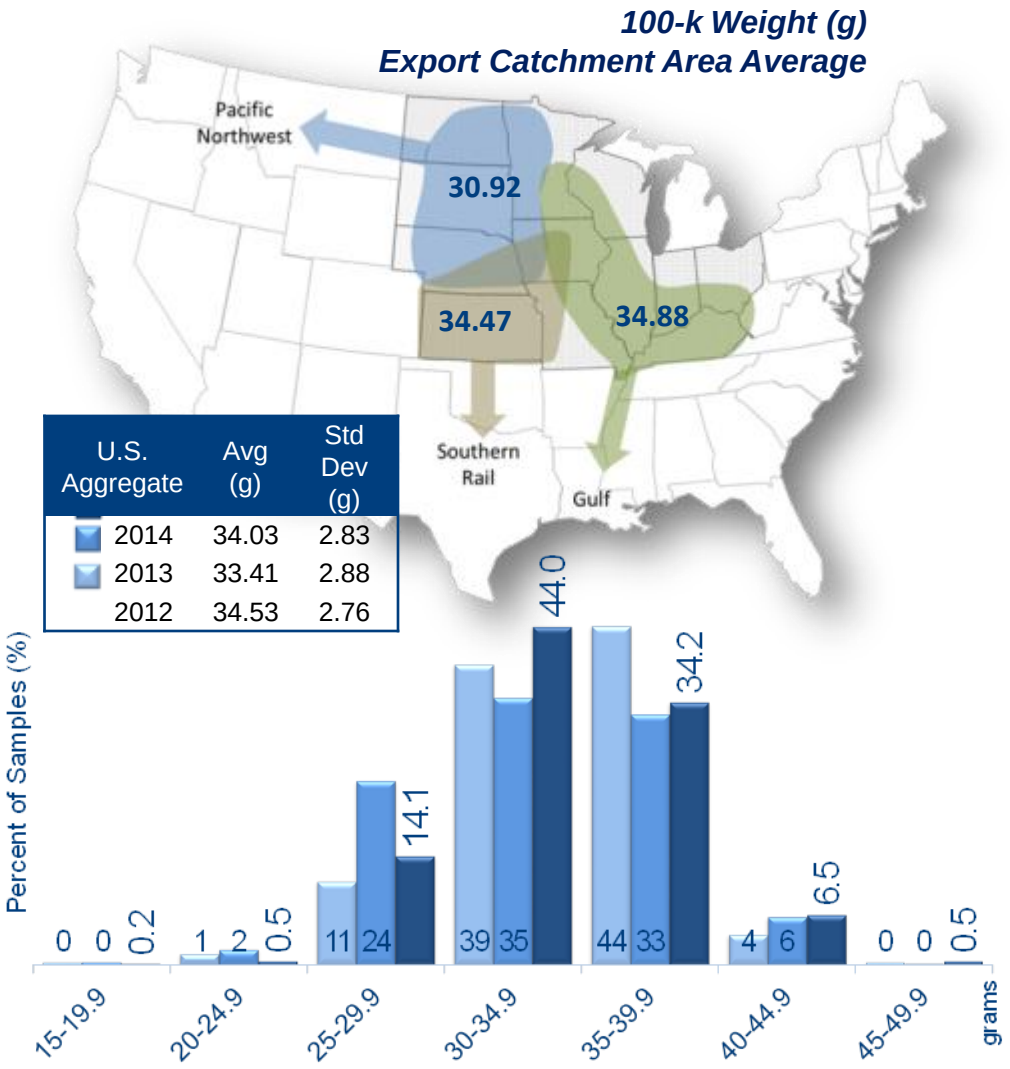
$$\frac{\text{100-Kernel Weight (mass) (g)}}{\text{Kernel Volume (cm}^3\text{)}} = \text{True Density (g/cm}^3\text{)}$$

- 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: 34.03 g

- Higher than 2013 and 3YA averages
- Pacific Northwest ECA has had the lowest 100-k weight of the three ECAs

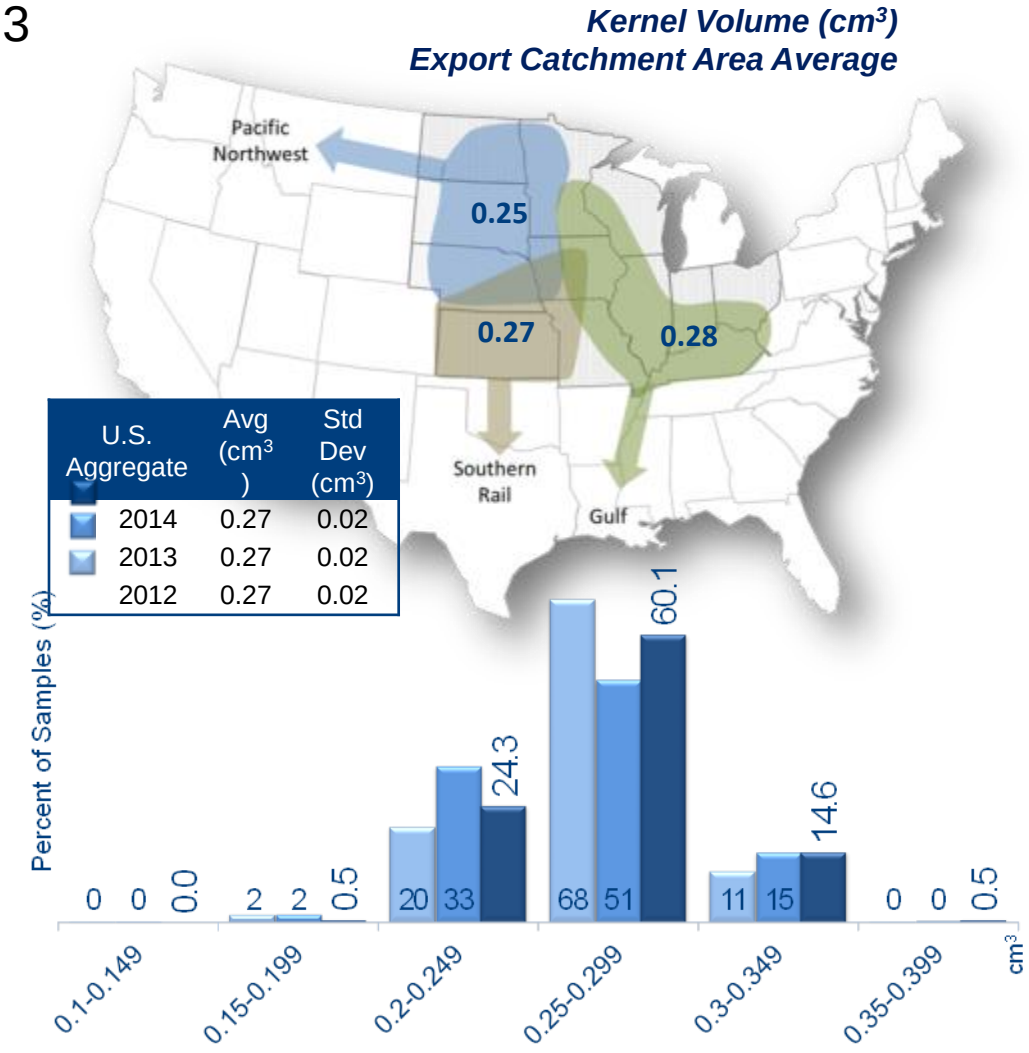


U.S. GRAINS COUNCIL

Kernel Volume (cm^3)

U.S. Aggregate: 0.27 cm^3

- Unchanged from 2013 and 3YA
- Pacific Northwest ECA has had lower kernel volumes than Southern Rail and Gulf ECAs

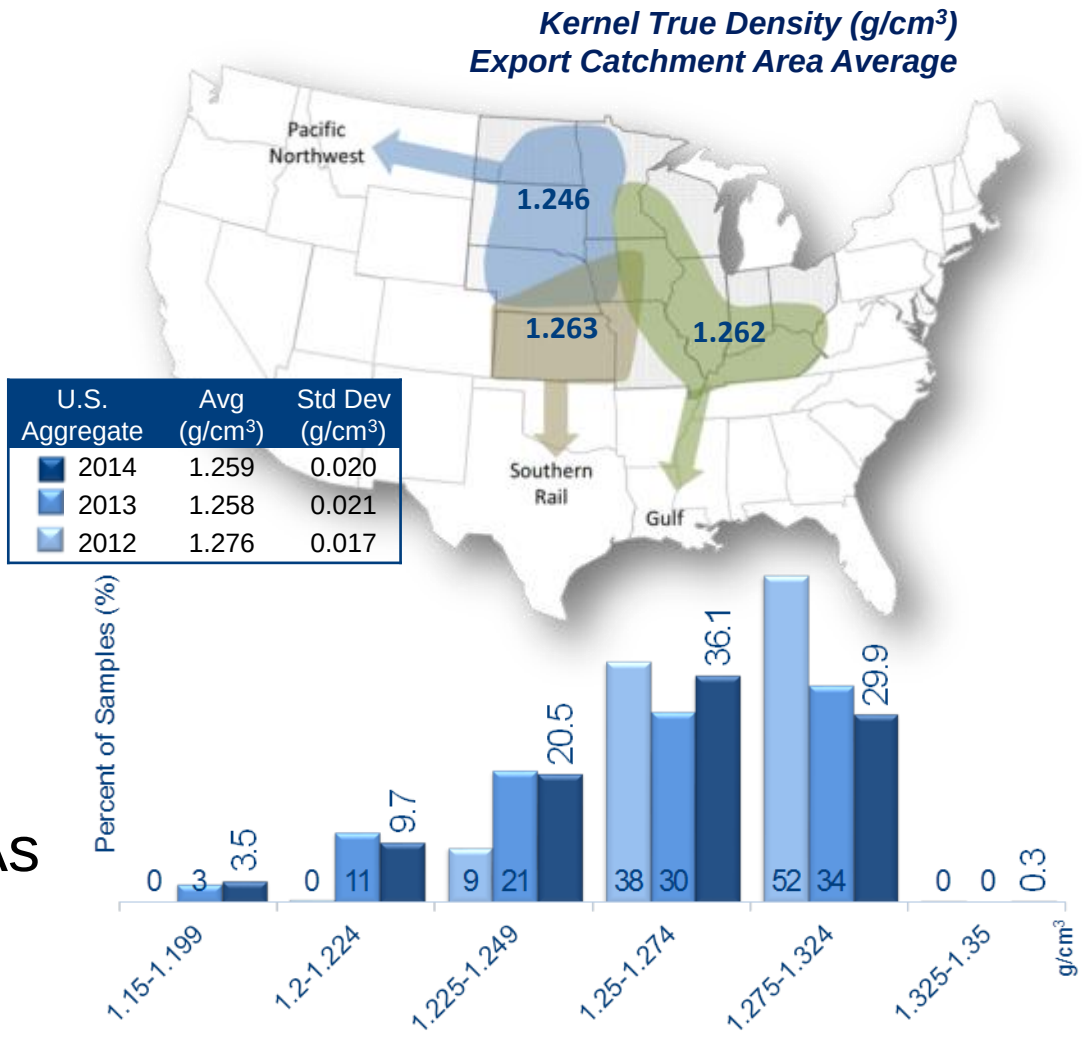


U.S. GRAINS COUNCIL

Kernel True Density (g/cm³)

U.S. Aggregate: 1.259 g/cm³

- Similar to 2013, but lower than 3YA
- Distribution shows a higher percentage of samples with lower true density in 2014 than in 2012 but was similar in softness to 2013
- Pacific Northwest ECA was lowest among ECAs in 2014, 2013 and for 3YA



U.S. GRAINS COUNCIL

Other Physical Properties

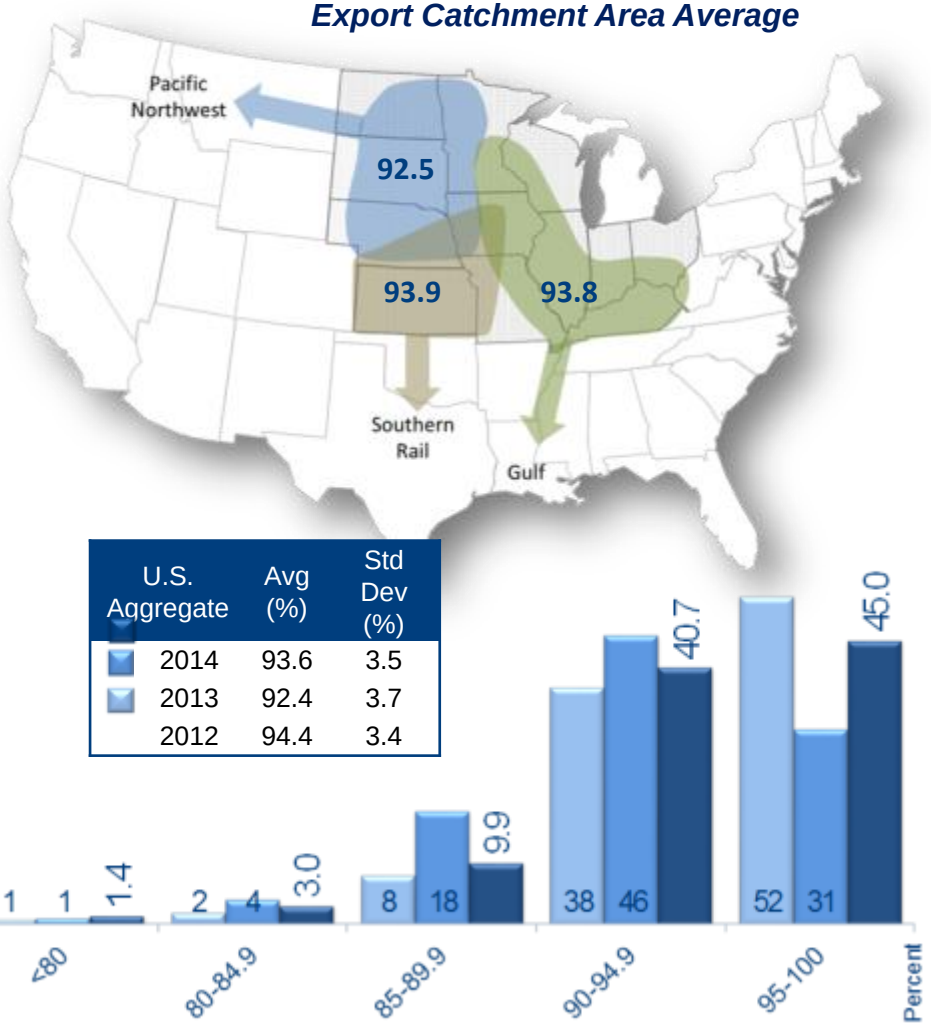
- **Whole kernels (%)**
  - Percentage of whole kernels of a 50 g sample
  - 'Broken Corn' in BCFM measures only kernel size, not whether it is broken or whole
  - Impacts alkaline cooking operations and susceptibility to mold invasion and breakage
- **Horneous (hard) endosperm (%)**
  - Measures the 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: 93.6%

- Significantly higher whole kernels than in 2013 and similar to 3YA
- The 3YA of each ECA illustrates little variation among the 3 ECAs

Whole Kernels (%)
Export Catchment Area Average

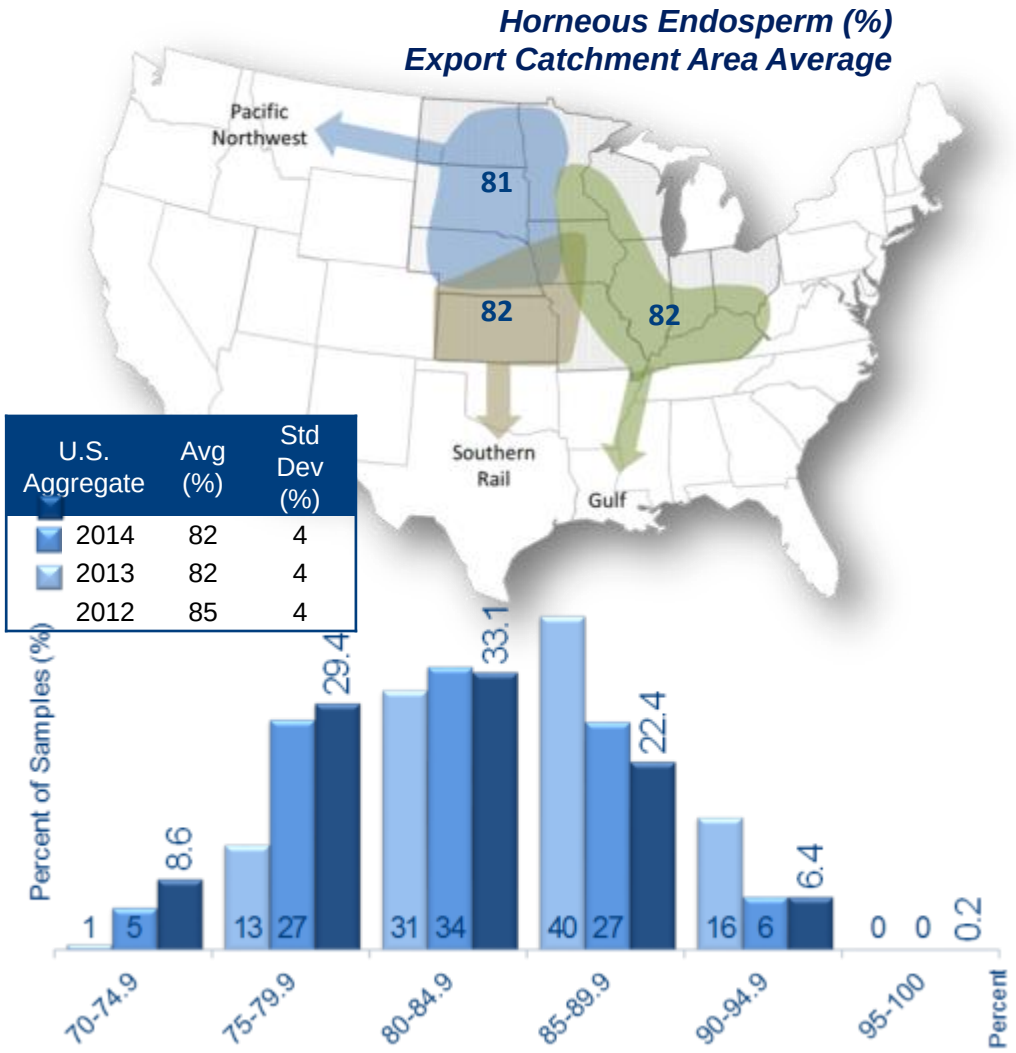


U.S. GRAINS COUNCIL

Horneous (Hard) Endosperm (%)

U.S. Aggregate: 82%

- Same as 2013 and lower than 3YA
- Pacific Northwest ECA had lowest horneous endosperm in 2014, 2013 and for 3YA
  - Similar pattern for true density



U.S. GRAINS COUNCIL

Mycotoxins: Aflatoxins and DON

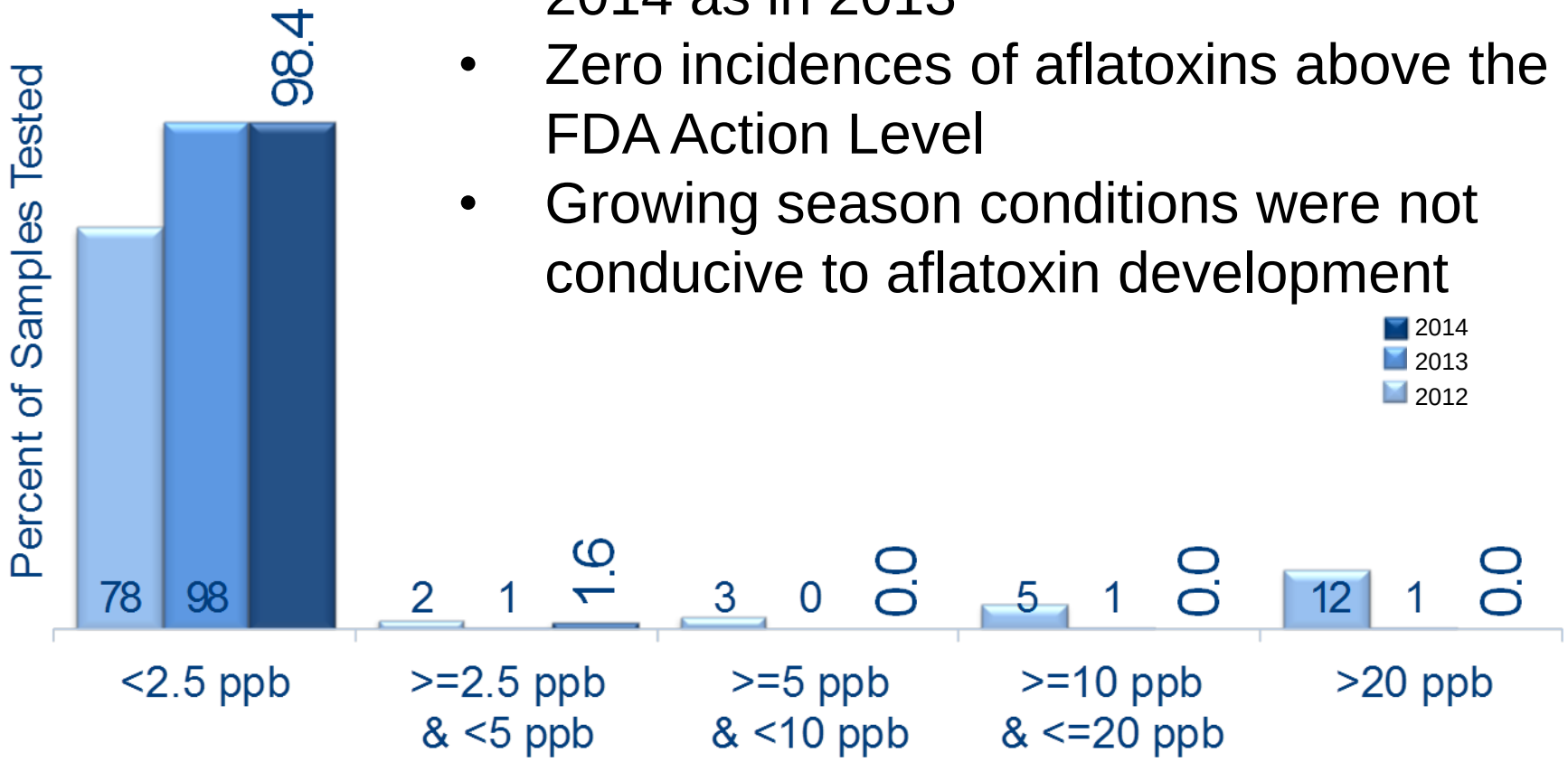
U.S. GRAINS COUNCIL

Mycotoxin Testing

- *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
- Tested a minimum of 25% of collected samples, same as in 2013 and 2012
- Positive results if above Limit of Detection (LOD)
  - Aflatoxins: 2.5 ppb
  - DON: 0.3 ppm

Aflatoxins Testing Results

- About the same percent of samples had no detectable levels of aflatoxins in 2014 as in 2013
- Zero incidences of aflatoxins above the FDA Action Level
- Growing season conditions were not conducive to aflatoxin development

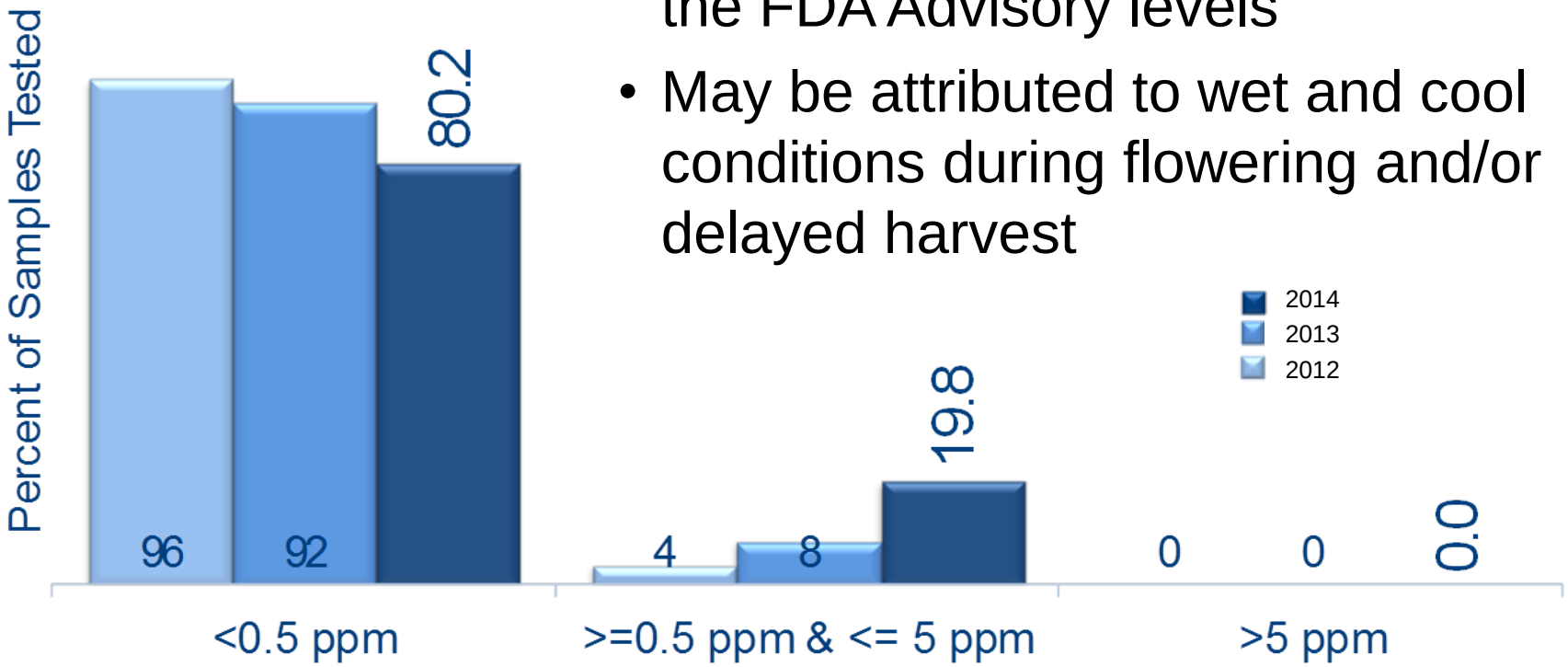


U.S. GRAINS COUNCIL

DON Testing Results

Corn Harvest Quality Report 2014/15

- Smaller percentage below 0.5 ppm in 2014 than in 2013 and 2012
- Zero incidences of DON exceeding the FDA Advisory levels
- May be attributed to wet and cool conditions during flowering and/or delayed harvest



U.S. GRAINS COUNCIL

Other Components of the Corn Harvest Quality Report

U.S. GRAINS COUNCIL

Other Features of the Report

- US Corn Production, Usage and Outlook
- Survey and Statistical Analysis Methods
- Testing Analysis Methods

Harvest Report: Conclusions

Corn Harvest Quality Report 2014/15

- 2014 harvest samples were, on average, good with 88% grading No. 2 or better
- Higher yields resulted in lower protein. This was accompanied by high starch and slightly higher oil concentration
- Late start to the growing season and harvest conditions contributed to higher average moisture contents than in 2012, higher total damage, and stress cracks similar to but slightly lower than 2013
- True density, horneous endosperm and test weight were all lower than 3YA, indicating a softer corn; still, a good supply of corn suitable for dry milling available
- Low levels of BCFM and high percent of whole kernels will help decrease susceptibility to storage problems and enhance processability
- Growing season was not conducive to aflatoxin development but may have contributed to greater incidences of DON

Building a Tradition: Thank You!

U.S. GRAINS COUNCIL

Developing markets. >> Enabling trade. >> Improving lives.

SUPPLEMENTAL SLIDES:
U.S. Grains Council Corn Harvest Quality Report 2014/15

U.S. GRAINS COUNCIL

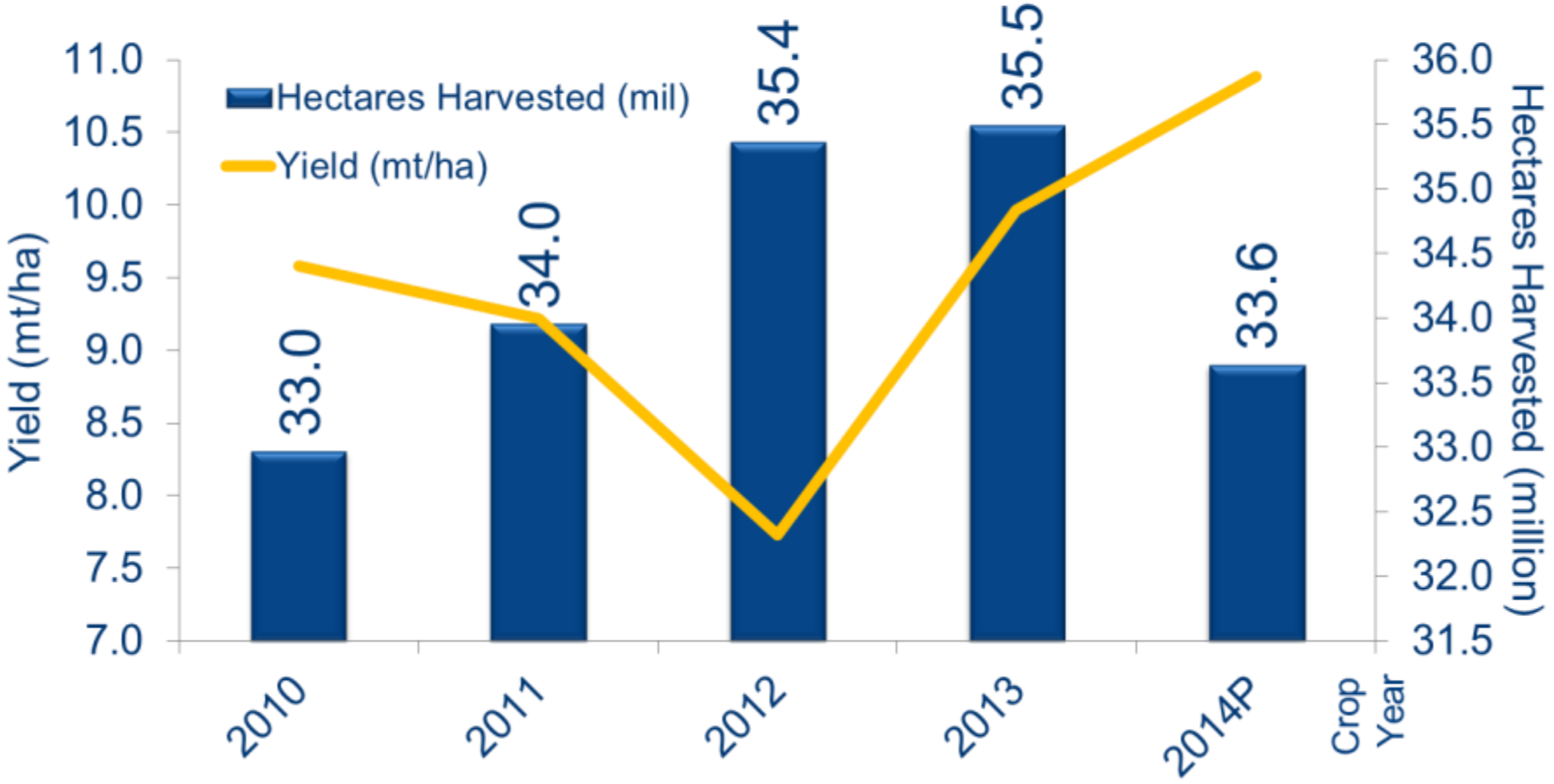
Developing markets. >> Enabling trade. >> Improving lives.

U.S. Corn Production, Supply & Demand Outlook

U.S. GRAINS COUNCIL

U.S. Corn Production and Yield

Corn Harvest Quality Report 2014/15



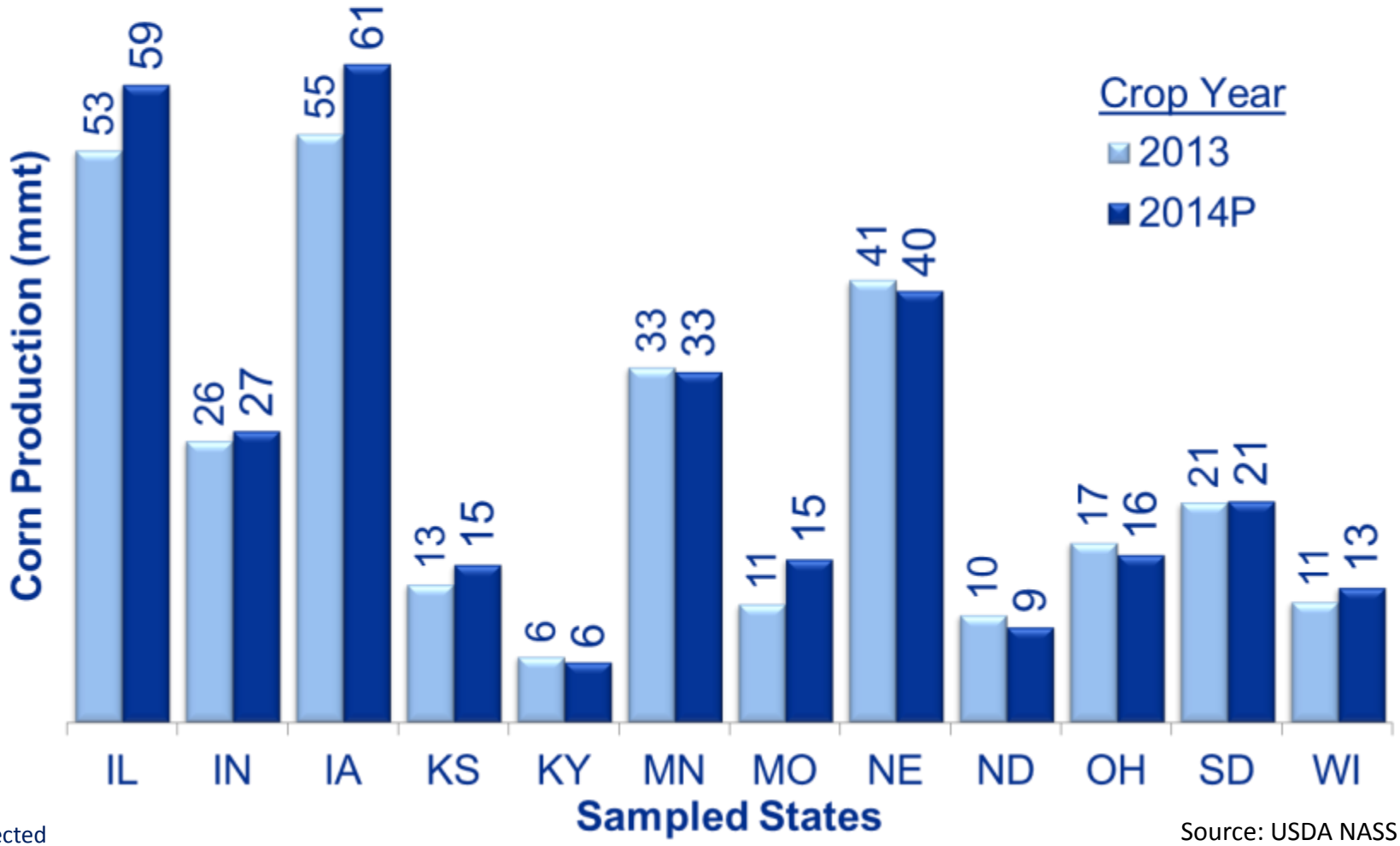
P=Projected

Source: USDA NASS

U.S. GRAINS COUNCIL

Surveyed State Production

Corn Harvest Quality Report 2014/15



P=Projected

Source: USDA NASS

U.S. GRAINS COUNCIL

Surveyed State Production

Corn Harvest Quality Report 2014/15

State	2013	2014P	Difference MMT	Difference Percent	Relative % Change* Acres	Relative % Change* Yield
Illinois	53	59	6	11%		
Indiana	26	27	1	3%		
Iowa	55	61	6	12%		
Kansas	13	15	2	14%		
Kentucky	6	6	(1)	-9%		
Minnesota	33	33	(0)	-1%		
Missouri	11	15	4	38%		
Nebraska	41	40	(1)	-2%		
North Dakota	10	9	(1)	-11%		
Ohio	17	16	(1)	-7%		
South Dakota	21	21	0	1%		
Wisconsin	11	13	1	12%		
Total	354	366	12	3%		

*Green indicates 2014 is higher than 2013 and red indicates 2014 is lower than 2013; bar height indicates the relative amount.

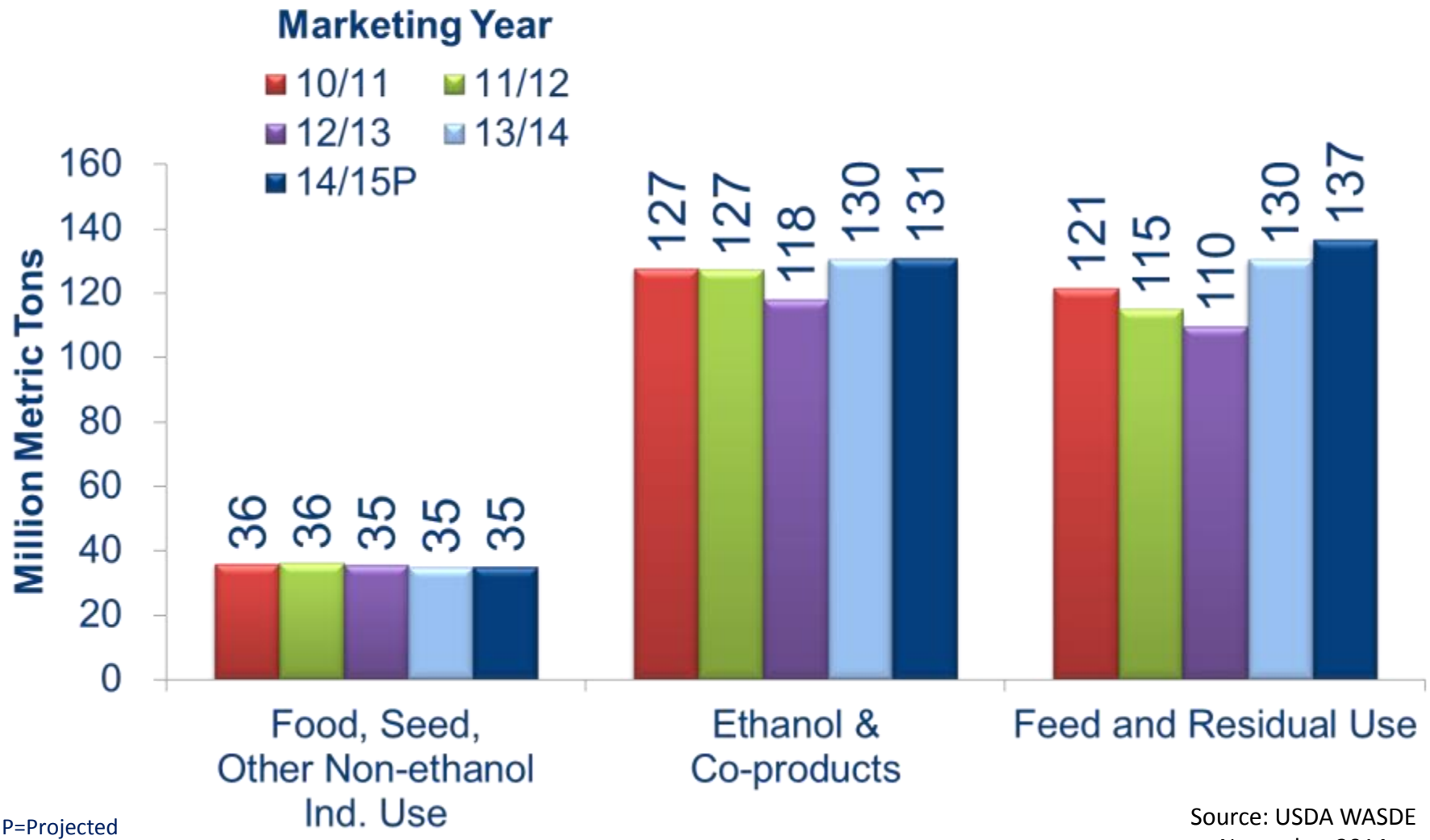
P=Projected

Source: USDA NASS

U.S. GRAINS COUNCIL

U.S. Corn Production and Use

Corn Harvest Quality Report 2014/15



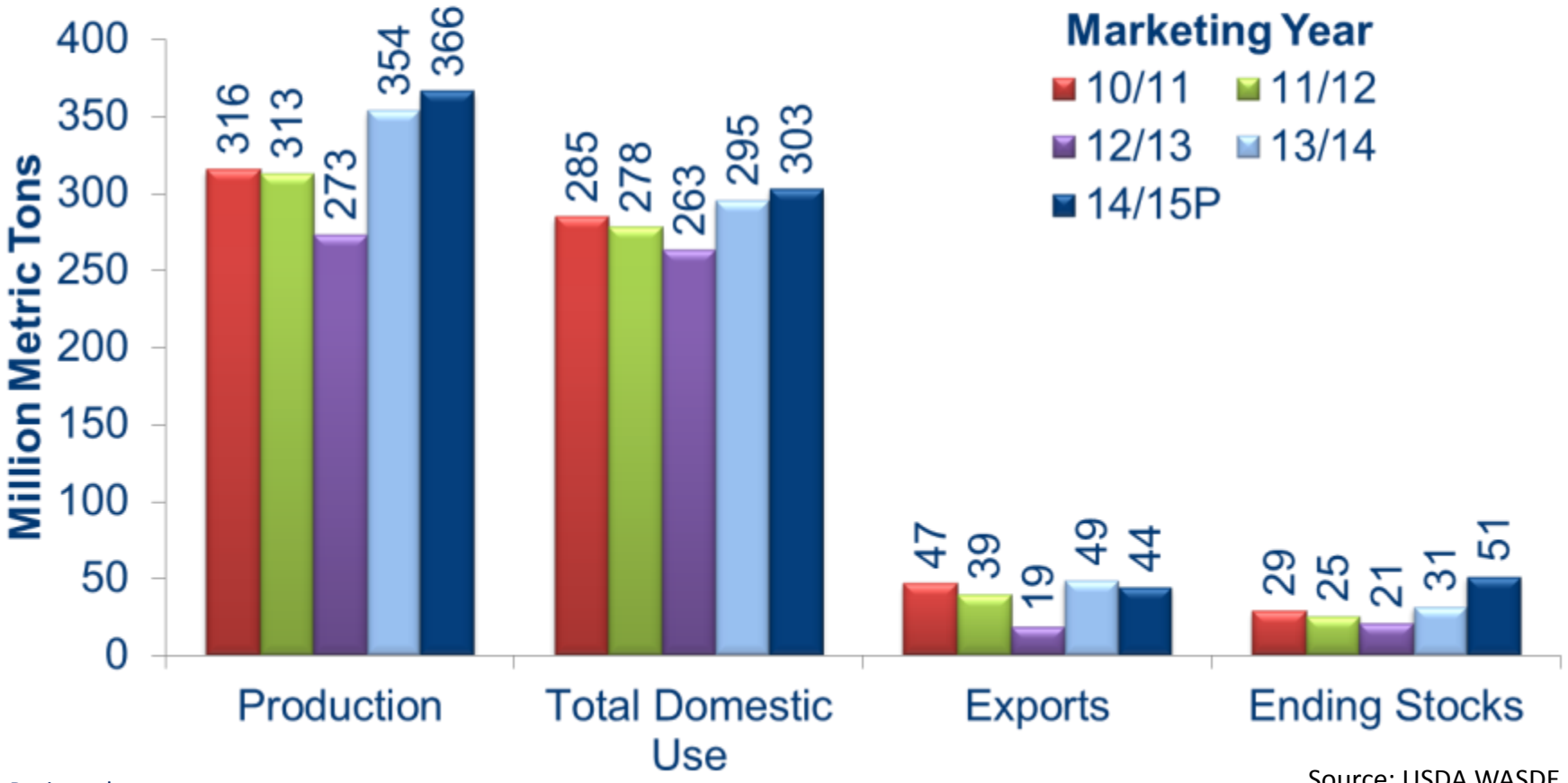
P=Projected

Source: USDA WASDE November 2014

U.S. GRAINS COUNCIL

U.S. Domestic Corn Use

Corn Harvest Quality Report 2014/15



P=Projected

Source: USDA WASDE November 2014

U.S. GRAINS COUNCIL

U.S. Corn Supply and Usage Summary

Corn Harvest Quality Report 2014/15

	10/11	11/12	12/13	13/14	14/15P
Acreage (million hectares)					
Planted	35.7	37.2	39.4	38.6	36.8
Harvested	33.0	34.0	35.4	35.5	33.6
Yield (mt/ha)	9.6	9.2	7.7	10.0	10.9
Supply (million metric tons)					
Beginning Stocks	43.4	28.6	25.1	20.9	31.4
Production	315.6	312.8	273.2	353.7	366.0
Imports	0.7	0.7	4.1	0.9	0.6
Total Supply	359.7	342.2	302.4	375.5	398.0
Usage (million million metric tons)					
Food, seed, other non-ethanol ind. use	35.7	36.1	35.5	34.6	35.2
Ethanol and co-products	127.5	127.0	117.9	130.4	130.8
Feed and residual	121.3	114.8	109.6	130.4	136.5
Exports	46.5	39.1	18.5	48.7	44.5
Total Use	331.1	317.1	281.5	344.1	347.0
Ending Stocks	28.6	25.1	20.9	31.4	51.0
Average Farm Price ($/mt*)	203.93	244.87	271.25	175.58	122.04-145.66

P-Projected

* Farm prices are weighted averages based on volume of farm shipment

Average farm price for 14/15P based on WASDE November projected price

Source: USDA WASDE November 2014

U.S. GRAINS COUNCIL

U.S. Corn Supply and Usage Summary

Corn Harvest Quality Report 2014/15

	10/11	11/12	12/13	13/14	14/15P
Acreage (million acres)					
Planted	88.2	91.9	97.3	95.4	90.9
Harvested	81.4	83.9	87.4	87.7	83.1
Yield (bu/ac)	152.6	146.8	123.1	158.8	173.4
Supply (million bushels)					
Beginning Stocks	1,708	1,128	989	821	1,236
Production	12,425	12,314	10,755	13,925	14,407
Imports	28	29	160	36	25
Total Supply	14,161	13,471	11,904	14,782	15,668
Usage (million bushels)					
Food, seed, other non-ethanol ind. Use	1,407	1,421	1,397	1,363	1,385
Ethanol and co-products	5,019	5,000	4,641	5,134	5,150
Feed and residual	4,777	4,520	4,315	5,132	5,375
Exports	1,831	1,541	730	1,917	1,750
Total Use	13,033	12,482	11,083	13,546	13,660
Ending Stocks	1,128	989	821	1,236	2,008
Average Farm Price ($/bu*)	5.18	6.22	6.89	4.46	3.10-3.70

P-Projected

* Farm prices are weighted averages based on volume of farm shipment

Average farm price for 14/15P based on WASDE November projected price

Source: USDA WASDE November 2014

U.S. GRAINS COUNCIL