

U.S. Grains Council 2015/2016 Sorghum Harvest Quality



U.S. GRAINS
COUNCIL

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

Mission

- Developing markets, enabling trade, improving lives

Reports

- Help buyers make better informed decisions
- Increase confidence in the capacity and reliability of the market
- Assist nations around the world in achieving food security through trade

Committed to global food security and mutual economic benefit through trade

- Excellence in Exports
- Growing the value of trade
- Promoting food security and economic growth
- Adding valuable expertise
- Nurturing reliable trade policies

Motivation

- Lack of information on quality of U.S. sorghum
- Growth of U.S. sorghum exports
- Success of USGC Corn Quality Reports

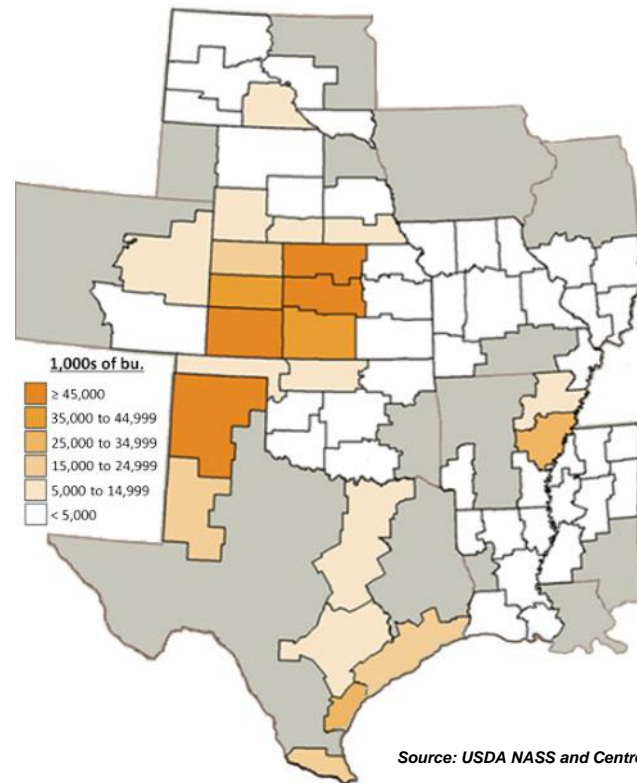
Objective

- To provide information proactively on the U.S. sorghum crop to international buyers
 - Harvest
 - Early exports

U.S. Production by ASD (2015P)

The geographic areas included in the Harvest sampling area include the highest sorghum-producing regions in the United States

This map represents projected 2015 sorghum production by USDA Agricultural Statistical District (ASD) and was used to allocate the 2015 sampling



Source: USDA NASS and Centrec Estimates

Early Harvest Quality Report

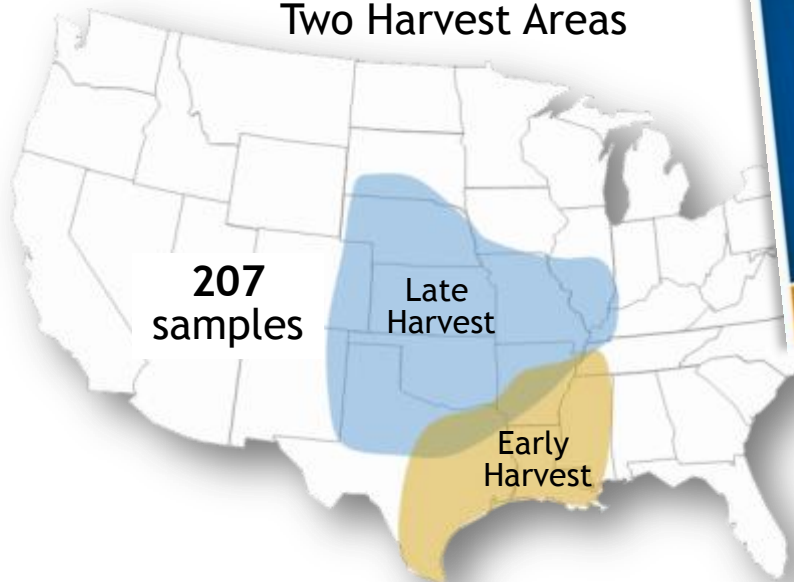


Initial look at crop quality from early harvest areas

50 samples collected during August and September

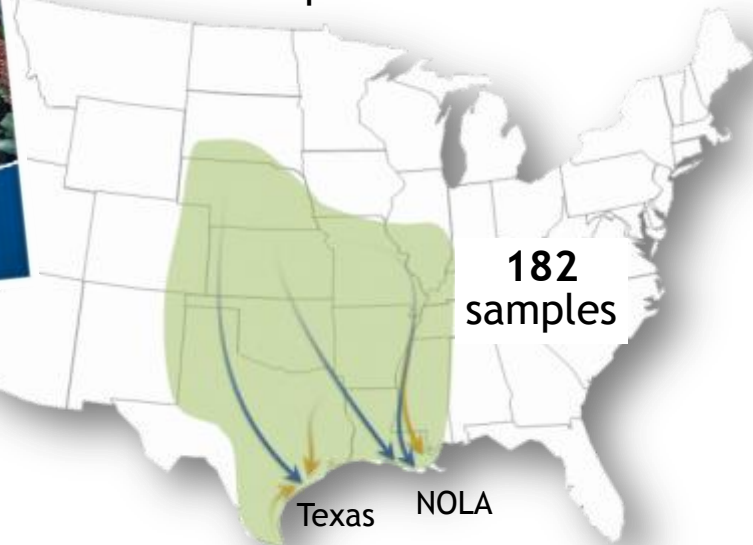
Harvest and Export Cargo Report

Harvest
U.S. Aggregate
Plus
Two Harvest Areas

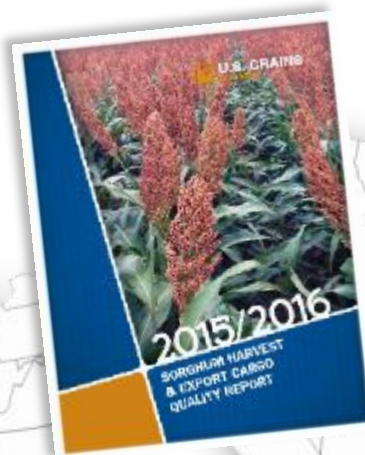


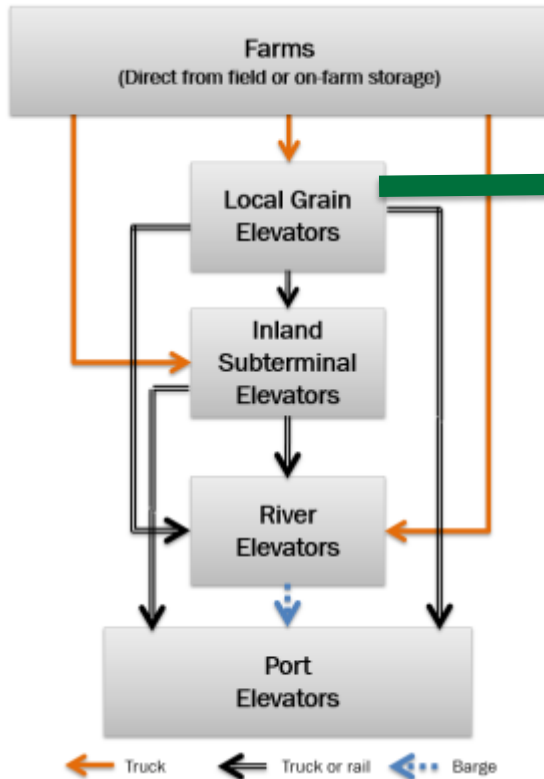
Quality across key production areas

Export Cargo
U.S. Aggregate
Plus
Two Export Outlets



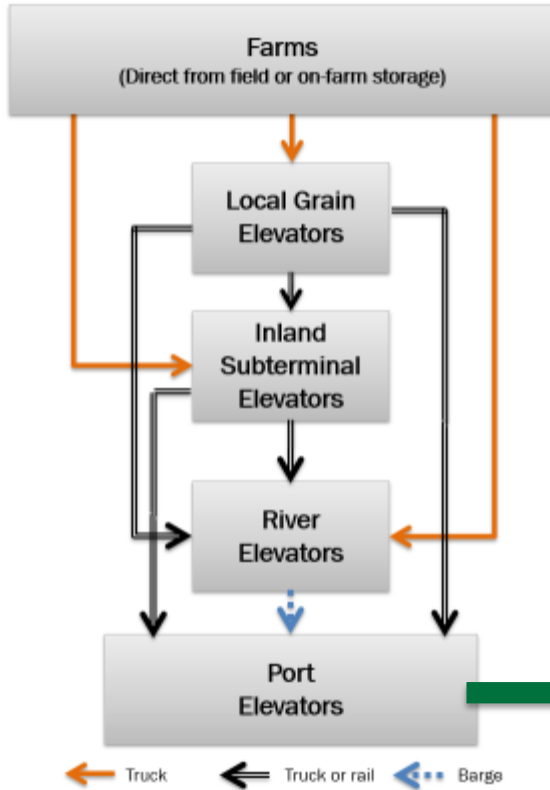
Export quality early in marketing year





Harvest Sampling

- Initial levels and variability of quality characteristics across the diverse geographic regions
- Inbound, unblended commodity samples from local elevators



Export Sampling

- Initial levels and variability of early export quality at ports
- Commodity sorghum samples collected by USDA at key export outlets

Quality Factors Tested

Grading Factors

Test weight
Broken kernel/foreign material
Foreign material
Total damage/Heat damage

Physical Factors

Kernel diameter
1000-kernel weight
Kernel volume
True density
Kernel hardness index

Moisture

Chemical Composition

Protein
Starch
Oil
Tannins

Mycotoxins

Aflatoxins
DON

2015 Growing Conditions and Impact on Crop Development

Relatively below normal or normal temperatures; abundant rains

Planting

Delayed early season planting progress

Early Harvest Area
Continued moist conditions through early pollination period

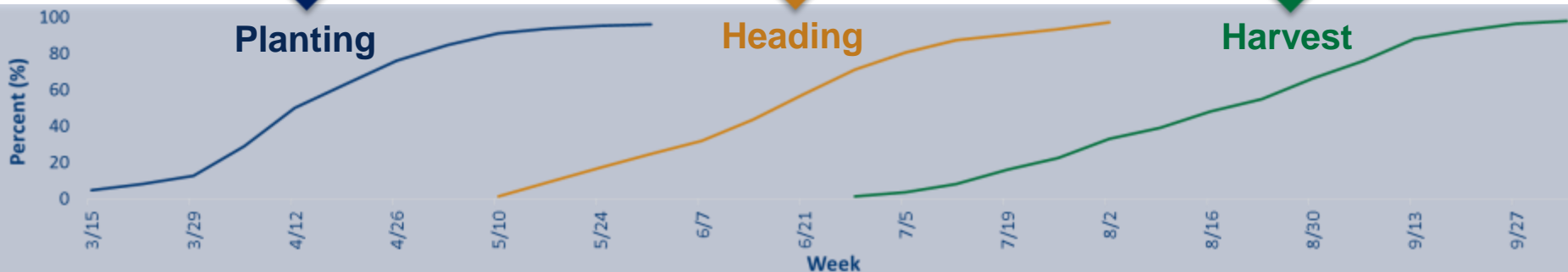
Heading

Slowed vegetative development and increased nutrient losses

Drier and warm conditions

Harvest

Hastened crop maturity; harvest progress was later than normal due to the crop's delayed start



2015 Growing Conditions and Impact on Crop Development

Late Harvest Area

Conditions changed from very wet to dry

Warm and dry September and October



Delayed planting progress

Shortened the grain fill period and accelerated maturity

Despite the crop's delayed planting, harvest progress comparable to 5YA

Grade Factors

- Average for all factors exceeded criteria for U.S. No. 1 grade

Chemical Composition

- Typical protein, starch, and oil concentrations compared to previous research
- All samples were considered tannin-free

Moisture

- Moisture recorded at the elevator averaged 14.1%

Physical Factors

- On average, U.S. Harvest Aggregate had less volume than typical for kernels from any sorghum crop
- Typical kernel diameter, weight, true density and hardness for any commercial sorghum hybrid sample

Aflatoxins

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

DON

- All samples tested below the FDA advisory level



Grade Factors and Moisture

Grades and Grade Requirements

Grade	Min. Test Weight per Bushel (Pounds)	----- Maximum Limits of -----			
		Heat Damaged (%)	Total Damage (%)	Foreign Material (part of total) (%)	Broken Kernel and Foreign Material (%)
U.S. No. 1	57.0	0.2	2.0	1.0	3.0
U.S. No. 2	55.0	0.5	5.0	2.0	6.0
U.S. No. 3	53.0	1.0	10.0	3.0	8.0
U.S. No. 4	51.0	3.0	15.0	4.0	10.0

Source: USDA Federal Grain Inspection Service (FGIS)

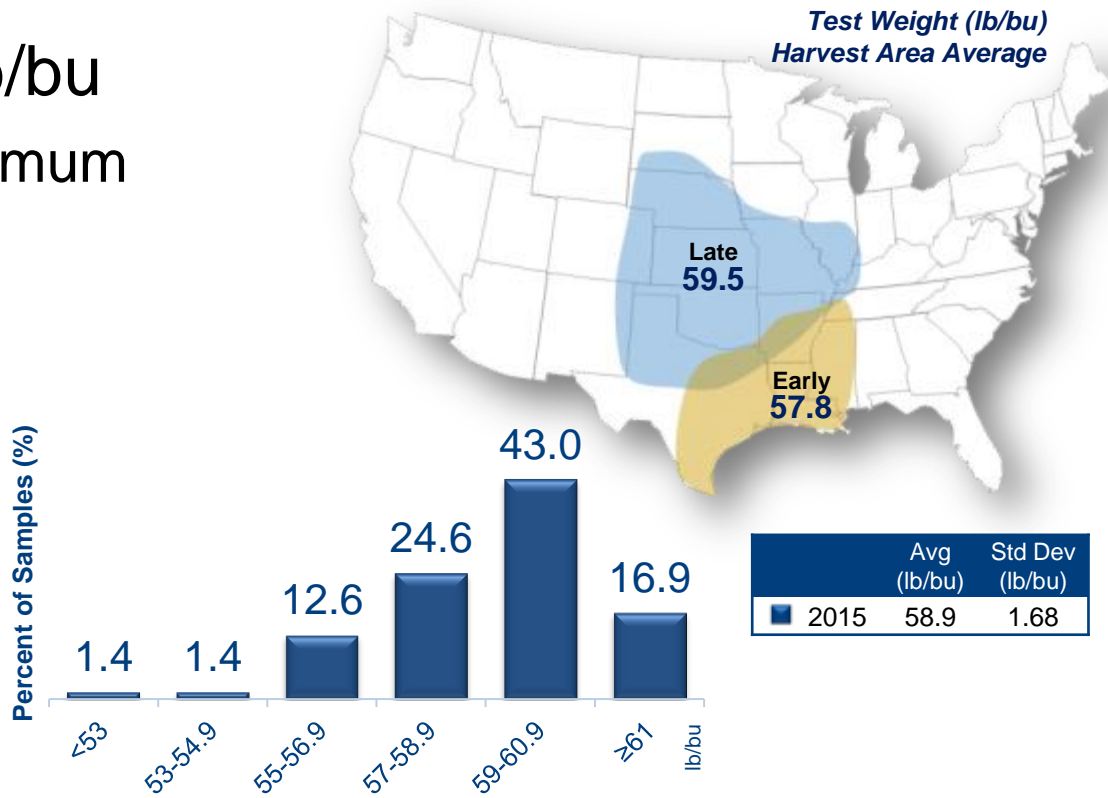
Grade Factors and Moisture

	No. of Samples	Avg.	Std. Dev.	Min.	Max.
Test Weight (lb/bu)	207	58.9	1.68	46.1	62.5
Test Weight (kg/hl)	207	75.9	2.16	59.3	80.4
BNFM (%)	207	1.7	0.93	0.0	6.7
Foreign Material (%)	207	0.6	0.41	0.0	4.8
Total Damage (%)	207	0.1	0.13	0.0	5.7
Heat Damage (%)	207	0.0	0.00	0.0	0.0
Moisture (%)	207	14.1	1.19	10.1	17.9

Test Weight – U.S. Units

U.S. Aggregate: 58.9 lb/bu

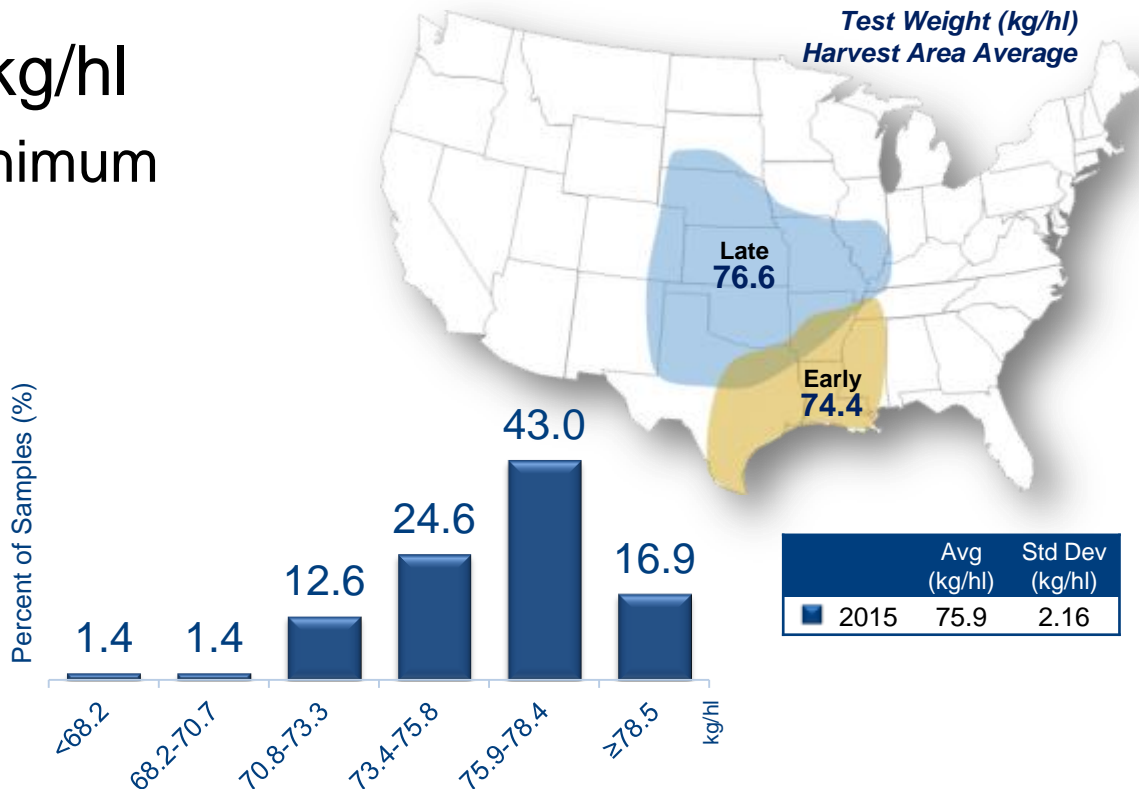
- Average above the minimum for U.S. No. 1 grade
- 97% of the samples at or above the limit for U.S. No. 2 grade
- Late Harvest average slightly higher than Early Harvest average



Test Weight - Metric

U.S. Aggregate: 75.9 kg/hl

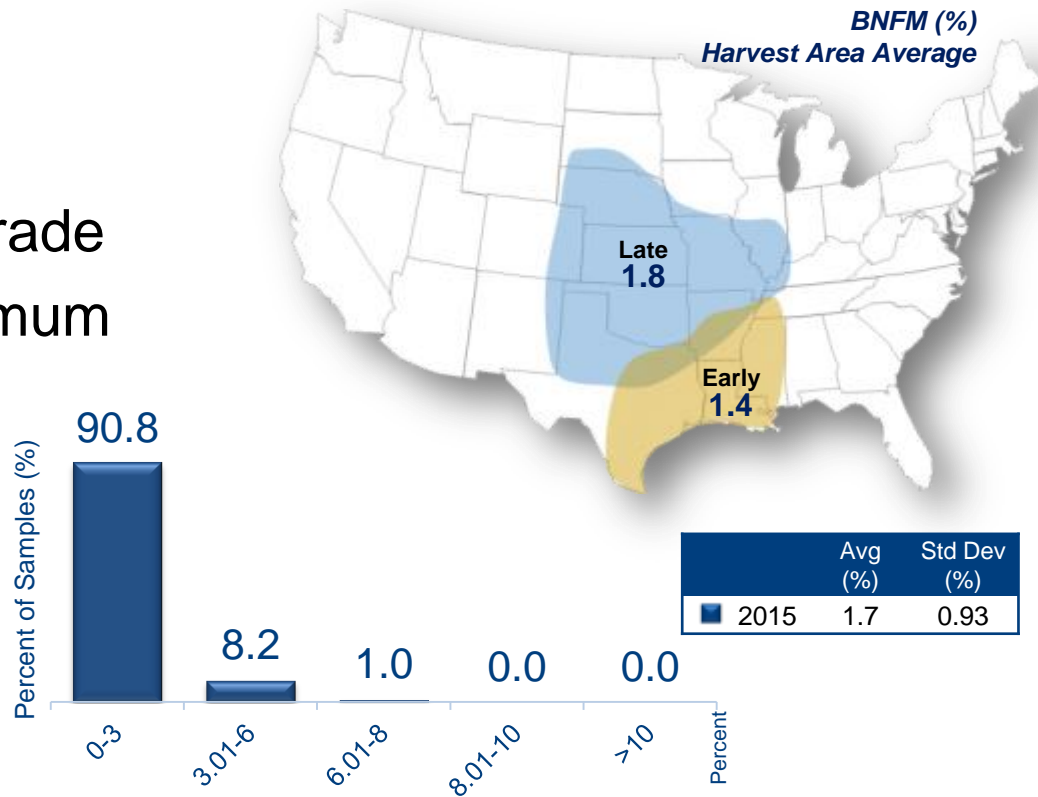
- Average above the minimum for U.S. No. 1 grade
- 97% of the samples at or above the limit for U. S. No. 2 grade
- Late Harvest average slightly higher than Early Harvest average



Broken Kernels and Foreign Material (BNFM) (%)

U.S. Aggregate: 1.7%

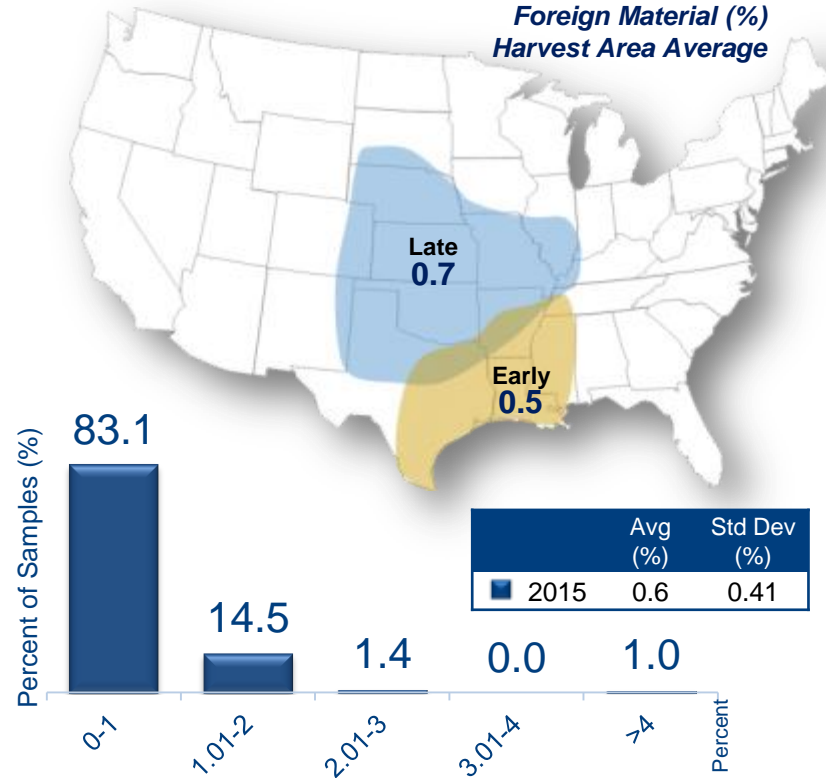
- Average well below the maximum for U.S. No. 1 grade
- 99% were below the maximum for U.S. No. 2 grade
- Early Harvest average lower than Late Harvest average



Foreign Material (%)

U.S. Aggregate: 0.6%

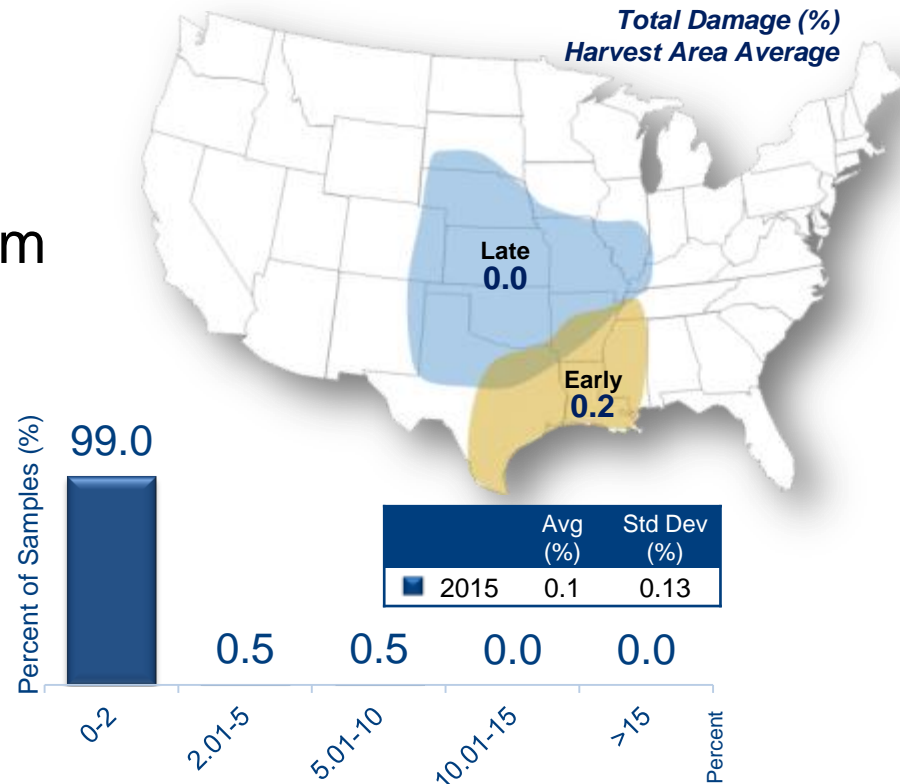
- Average below the maximum for U.S. No. 1 grade
- 98% contained less than the maximum allowable for U.S. No. 2 grade
- Early Harvest average slightly lower than Late Harvest average



Total Damage (%)

Total Damage U.S. Aggregate: 0.1%

- Average well below the maximum for U.S. No. 1 grade
- 99.5% had less than the maximum allowable for U.S. No. 2 grade
- No damage in Late Harvest samples



Heat Damage: Zero

- None observed at harvest
- The absence of heat damage likely was due, in part, to recently-harvested samples coming directly from farm to elevator with minimal prior drying

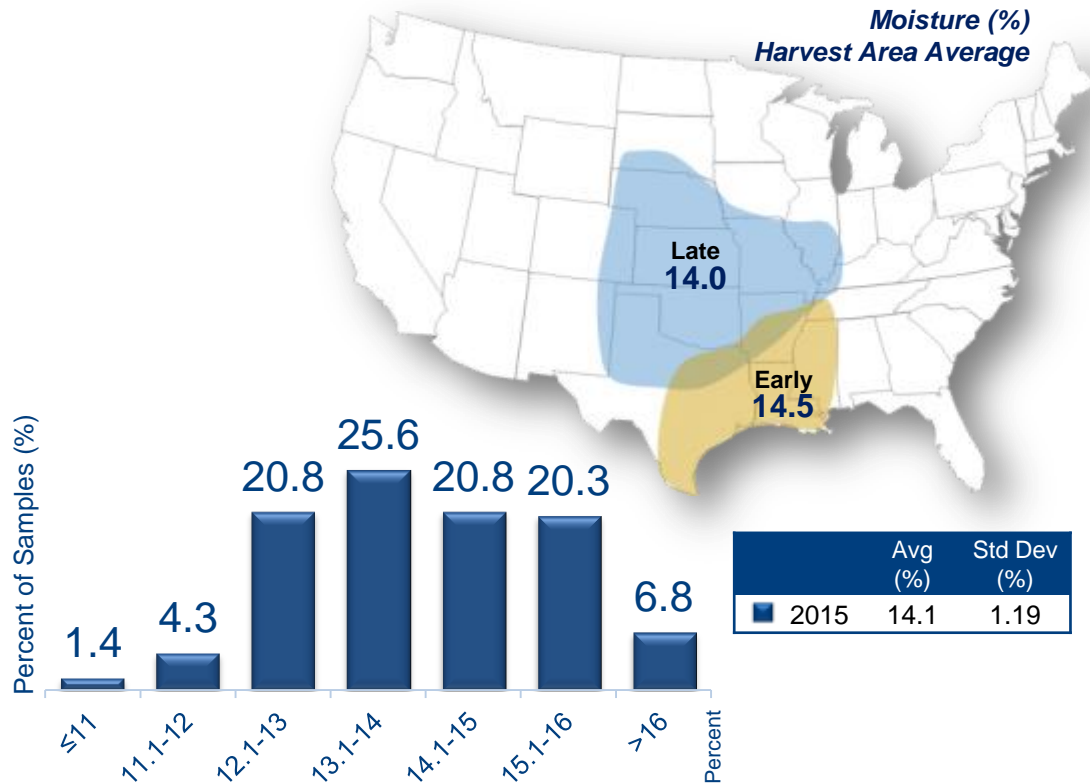


Moisture (%)

Not a grade factor

U.S. Aggregate: 14.1%

- 48% of the samples exceeded 14% moisture
- Drying may have been needed for part of the Harvest crop
- Late Harvest average slightly less than Early Harvest average





Sorghum Chemical Composition



Protein

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

Starch

- Important source of metabolizable energy and substrates

Oil

- Supplies energy and fatty acids
- Important co-product of value-added processing

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

Influenced by genetics, weather and crop yields

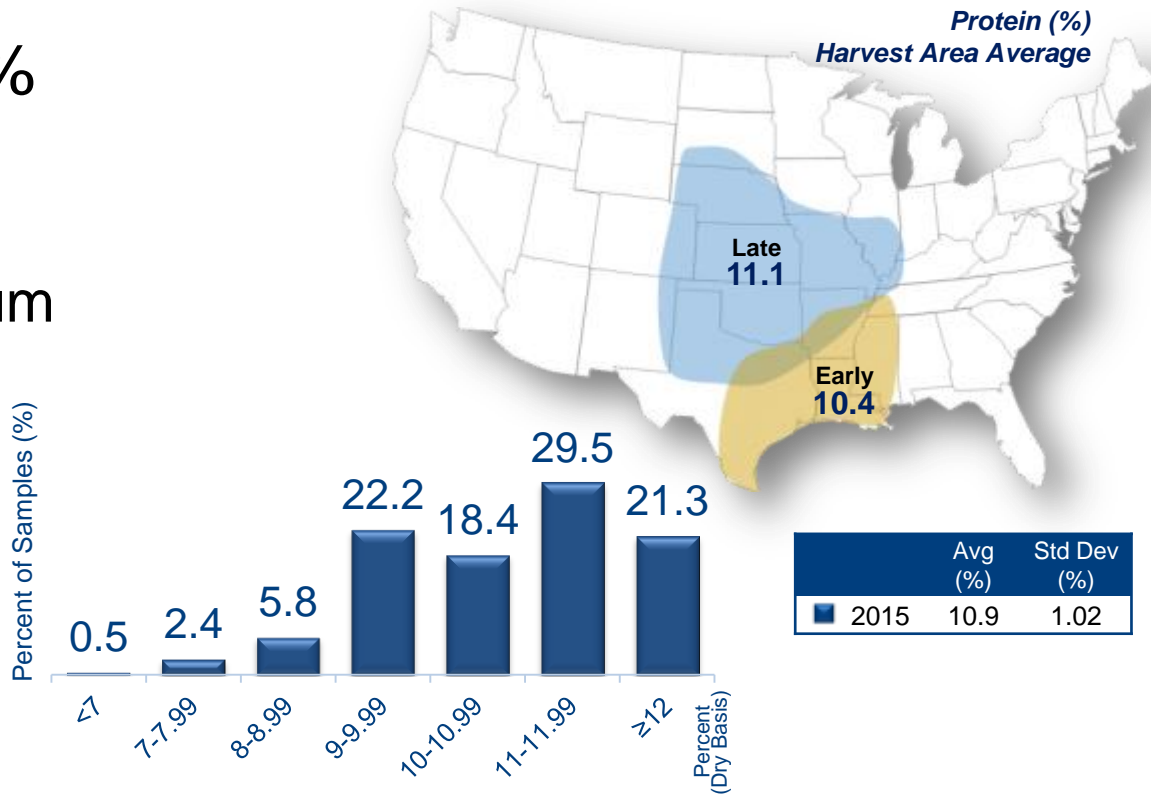
Chemical Composition Factors

	No. of Samples	Avg.	Std. Dev.	Min.	Max.
Protein (Dry Basis %)	207	10.9	1.02	6.8	14.1
Starch (Dry Basis %)	207	73.2	0.80	68.7	75.6
Oil (Dry Basis %)	207	4.5	0.27	3.0	5.1

Protein (Dry basis %)

U.S. Aggregate: 10.9%

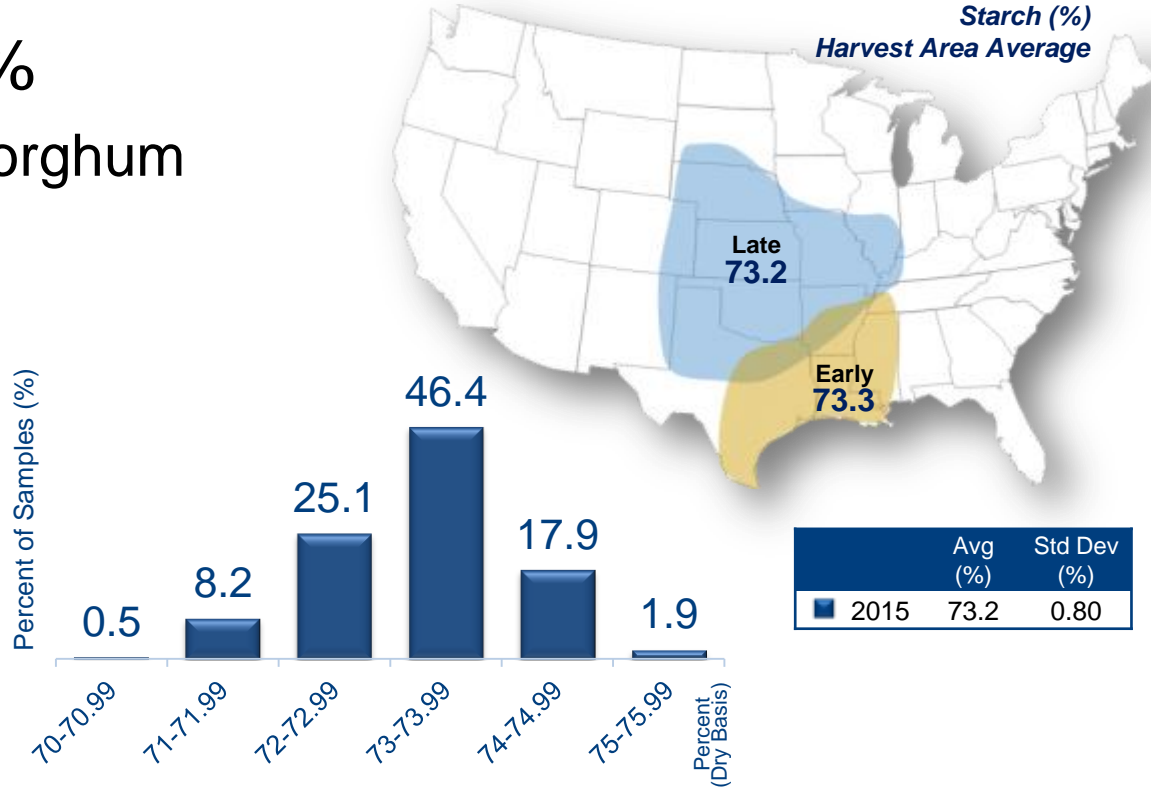
- In the range of typical protein concentration values for U.S. sorghum
- Late Harvest average greater than Early Harvest average



Starch (Dry basis %)

U.S. Aggregate: 73.2%

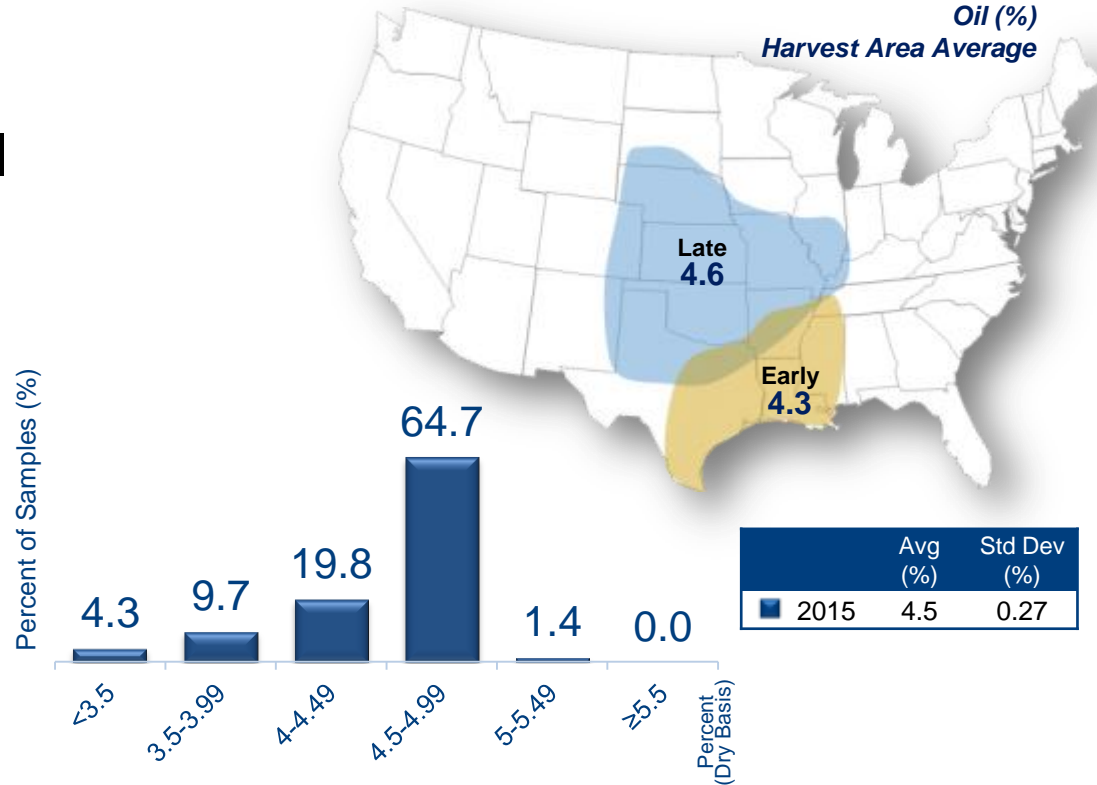
- Typical level for any sorghum crop
- Late Harvest range (68.7 to 75.6%) greater than Early Harvest range (71.1 to 75.0%)



Oil (Dry basis %)

U.S. Aggregate: 4.5%

- In the range of typical oil concentration values for U.S. sorghum
- Late Harvest average greater than Early Harvest average



Tannins Testing

Quantitative test (levels to indicate presence of tannins) was used instead of qualitative test (Yes or No) for more accurate results.



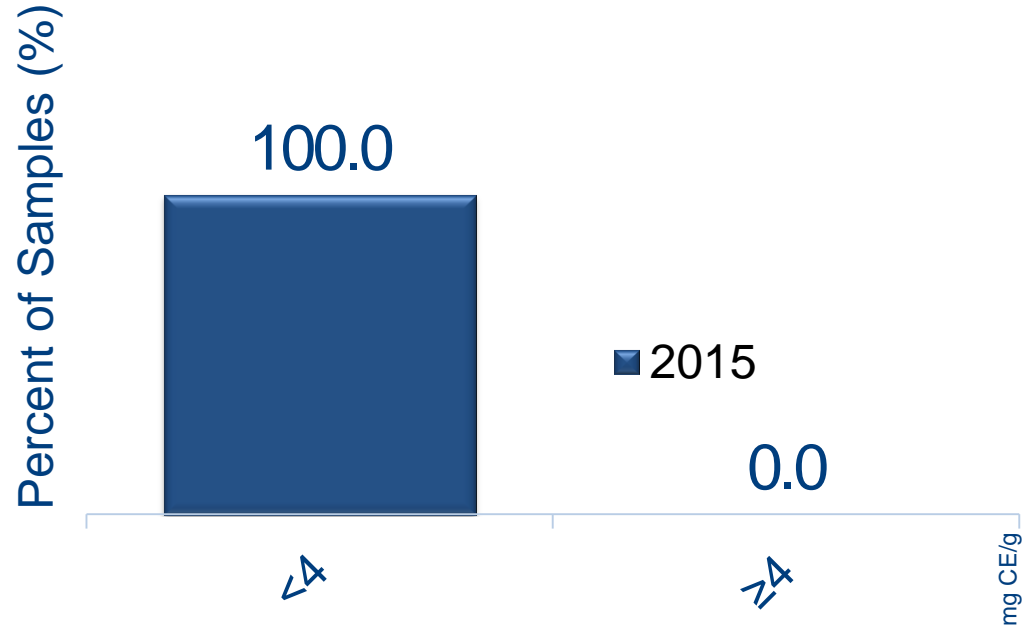
- Values near or below 4.0 mg catechin equivalents (CE) per one g sample by this method generally imply absence of condensed tannins.^{1,2}
- Type III tannin sorghums usually have values greater than 8.0 mg CE/g.

¹Awika, J.M., L.W. Rooney, 2004. Sorghum phytochemicals and their potential impact on human health. *Phytochemistry* 65, 1199-1221.

²Price, Martin L., Van Scoyoc, S., Butler, L.G., 1978. A critical evaluation of vanillin reaction as an assay for tannin sorghum. *Journal of Agricultural and Food Chemistry* 26, 1214-1218.

Tannins (mg CE/g)

- 100% of all harvest sorghum samples were below the threshold of 4.0 mg CE/g
- All samples were considered tannin-free





Physical Factors



Related to processing characteristics, storability and potential for breakage

- Kernel weight, volume and density
- Kernel diameter
- Kernel hardness index

Physical Factors

	No. of Samples	Avg.	Std. Dev.	Min.	Max.
Kernel Diameter (mm)	207	2.53	0.09	2.18	2.90
TKW (g)	207	26.30	2.00	19.49	34.66
Kernel Volume (mm ³)	207	19.34	1.44	14.31	25.40
True Density (g/cm ³)	207	1.359	0.013	1.295	1.402
Kernel Hardness Index	207	71.0	6.2	37.1	91.5

Kernel Weight, Volume, Density

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

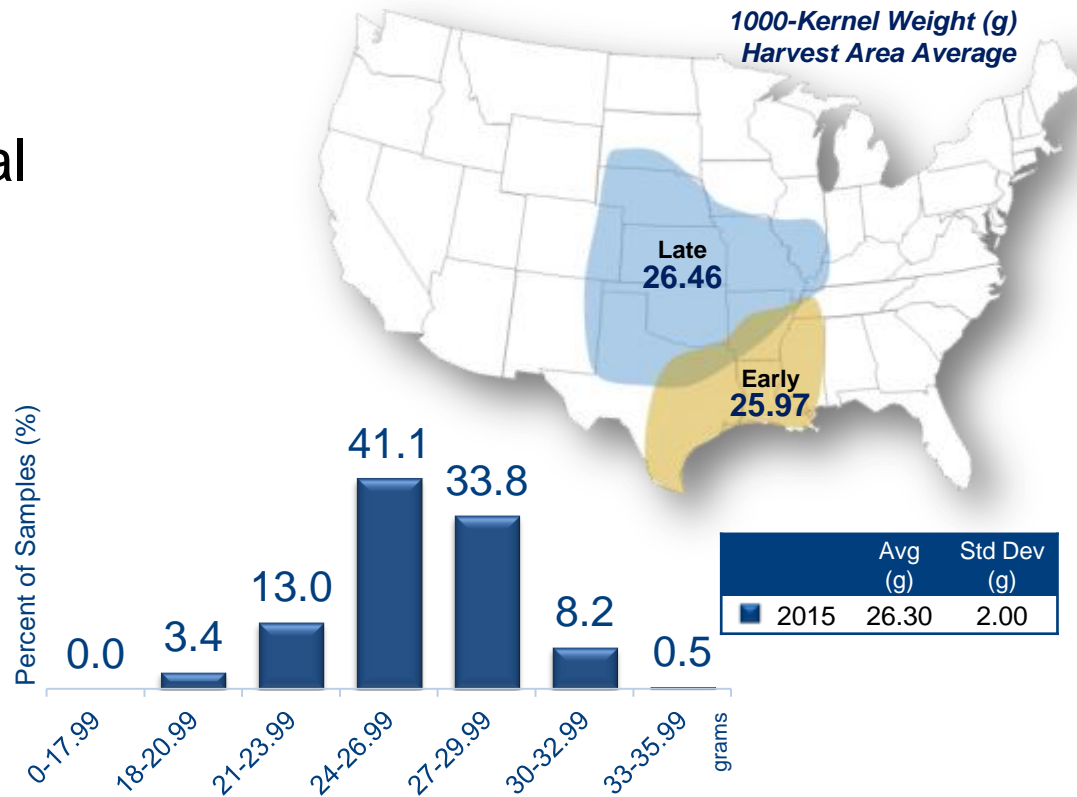
$$\frac{\text{1000-Kernel Weight (TKW) (mass) (g)}}{\text{Kernel Volume (mm}^3\text{)} \times \frac{1 \text{ cm}^3}{1000 \text{ mm}^3}} = \text{True Density (g/cm}^3\text{)}$$

- True density reflects kernel hardness
- Higher density – harder kernels; less susceptible to breakage
- Lower density – softer kernels; process well in size reduction; good for feed use

1000-kernel Weight (TKW) (g)

U.S. Aggregate: 26.30 g

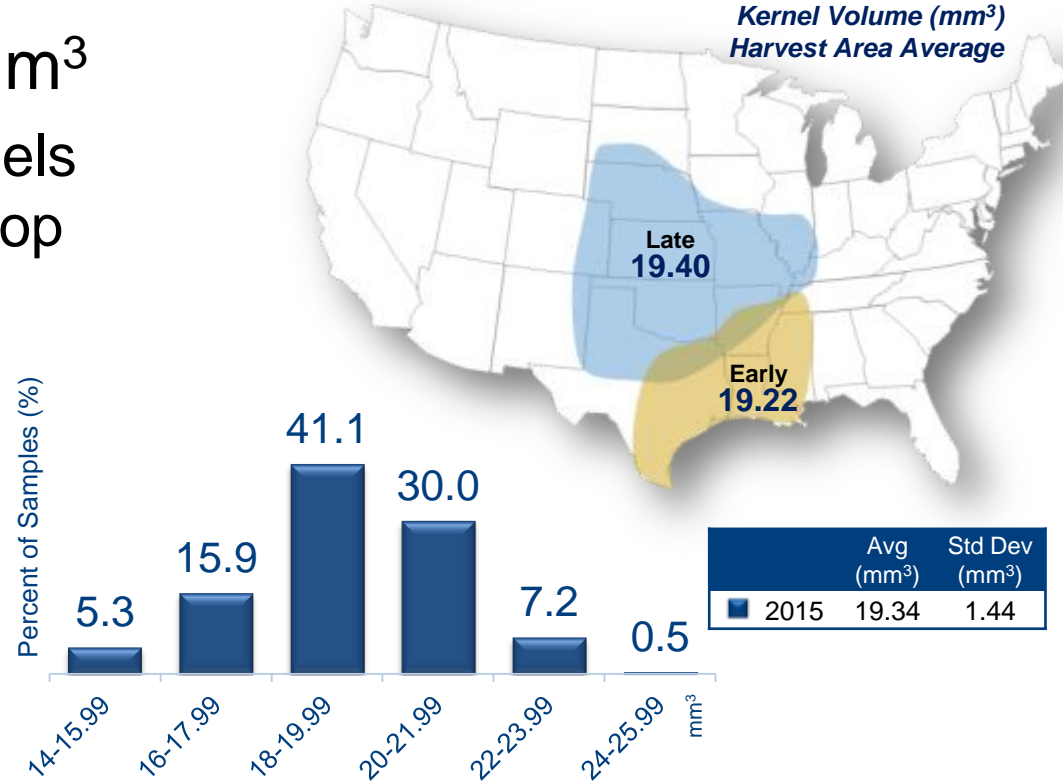
- Within the range of typical levels for U.S. sorghum
- Late Harvest average slightly higher than Early Harvest average



Kernel Volume (mm³)

U.S. Aggregate: 19.34 mm³

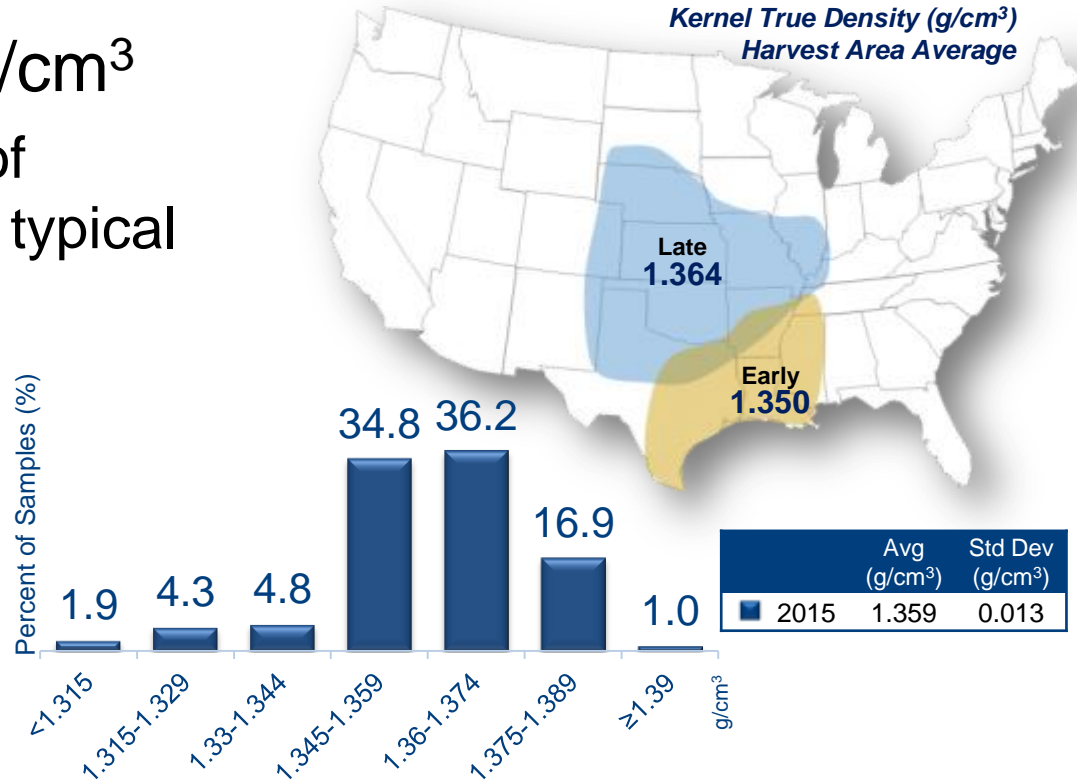
- On the lower end for kernels from a typical sorghum crop
- Late Harvest average slightly higher than Early Harvest average



Kernel True Density (g/cm³)

U.S. Aggregate: 1.359 g/cm³

- Within the typical range of values for kernels from a typical sorghum crop
- 71% were between 1.345 and 1.374 g/cm³
- Late Harvest average slightly greater than Early Harvest average



Kernel Diameter

- Directly correlated with kernel volume
- Impacts size reduction behavior and material handling practices
- May indicate maturity of kernel

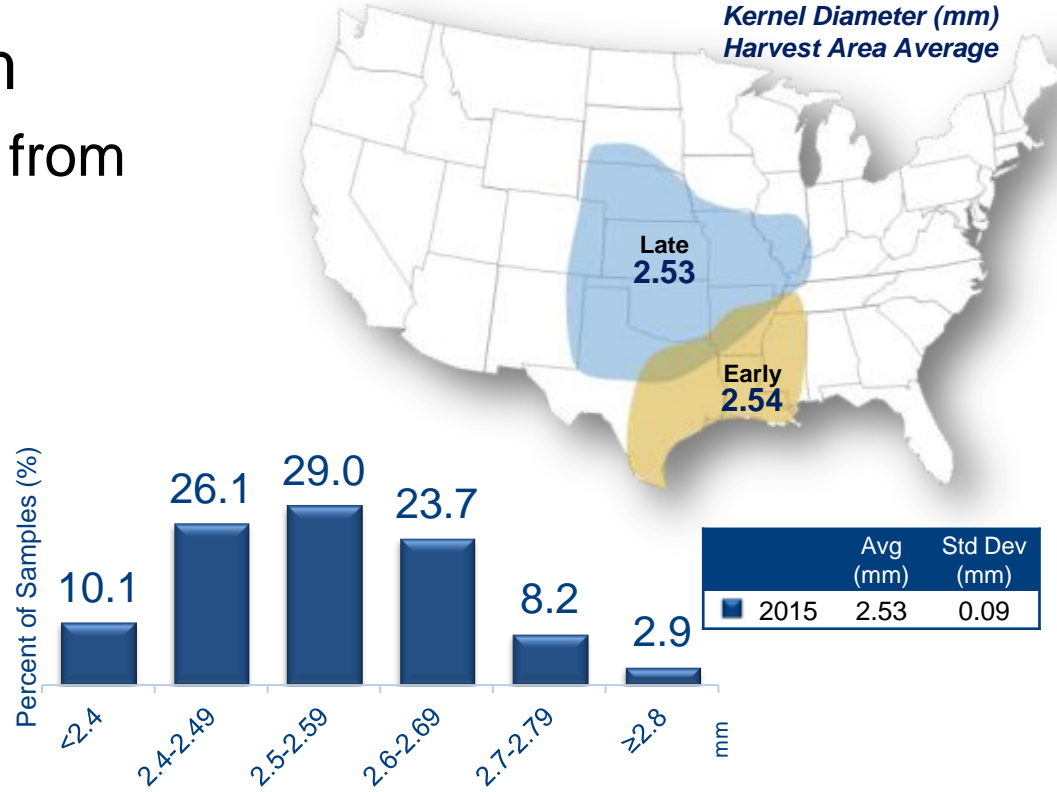
Kernel Hardness Index

- The higher the value, the harder the kernel
- Impacts end-use of sorghum

Kernel Diameter (mm)

U.S. Aggregate: 2.53 mm

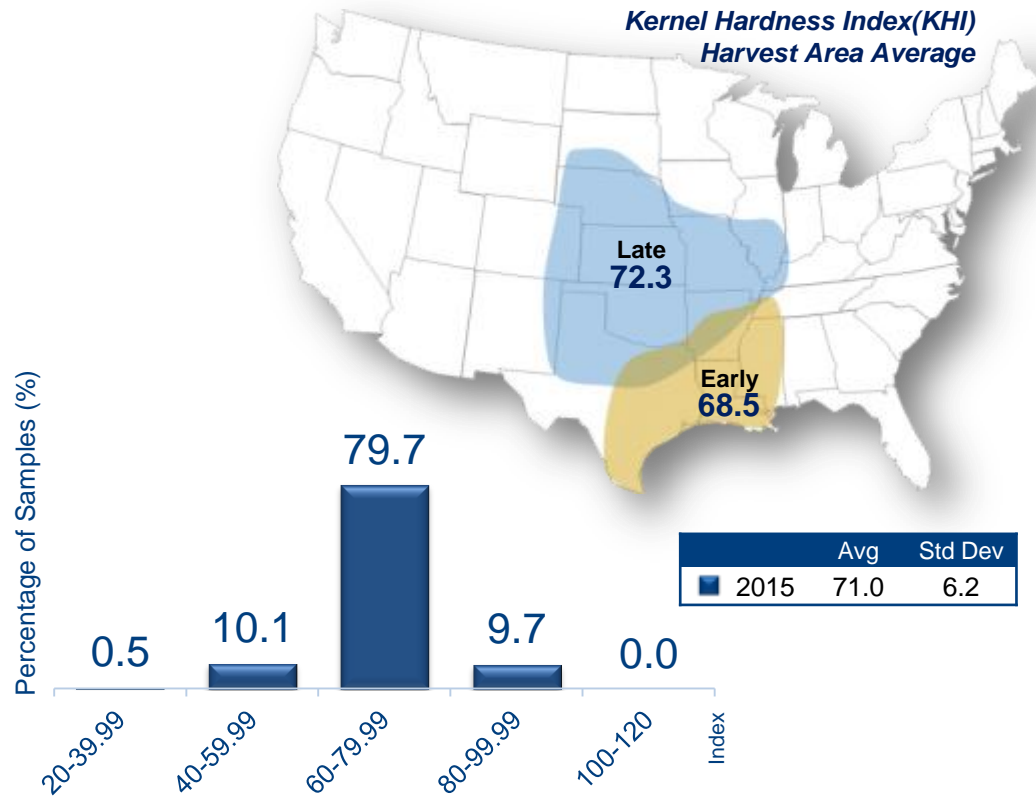
- Typical values for kernels from any sorghum crop
- 53% were between 2.5 and 2.69 mm
- Late Harvest average about the same as Early Harvest average



Kernel Hardness Index (KHI)

U.S. Aggregate: 71.0

- Average value typical for any sorghum crop
- Almost 80% ranged from 60 to 79.99
- Slightly higher Late Harvest average than Early Harvest average





Mycotoxins: Aflatoxins and DON



Sorghum harvest sampling

- Shows ONLY the frequency of detection in harvest samples
- Does NOT predict the presence or levels of mycotoxins in U.S. sorghum exports

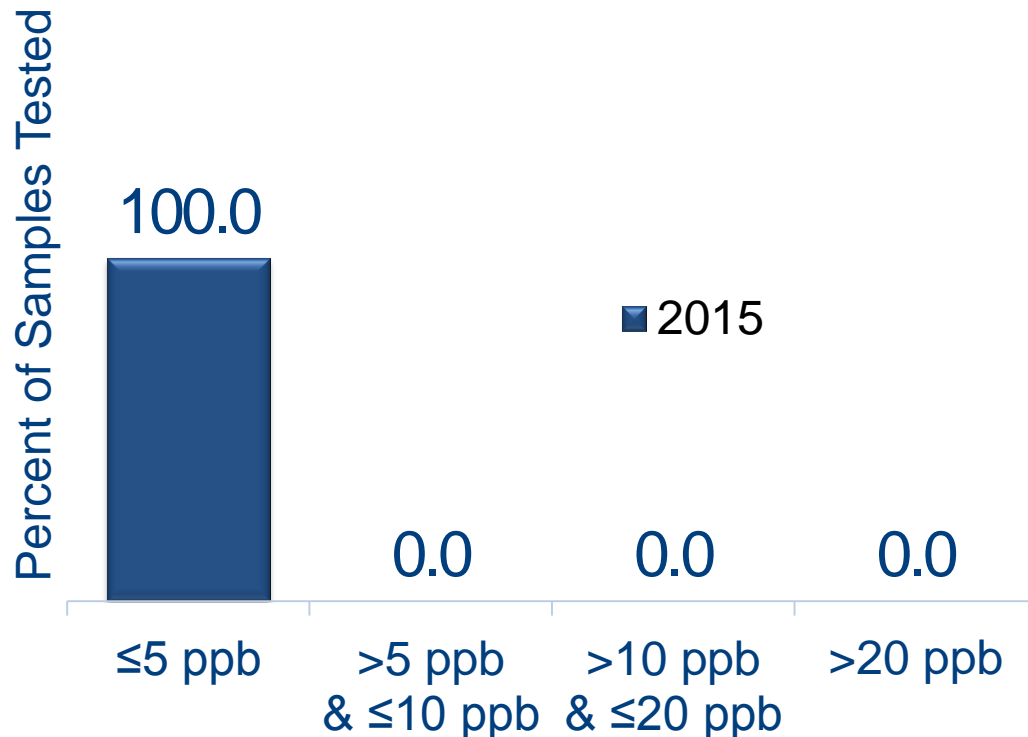
Tested a minimum of 25% of collected samples

Positive results if above FGIS's "Lower Conformance Limit"

- Aflatoxins: 5.0 ppb
- DON: 0.5 ppm

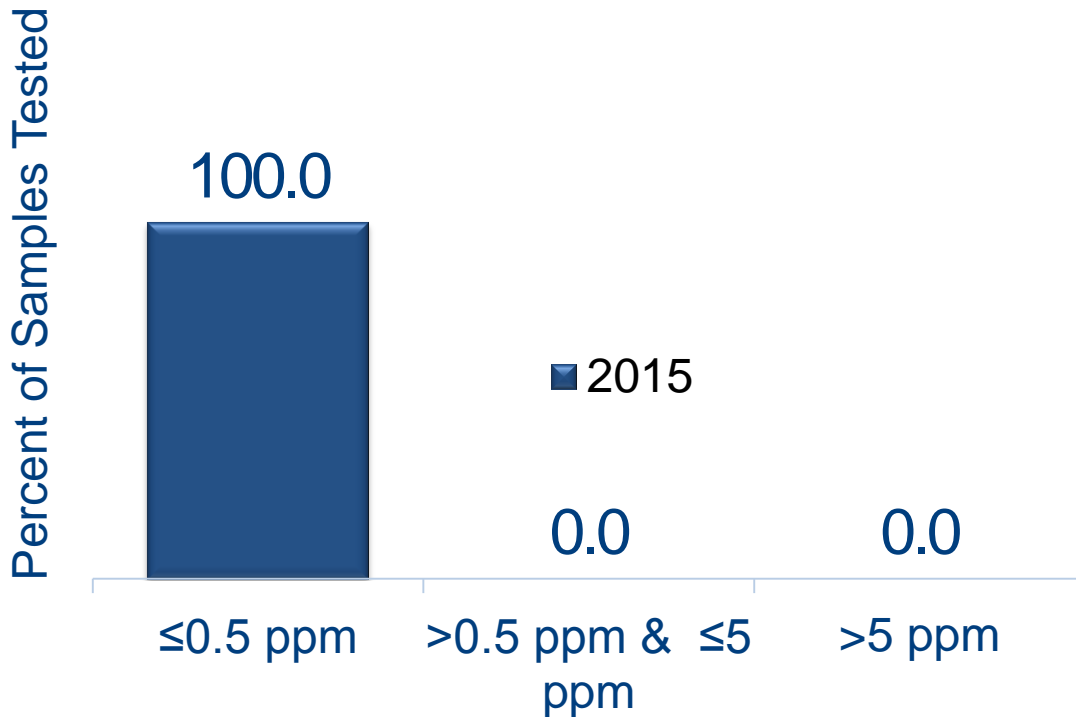
Aflatoxins Testing Results

- 100% had no detectable levels (≤ 5 ppb) of aflatoxins
- All samples below the FDA action level of 20 ppb
- Growing season conditions were not conducive to aflatoxin development



DON Testing Results

- 100% had no detectable levels (≤ 0.5 ppm) of DON
- All samples below the FDA advisory level of 5 ppm
- Growing season conditions were not conducive to DON development





Harvest Quality Conclusions

Harvest Quality Conclusions

- 2015 harvest samples were, on average, very good with 94% grading U.S. No. 2 or better
- Average moisture at near optimum level for harvest moisture
- Average composition within the range of reported concentration values for U.S. sorghum hybrids
- Sorghum harvest samples were tannin-free
- Kernel diameter, hardness, weight and true density typical for kernels from any sorghum crop
- Growing season was not conducive to aflatoxin and DON development



Other Features of the Report

- Export Quality Test Results
- Crop and Weather Conditions
- U.S. Sorghum Export System
- U.S. Sorghum Production, Usage and Outlook
- Survey and Statistical Analysis Methods
- Testing Analysis Methods



Sorghum Quality

Harvest – impacted by several factors including geography, genetics and weather

Export – affected by many factors in the U.S. grain marketing system, in addition to building on the quality established at harvest

Understanding Quality

Provides information for evaluating patterns in quality across geographies, how weather affects quality, and changes in quality between harvest and export

Report Value

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 will surface

Building a Tradition: Thank You!



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SUPPLEMENTAL SLIDES:
U.G. Grains Council
2015/2016 Sorghum Harvest Quality



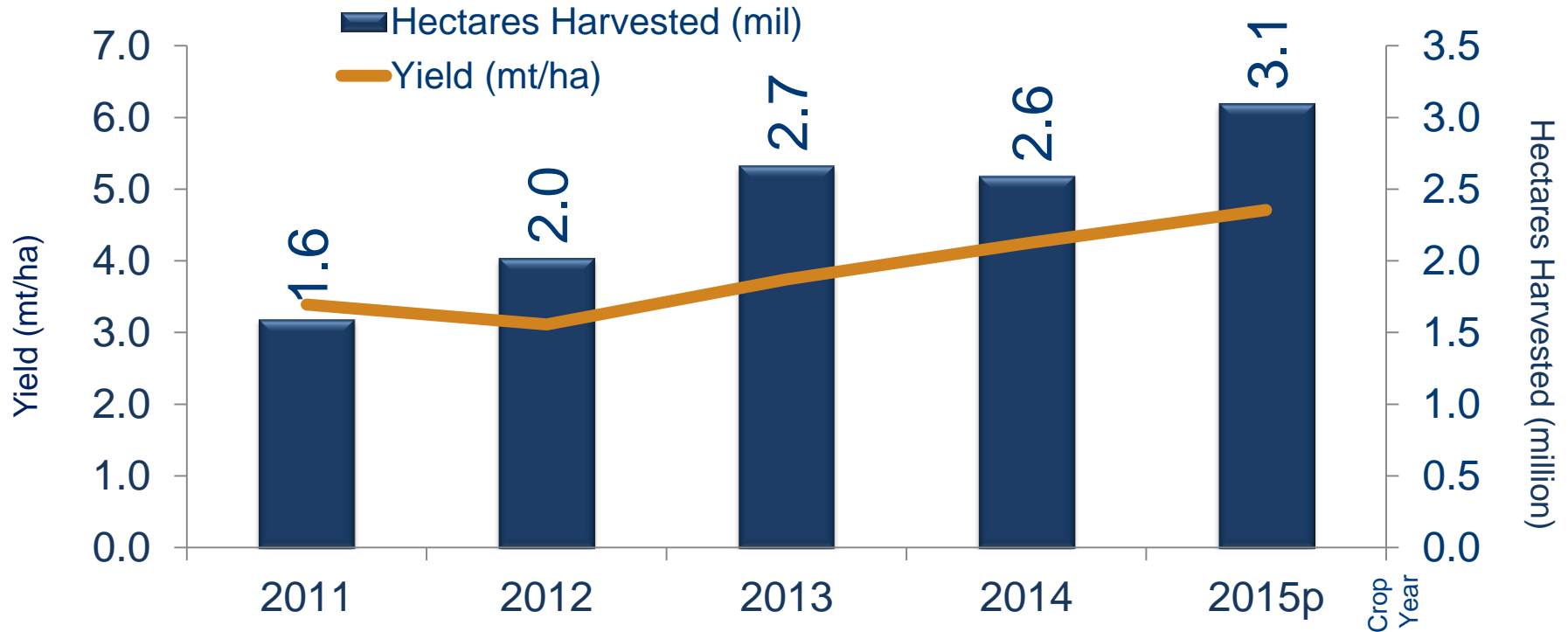
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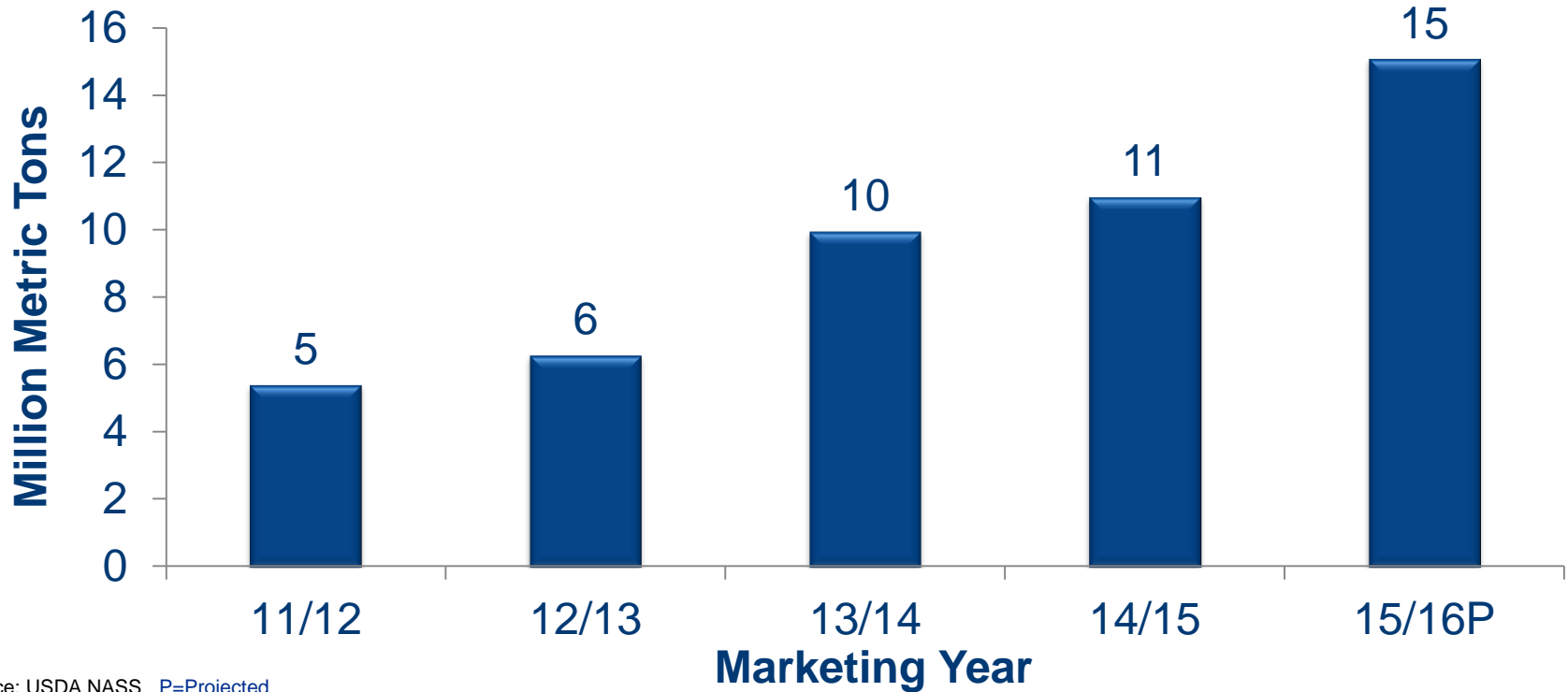
U.S. Sorghum Production Supply & Demand Outlook

U.S. Sorghum Production and Yield



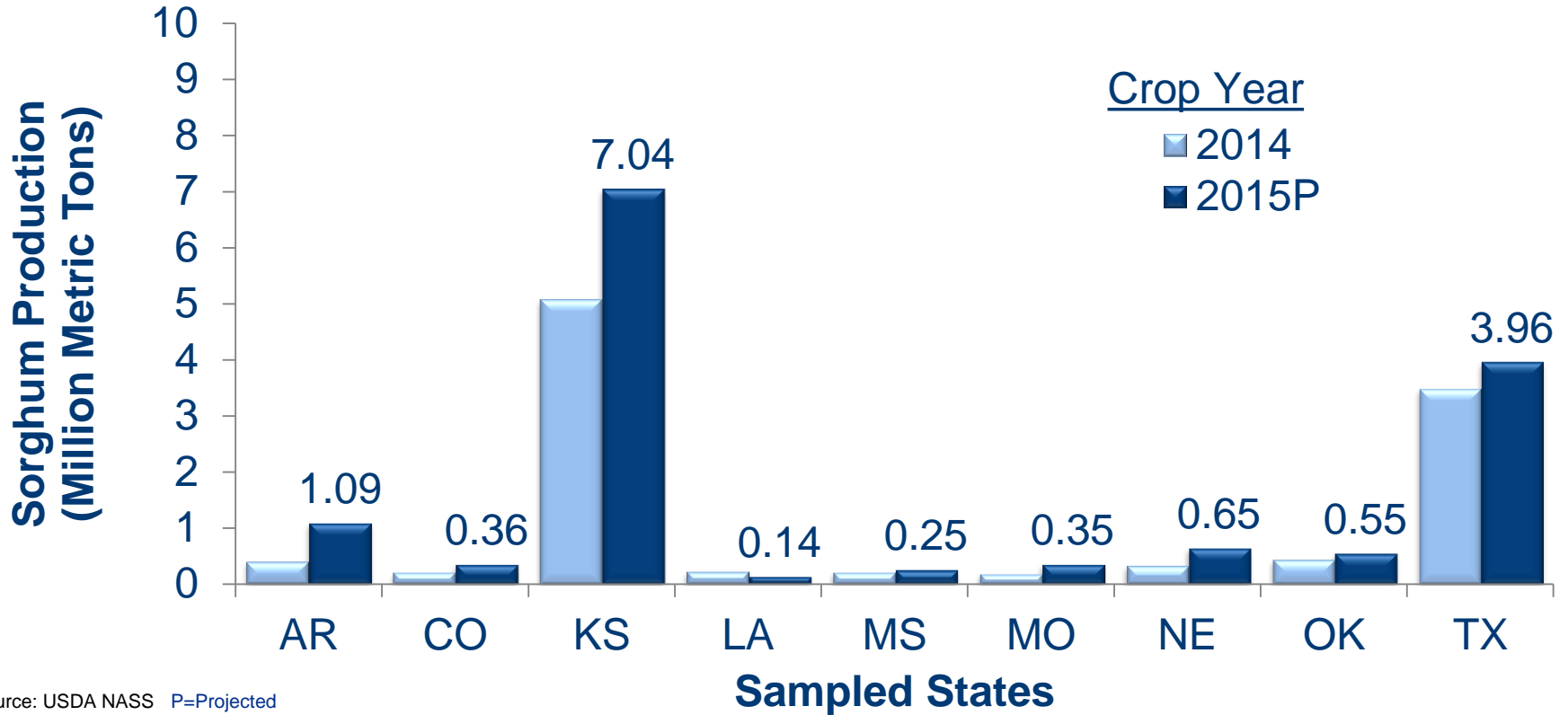
Source: USDA NASS P=Projected

U.S. Sorghum Production



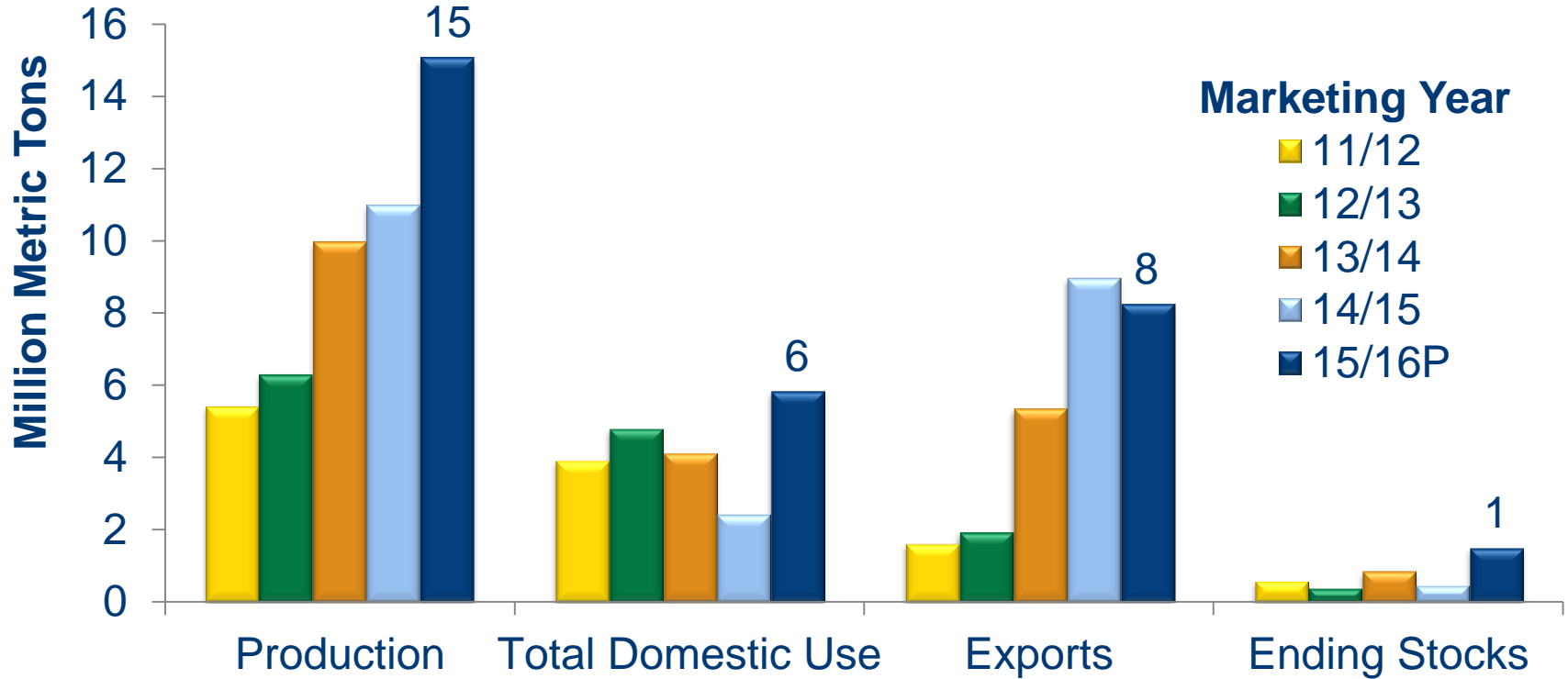
Source: USDA NASS P=Projected

U.S. Sorghum Production by State



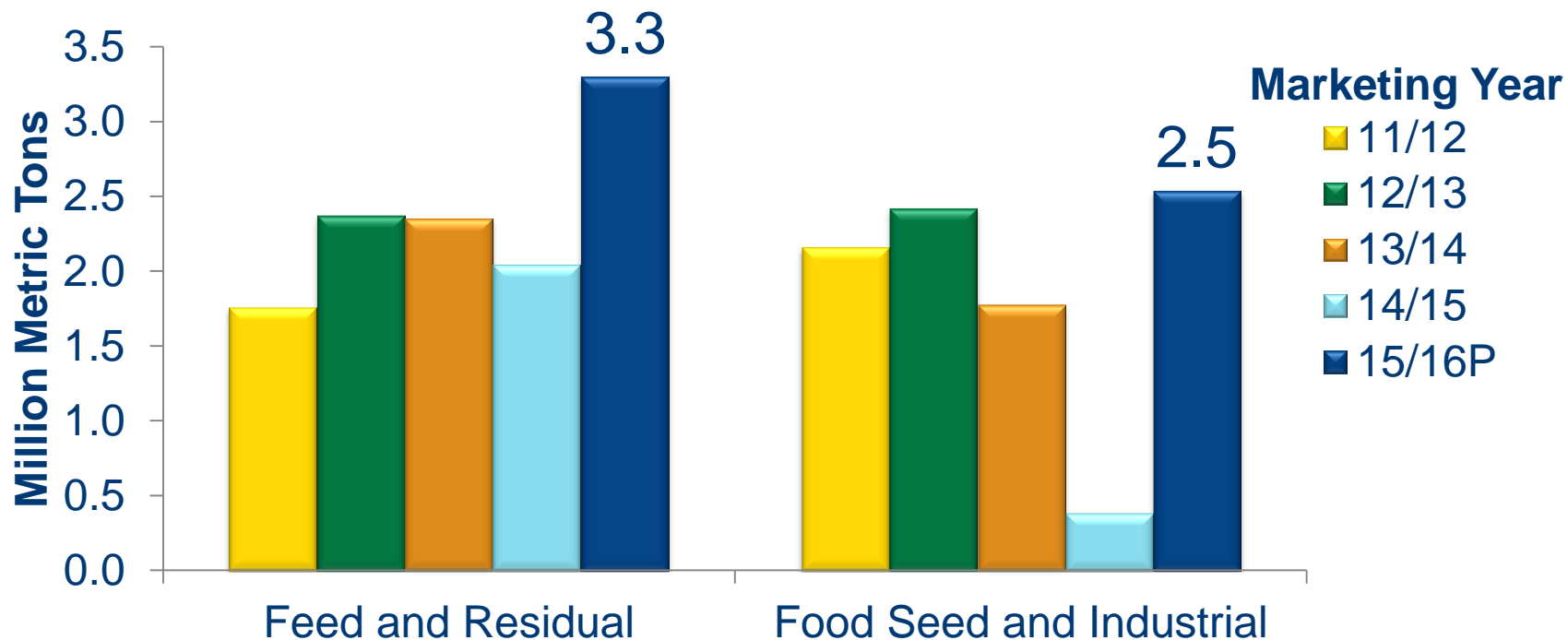
Source: USDA NASS P=Projected

U.S. Sorghum Production and Disappearance



Source: USDA NASS P=Projected

U.S. Sorghum Domestic Sorghum Use



Source: USDA NASS P=Projected



U.S. Sorghum Supply and Usage Summary

	11/12	12/13	13/14	14/15	15/16P
Acreage (million hectares)					
Planted	2.2	2.5	3.3	2.9	3.5
Harvested	1.6	2.0	2.7	2.6	3.1
Yield (metric ton/hectare)	3.4	3.1	3.7	4.2	4.9
<i>In Millions of Metric Tons</i>					
Supply (million metric tons)					
Beginning Stocks	0.7	0.6	0.4	0.9	0.5
Production	5.4	6.3	10.0	11.0	15.1
Imports	0.0	0.2	0.0	0.0	0.0
Total Supply	6.1	7.1	10.4	11.9	15.6
Usage (million metric tons)					
Food, seed, and industrial use	2.2	2.4	1.8	0.4	2.5
Feed and residual use	1.8	2.4	2.4	2.0	3.3
Exports	1.6	1.9	5.4	9.0	8.3
Total Use	5.5	6.7	9.5	11.4	14.1
Ending Stocks	0.6	0.4	0.9	0.5	1.5
Avg farm price (\$/mt*)	235.89	249.12	168.43	158.73	125.98-149.60

P-Projected

* Farm prices are weighted averages based on volume of farm shipment
Average farm price for 15/16P based on WASDE December projected price

Source: USDA WASDE
December 2015

U.S. Sorghum Supply and Usage Summary

	11/12	12/13	13/14	14/15	15/16P
Acreage (million acres)					
Planted	5.5	6.3	8.1	7.1	8.7
Harvested	3.9	5.0	6.6	6.4	7.6
Yield (bushels/acre)	54.0	49.6	59.6	67.6	77.7
<i>In Millions of Bushels</i>					
Supply (million bushels)					
Beginning Stocks	27	23	15	34	18
Production	213	248	392	433	594
Imports	0	10	0	0	2
Total Supply	241	280	408	467	614
Usage (million bushels)					
Food, seed, and industrial use	85	95	70	15	100
Feed and residual use	69	93	93	80	130
Exports	63	76	211	353	325
Total Use	218	265	374	449	555
Ending Stocks	23	15	34	18	59
Avg farm price (\$/bushel**)	5.99	6.33	4.28	4.03	3.20-3.80

P-Projected

* Farm prices are weighted averages based on volume of farm shipment
Average farm price for 15/16P based on WASDE December projected price

Source: USDA WASDE
December 2015