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

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

U.S. GRAINS COUNCIL

Sorghum Quality Reports

2015/2016 Sorghum
Early Harvest Quality Report

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

Sorghum Quality Reports

2015/2016 Sorghum
Early Harvest Quality Report

Early Harvest Quality Report

- Initial look at crop quality from early harvest areas
- Samples collected from southern part of growing area during August and September

Harvest and Export Cargo Quality Report

Harvest

- Evaluation of quality of crop over entire harvest season; includes early and late harvest
- Samples collected from key sorghum - producing states

Export Cargo

- Represents export quality early in the marketing year
- Samples collected during federal inspection at key sorghum - exporting ports

Sorghum Quality Reports

Sampling Methodology

- Same as Corn Harvest and Export Cargo Quality Reports

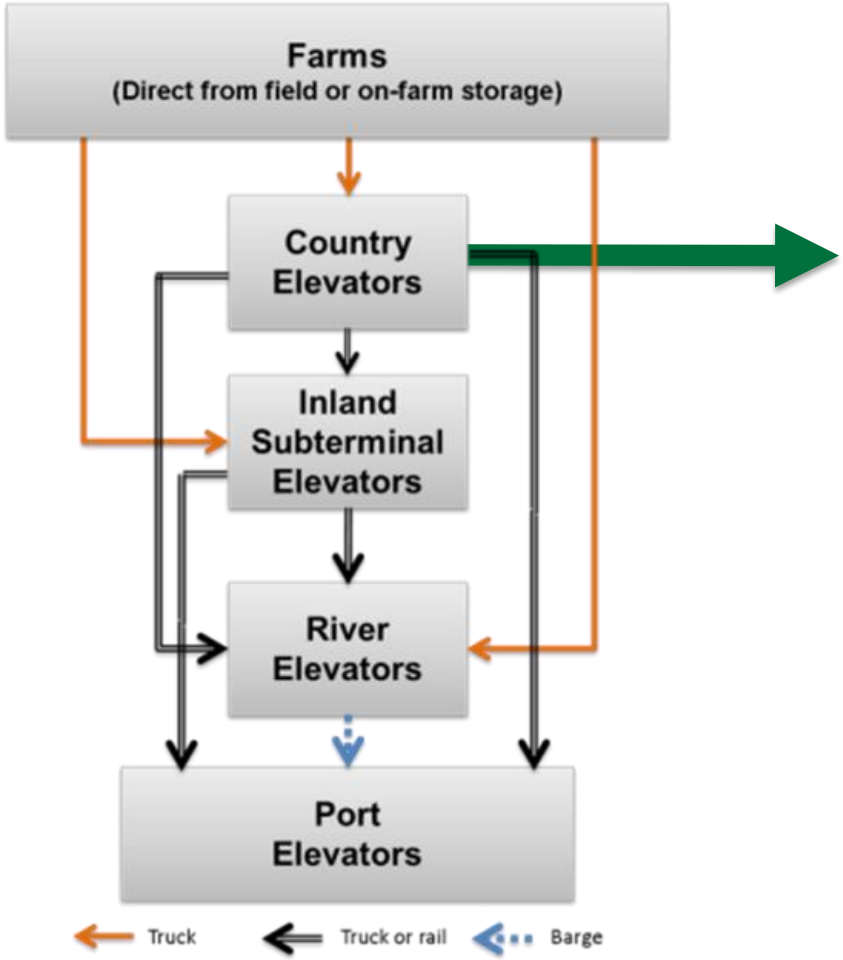
Quality Factors Tested

- Similar to corn factors with minor changes

Reporting

- Altered from corn reports due to differences in production, harvest and export patterns

USGC Quality Sampling

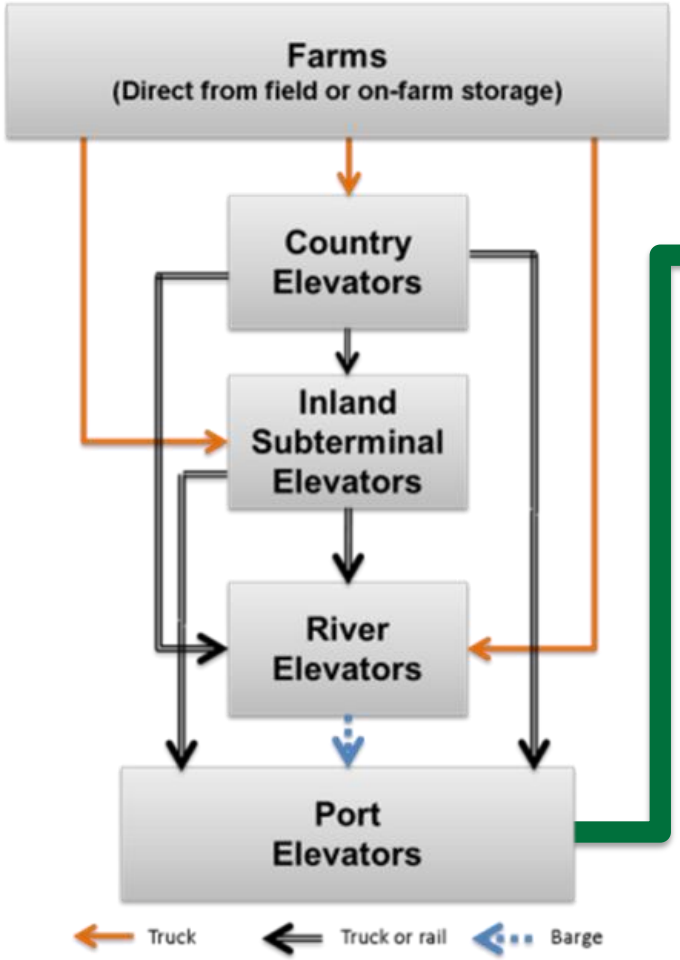


Harvest Sampling

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

U.S. GRAINS COUNCIL

USGC Quality Sampling



Export Sampling

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

U.S. GRAINS COUNCIL

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

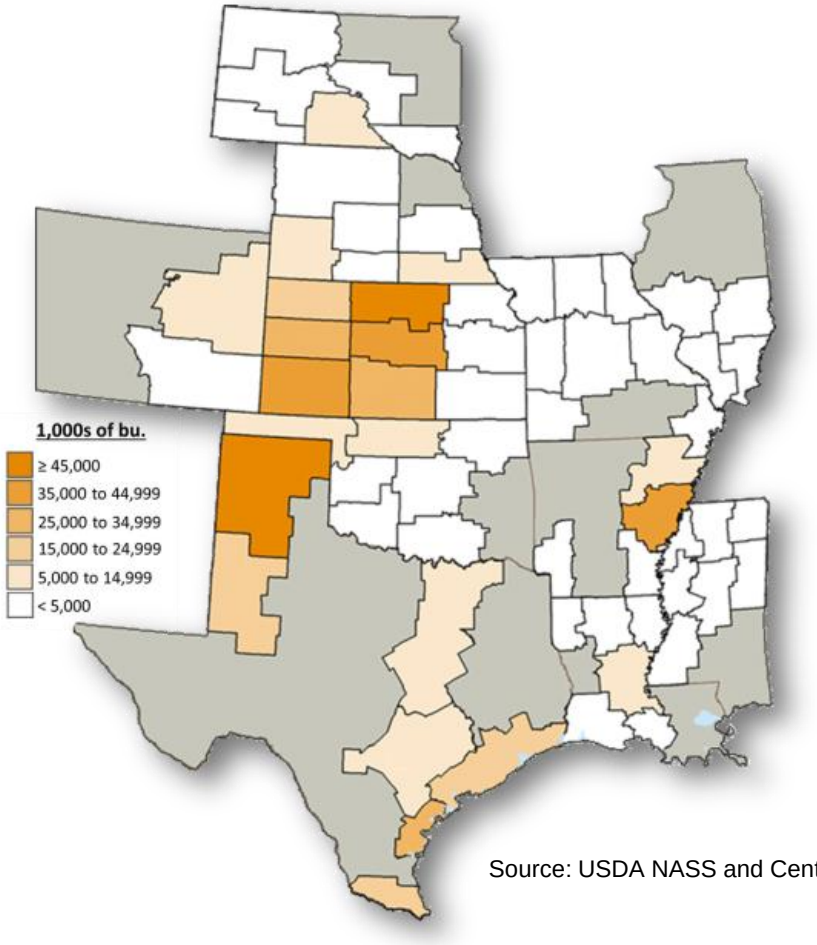
Reported in Harvest/Export Report only

U.S. GRAINS COUNCIL

U.S. Production by ASD (2015P)

2015/2016 Sorghum
Early Harvest Quality Report

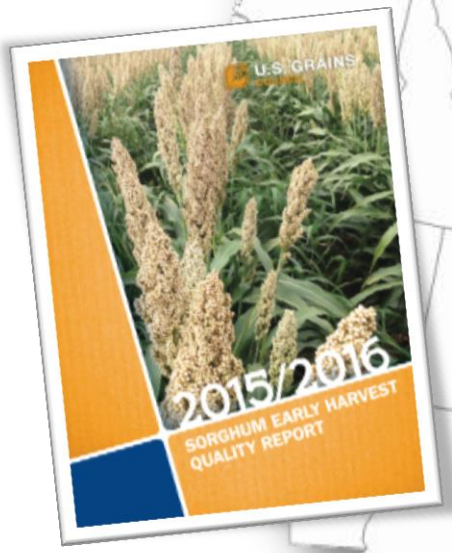
The geographic areas included in the Harvest sampling area include the highest sorghum-producing areas in the United States



Source: USDA NASS and Centrec Estimates

U.S. GRAINS COUNCIL

Early Harvest Quality Report



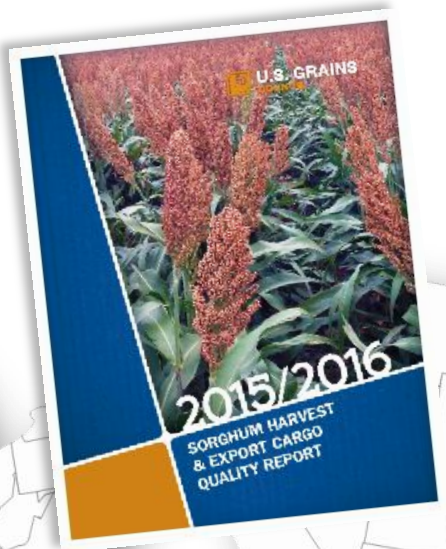
50 samples from Early Harvest area during August and September

U.S. GRAINS COUNCIL

Harvest and Export Cargo Report

2015/2016 Sorghum
Early Harvest Quality Report

Harvest
U.S. Aggregate
Plus
Two Harvest Regions

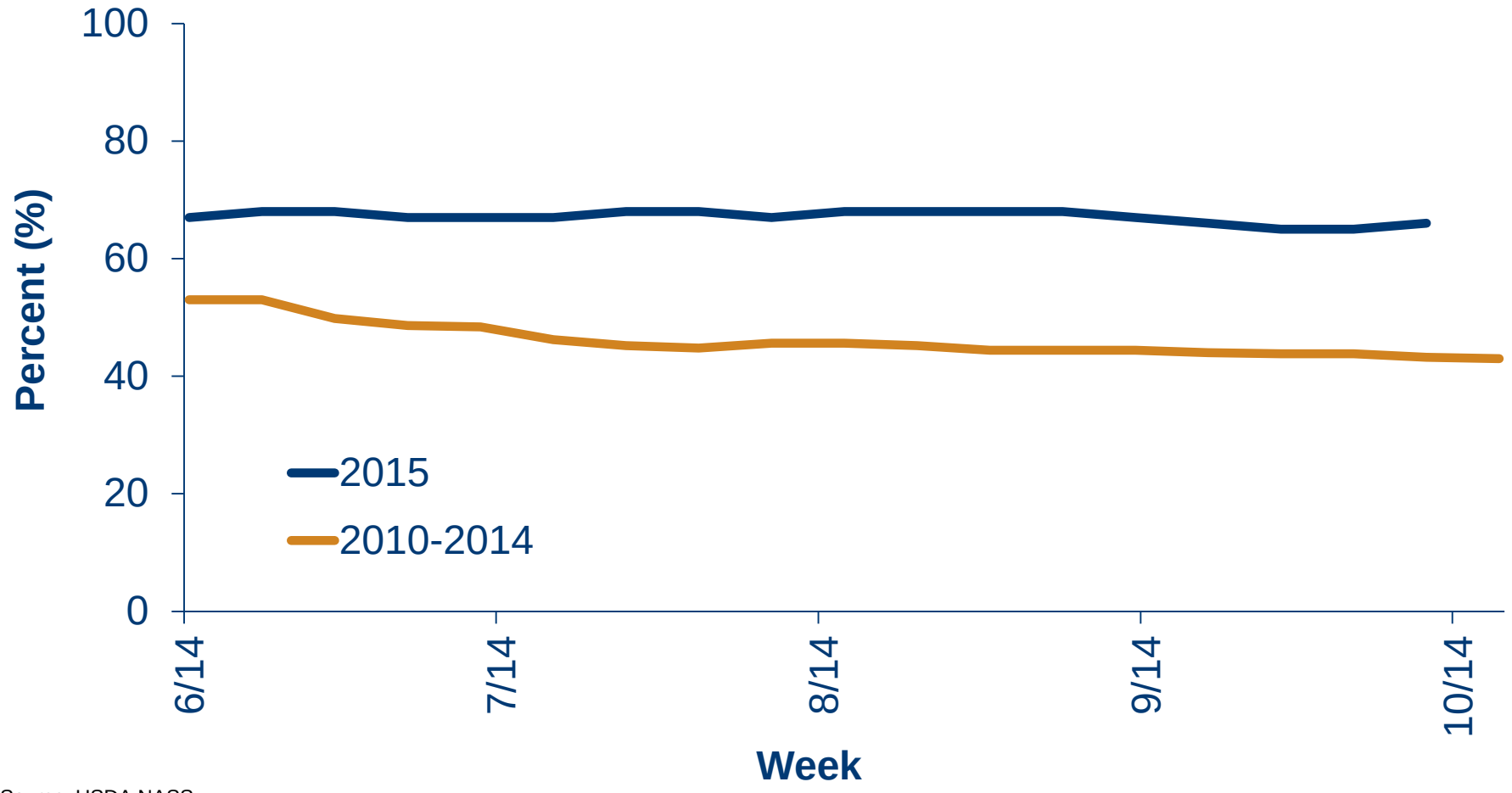


Export Cargo
U.S. Aggregate
Plus
Two Export Regions

U.S. GRAINS COUNCIL

Crop Condition (Rated Good or Excellent)

2015/2016 Sorghum
Early Harvest Quality Report

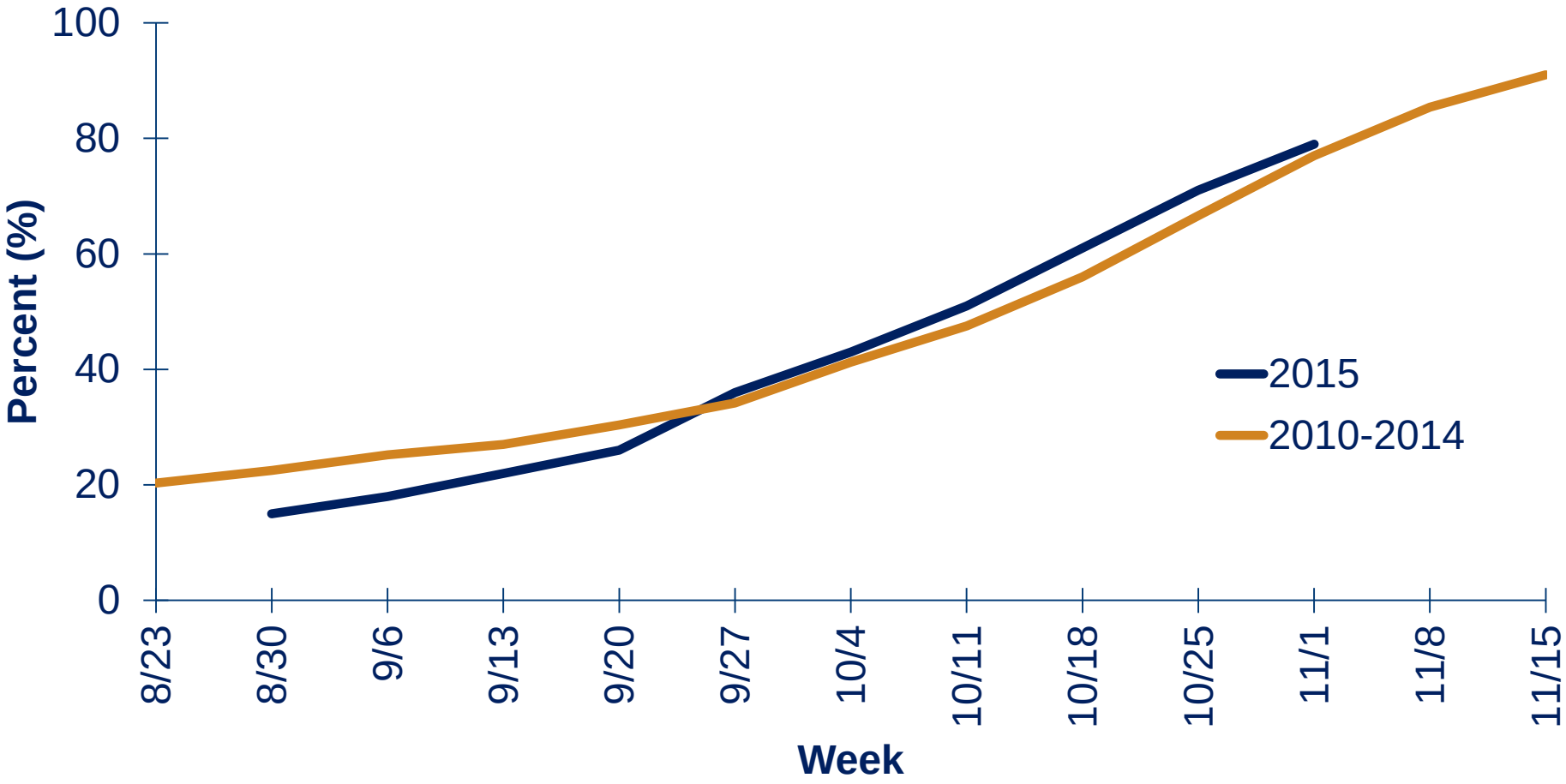


Source: USDA NASS

U.S. GRAINS COUNCIL

Crop Progress

2015/2016 Sorghum
Early Harvest Quality Report

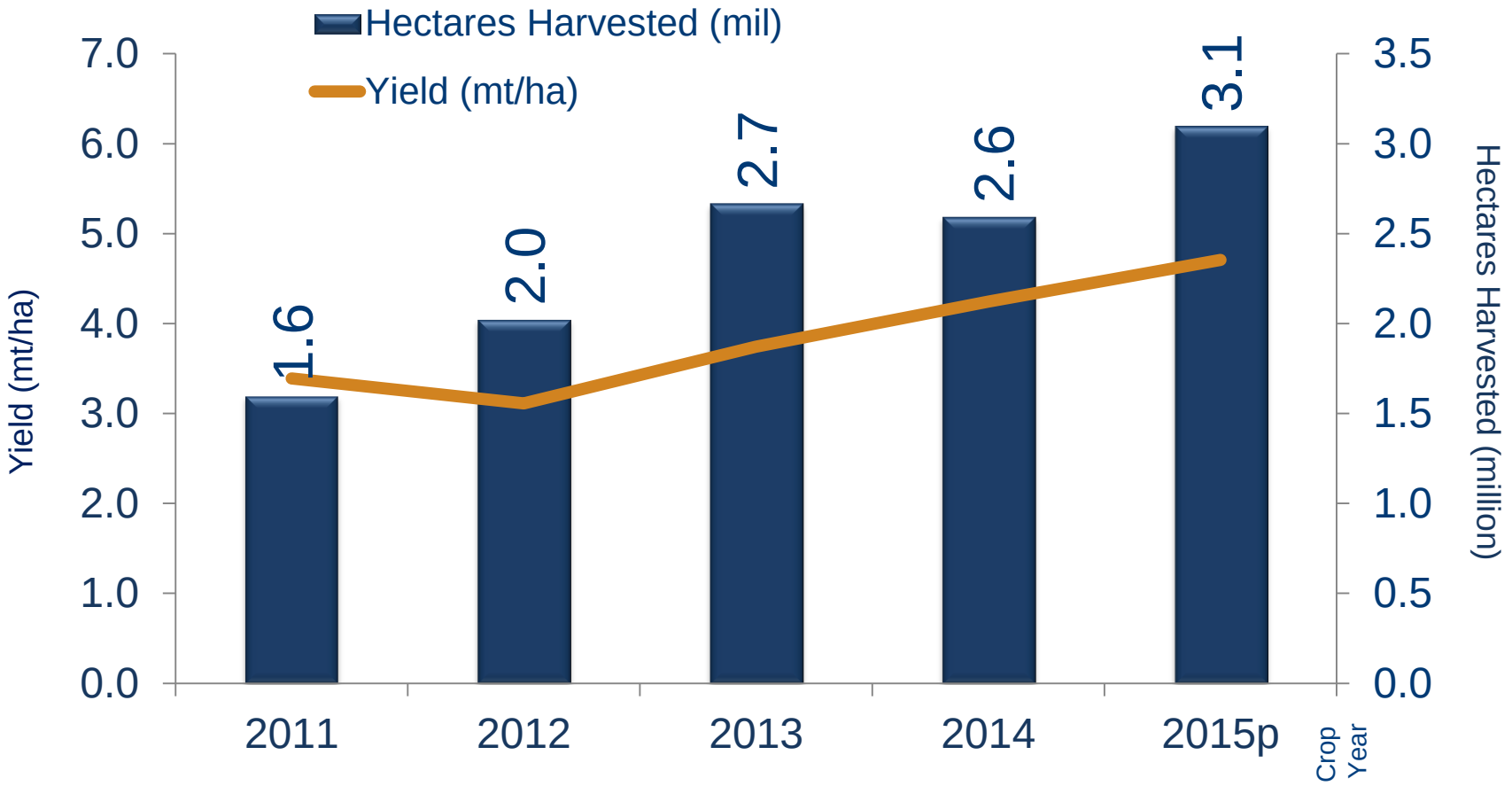


Source: USDA NASS

U.S. GRAINS COUNCIL

U.S. Production

2015/2016 Sorghum
Early Harvest Quality Report

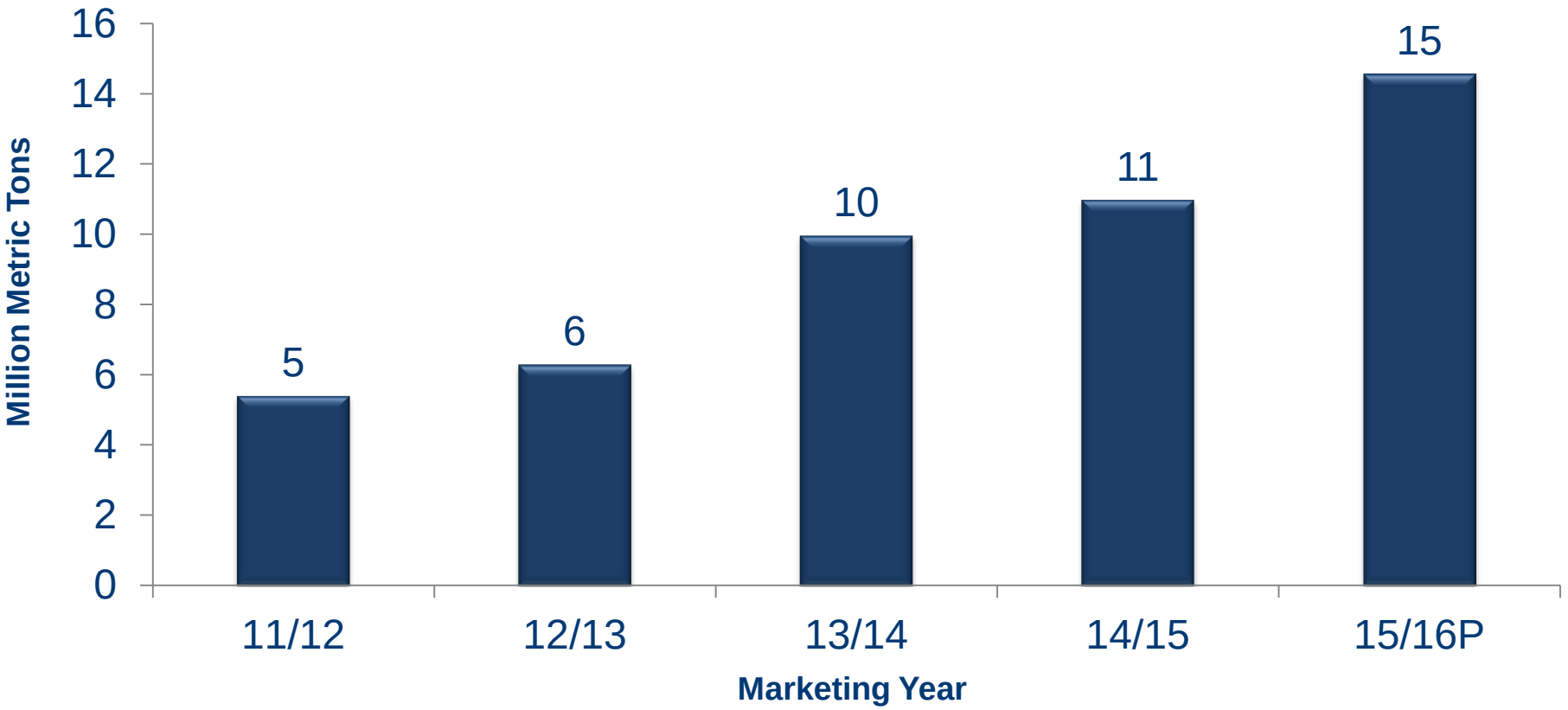


Source: USDA NASS P=Projected

U.S. GRAINS COUNCIL

U.S. Production

2015/2016 Sorghum
Early Harvest Quality Report

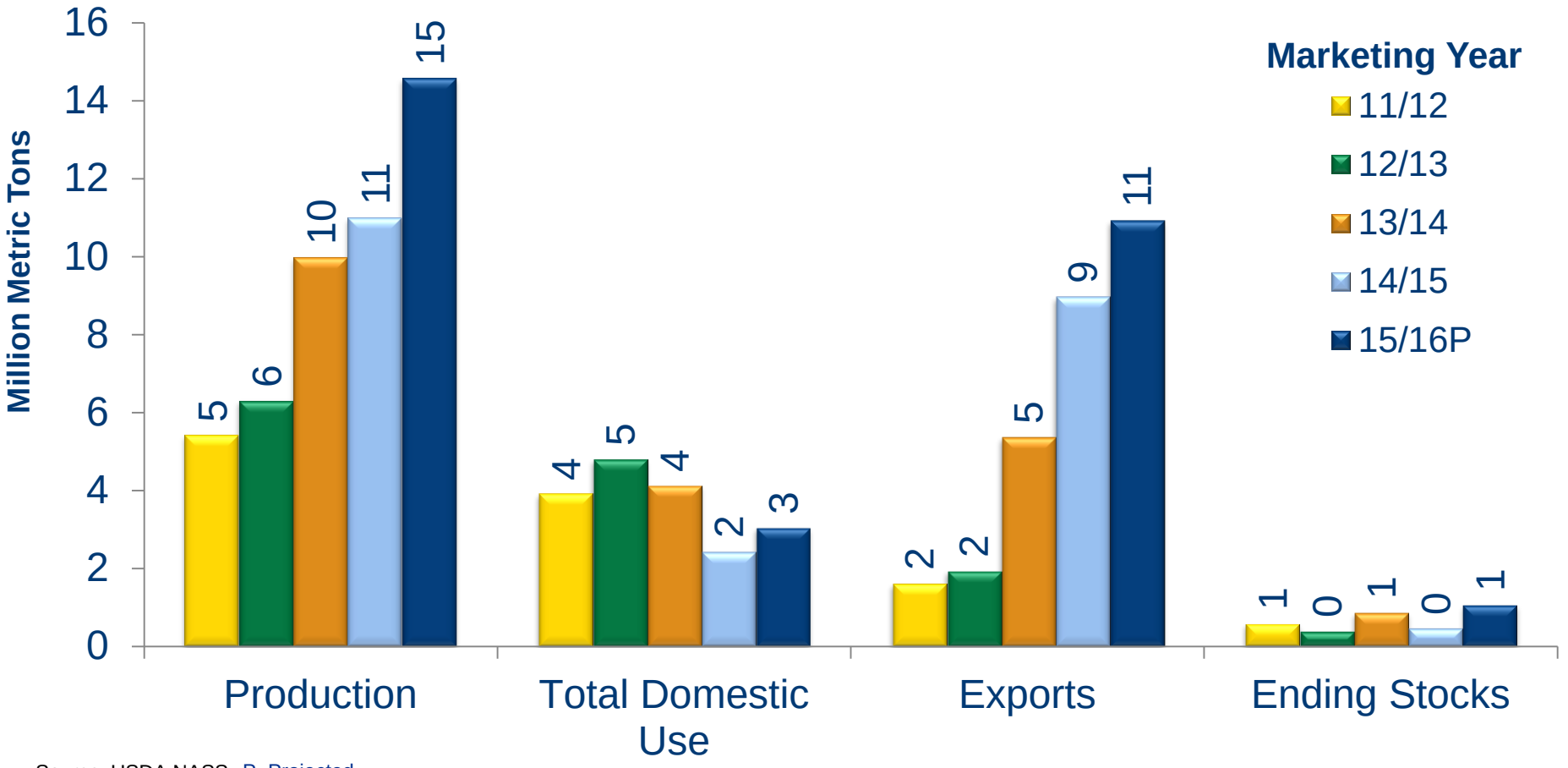


Source: USDA NASS P=Projected

U.S. GRAINS COUNCIL

U.S. Production and Disappearance

2015/2016 Sorghum
Early Harvest Quality Report

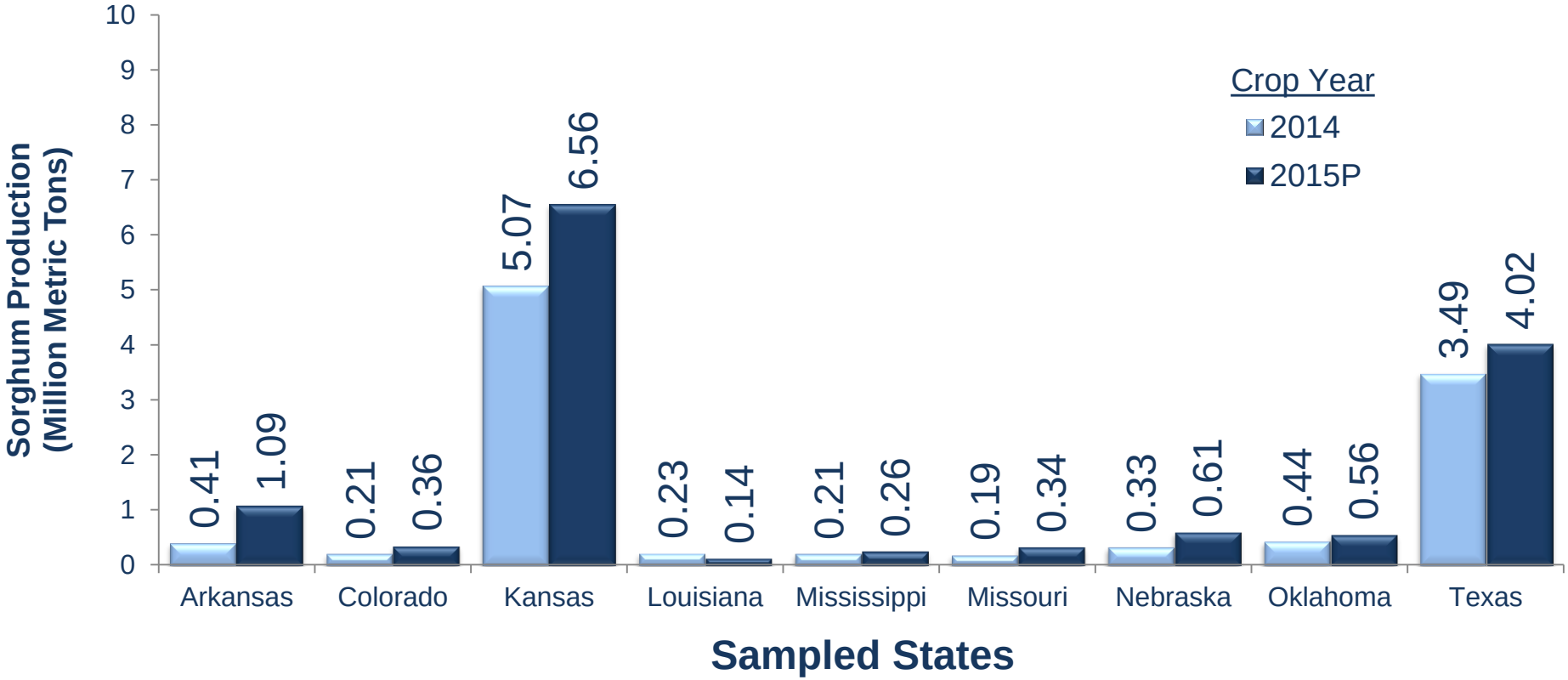


Source: USDA NASS P=Projected

U.S. GRAINS COUNCIL

U.S. Production by State

2015/2016 Sorghum
Early Harvest Quality Report

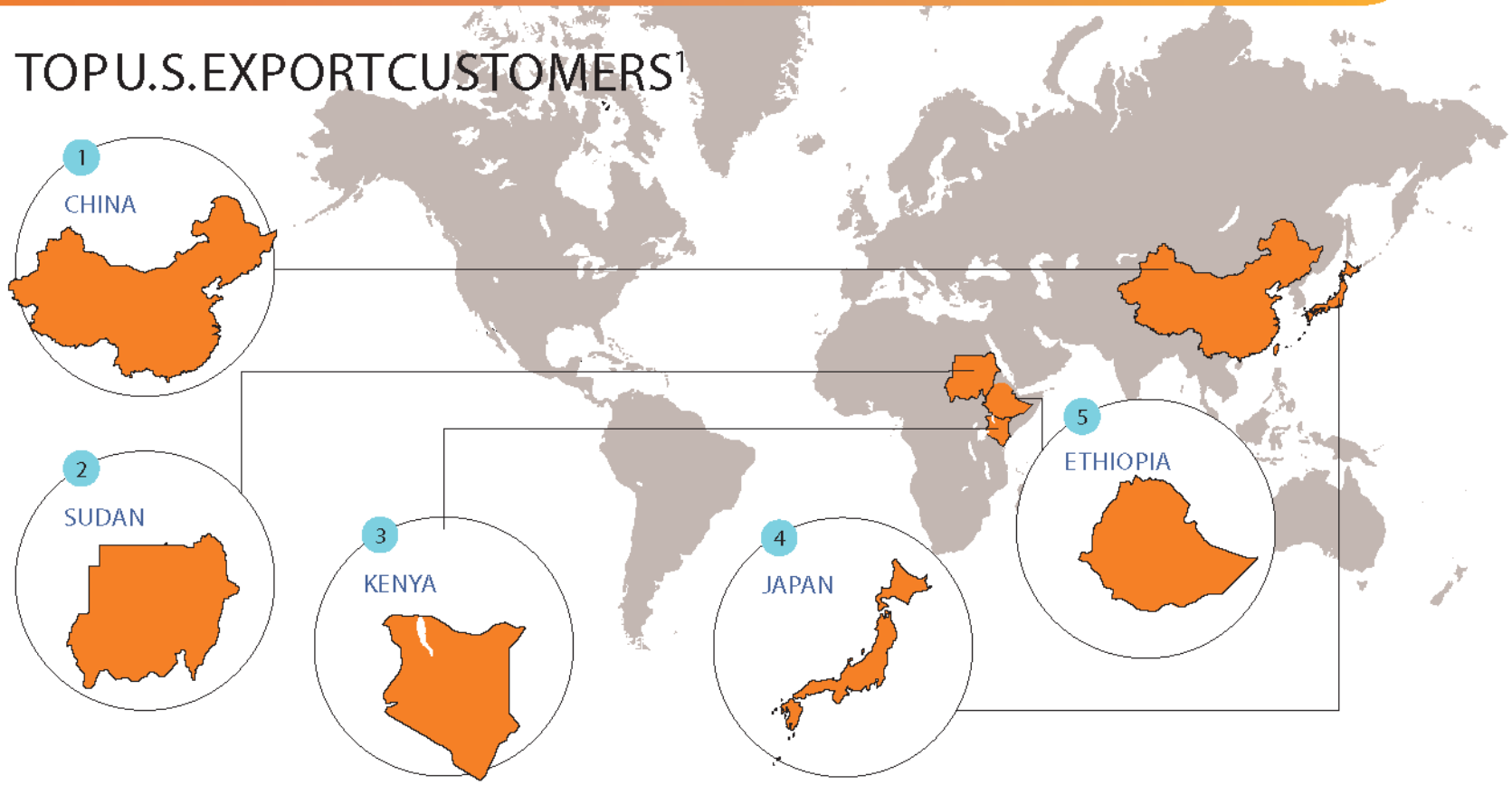


Source: USDA NASS P=Projected

U.S. GRAINS COUNCIL

Where is U.S. Sorghum Going?

TOP U.S. EXPORT CUSTOMERS[1]



Dollar amount

1	CHINA	$1.97 BILLION
2	SUDAN	$51.8 MILLION
3	KENYA	$27.8 MILLION
4	JAPAN	$17.7 MILLION
5	ETHIOPIA	$12.8 MILLION

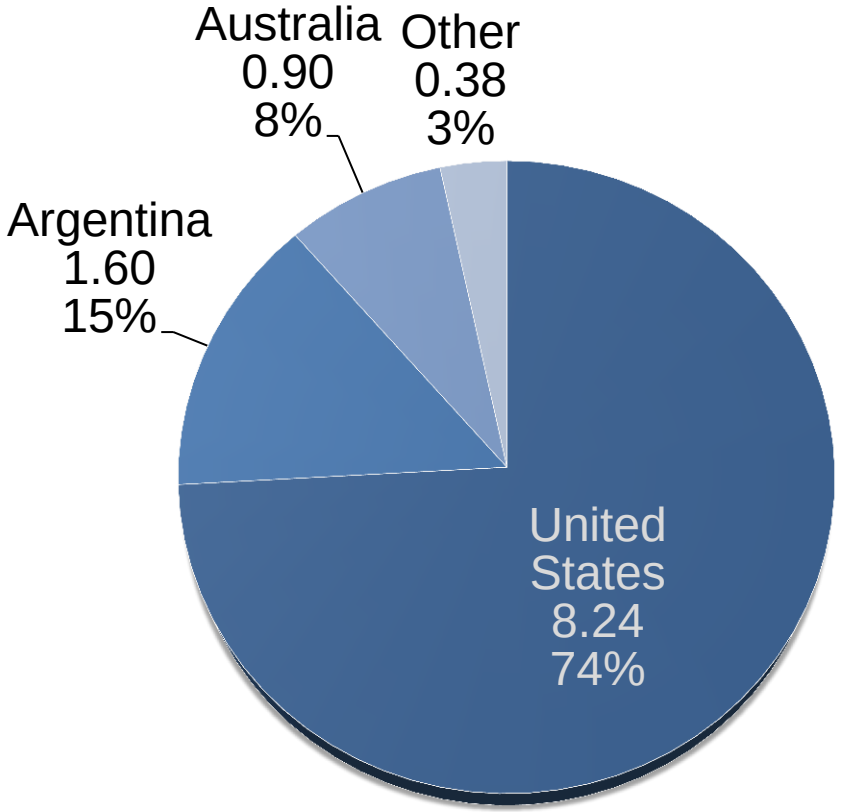
Metric tons

Source: [1]USDA Global Agricultural Trade System report for marketing year Sept 1, 2014 to Aug 31, 2015

U.S. GRAINS COUNCIL
www.grains.org

Key Global Sorghum Exporters

2015/2016 Sorghum
Early Harvest Quality Report



2015/2016P
(Million Metric Tons)

Source: USDA FAS P=Projected

U.S. GRAINS COUNCIL

Early Harvest 2015 Highlights

Grade Factors

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

Moisture

- Drying may have been needed for part of the Early Harvest crop

Chemical Composition

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

Physical Factors

- Values were generally typical for kernels from any sorghum crop

Grade Factors and Moisture

U.S. GRAINS COUNCIL

Grades and Grade Requirements

2015/2016 Sorghum
Early Harvest Quality Report

Grade	Min. Test Weight per Bushel (Pounds)	Maximum Limits of Heat Damaged (%)	Maximum Limits of Total Damage (%)	Maximum Limits of Foreign Material (part of total) (%)	Maximum Limits of 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

2015/2016 Sorghum
Early Harvest Quality Report

	No. of Samples	Avg.	Std. Dev.	Min.	Max.
Test Weight (lb/bu)	50	57.9	2.20	46.3	62.0
Test Weight (kg/hl)	50	74.5	2.84	59.6	79.8
BNFM (%)	50	1.4	0.62	0.5	4.5
Foreign Material (%)	50	0.5	0.27	0.1	2.1
Total Damage (%)	50	0.2	0.38	0.0	5.7
Heat Damage (%)	50	0.0	0.00	0.0	0.0
Moisture (%)	50	14.5	0.88	11.7	17.3

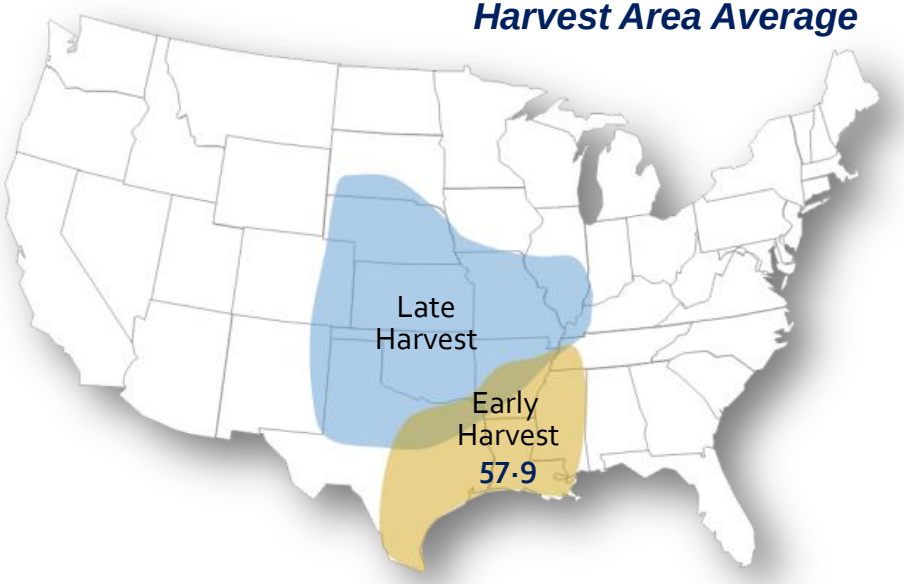
Test Weight – U.S. Units

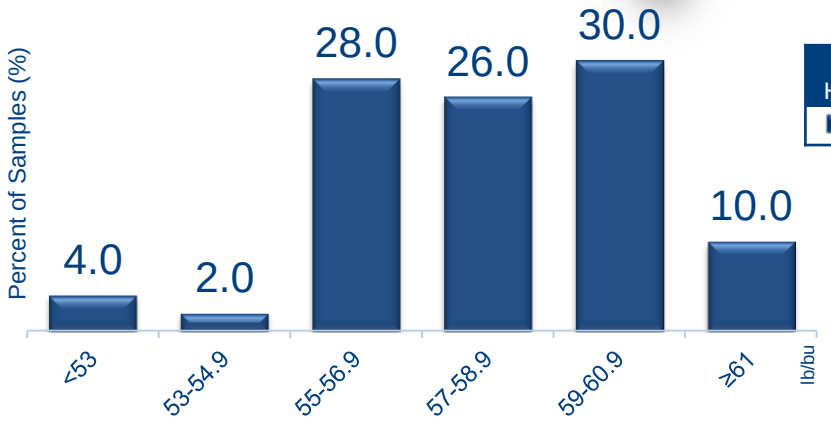
2015/2016 Sorghum
Early Harvest Quality Report

Early Harvest:
57.9 lb/bu

- Average above the minimum for No. 1 grade
- 94% of the samples at or above the limit for No. 2 grade

Test Weight (lb/bu)
Harvest Area Average





Early Harvest	Avg (lb/bu)	Std Dev (lb/bu)
2015	57.9	2.20

U.S. GRAINS COUNCIL

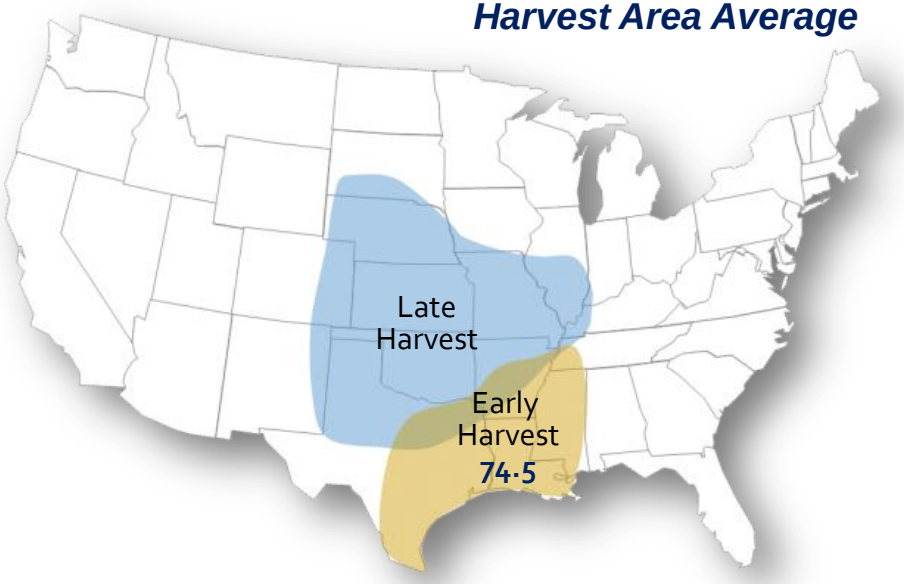
Test Weight - Metric

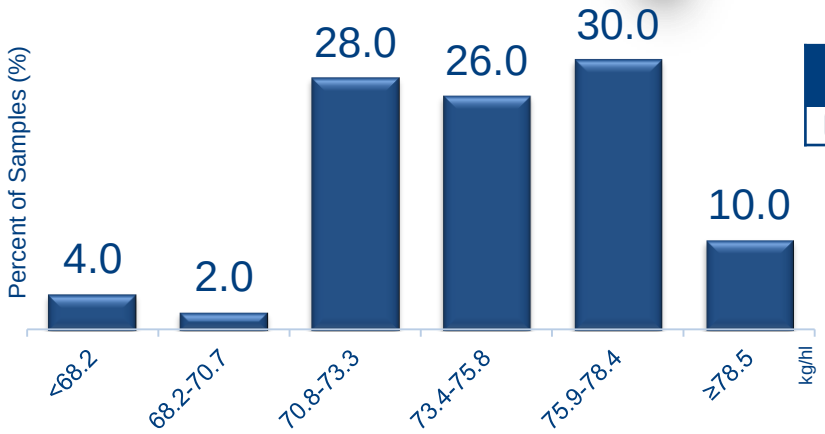
2015/2016 Sorghum
Early Harvest Quality Report

Early Harvest:
74.5 kg/hl

- Average above the minimum for No. 1 grade
- 94% of the samples at or above the limit for No. 2 grade

Test Weight (kg/hl)
Harvest Area Average





Early Harvest	Avg (kg/hl)	Std Dev (kg/hl)
2015	74.5	2.84

U.S. GRAINS COUNCIL

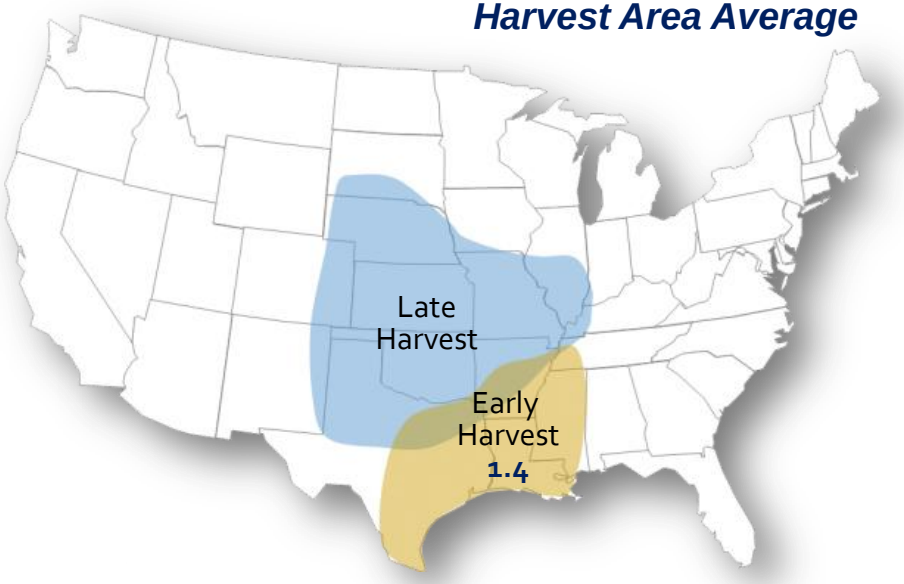
Broken Kernels & Foreign Material (BNFM) (%)

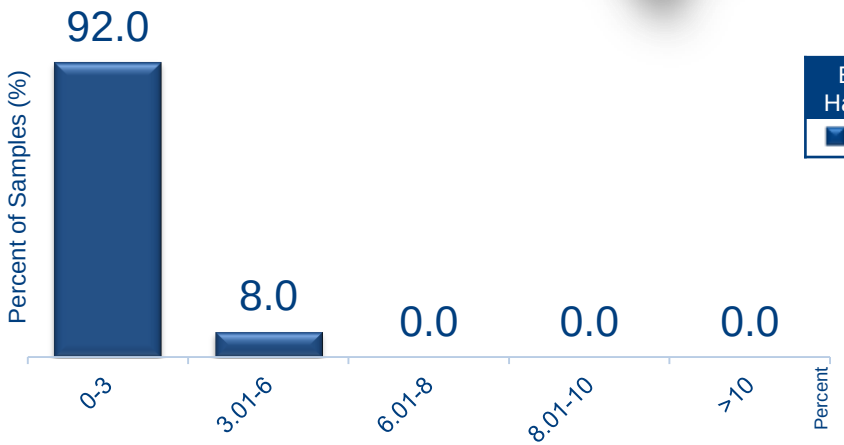
2015/2016 Sorghum
Early Harvest Quality Report

Early Harvest: 1.4%

- Average well below the maximum for No. 1 grade
- All samples were below the maximum for No. 2 grade

BNFM (%)
Harvest Area Average





Early Harvest	Avg (%)	Std Dev (%)
2015	1.4	0.62

U.S. GRAINS COUNCIL

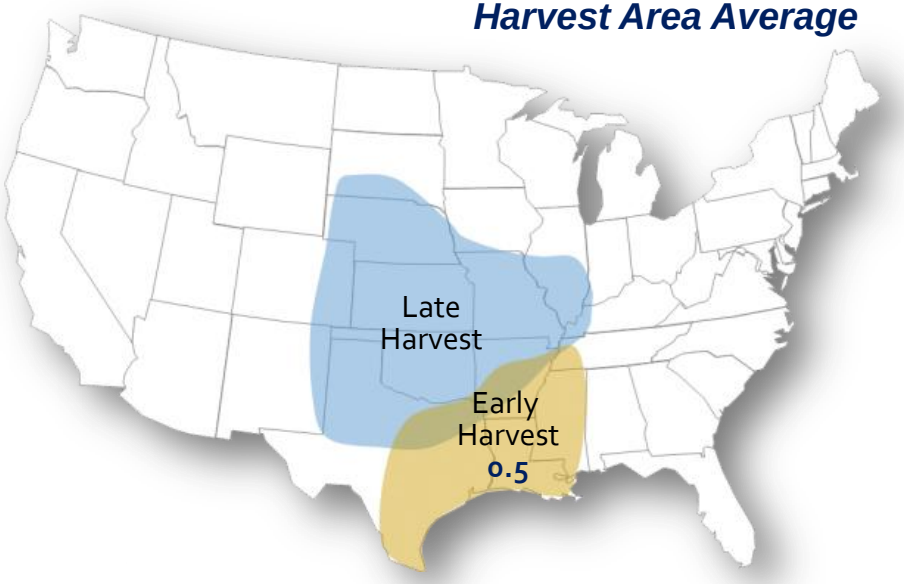
Foreign Material (%)

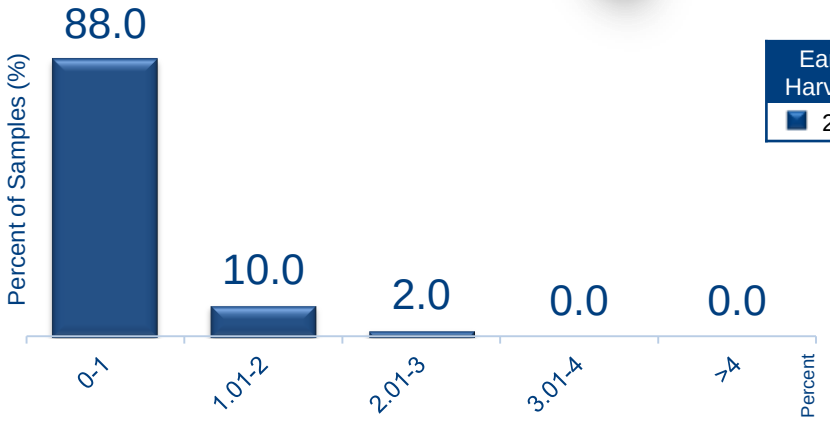
2015/2016 Sorghum
Early Harvest Quality Report

Early Harvest:
0.5%

- Average below the maximum for No. 1 grade
- 98% of the samples contained less than the maximum FM allowable for No. 2 grade

Foreign Material (%)
Harvest Area Average





Early Harvest	Avg (%)	Std Dev (%)
2015	0.5	0.27

U.S. GRAINS COUNCIL

Total Damage and Heat Damage (%)

2015/2016 Sorghum
Early Harvest Quality Report

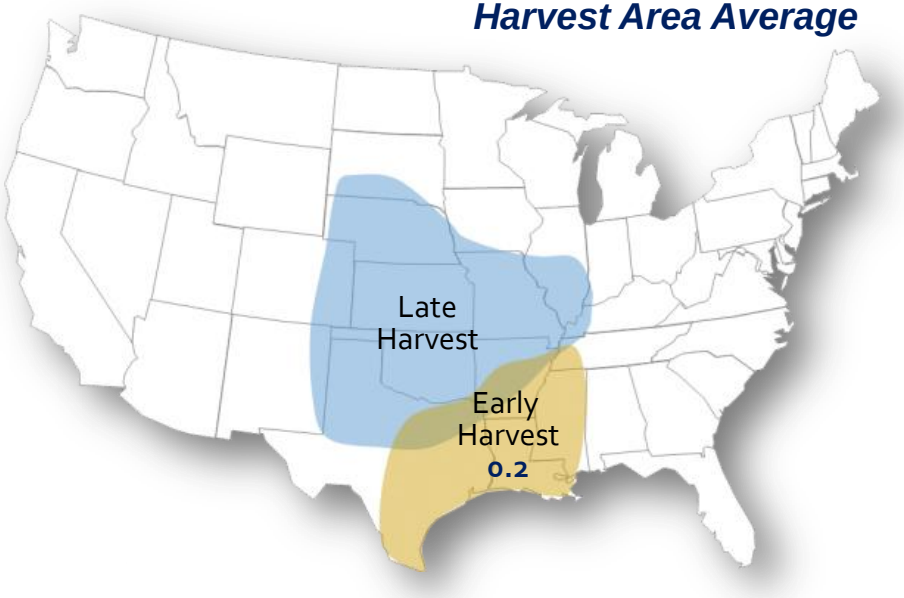
Total Damage
Early Harvest: 0.2%

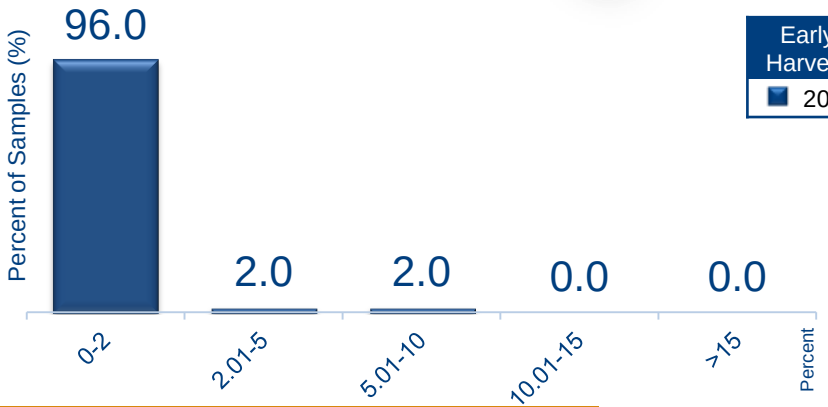
- Average well below the maximum for No. 1 grade
- 98% had less than the maximum allowable for No. 2 grade

Heat Damage: Zero

- Not expected at harvest

Total Damage (%)
Harvest Area Average





Early Harvest	Avg (%)	Std Dev (%)
2015	0.2	0.38

U.S. GRAINS COUNCIL

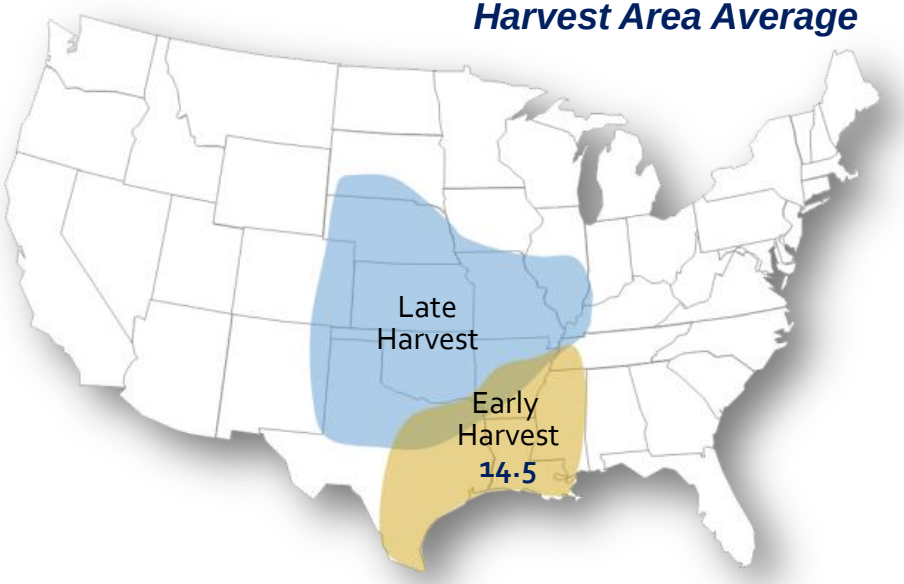
Moisture (%)

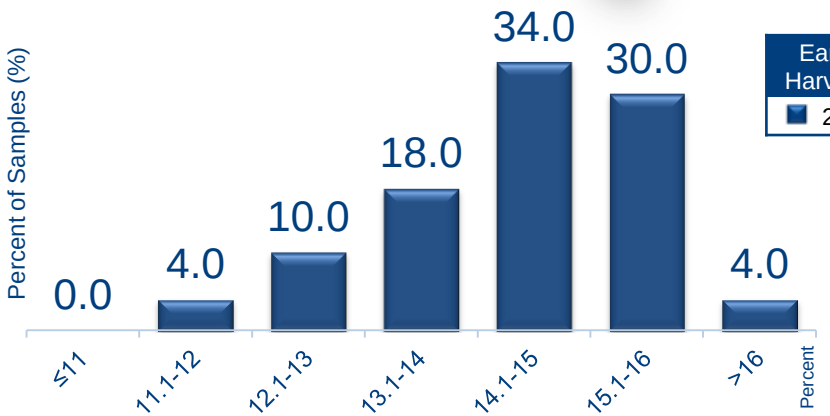
2015/2016 Sorghum
Early Harvest Quality Report

Early Harvest: 14.5%

- Considered normal variability
- 68% exceeded 14% moisture
- Drying may have been needed for part of the Early Harvest crop

Moisture (%)
Harvest Area Average





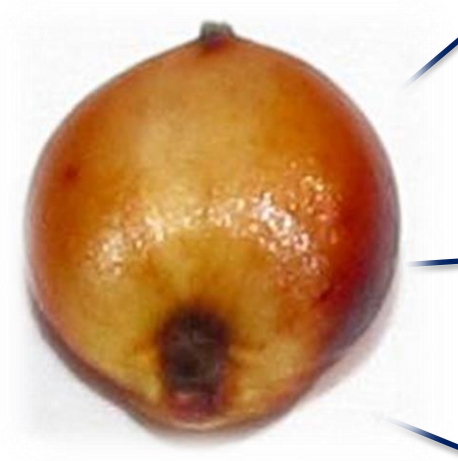
Early Harvest	Avg (%)	Std Dev (%)
2015	14.5	0.88

U.S. GRAINS COUNCIL

Chemical Composition

U.S. GRAINS COUNCIL

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

U.S. GRAINS COUNCIL

Chemical Composition Factors

2015/2016 Sorghum
Early Harvest Quality Report

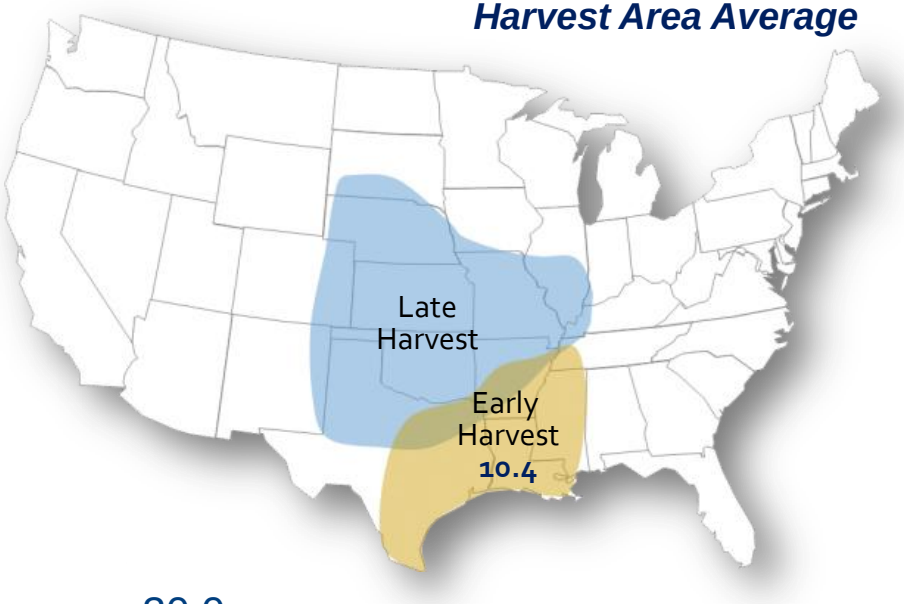
	No. of Samples	Avg.	Std. Dev.	Min.	Max.
Protein (Dry Basis %)	50	10.4	0.75	7.1	12.7
Starch (Dry Basis %)	50	73.3	0.69	71.1	75.0
Oil (Dry Basis %)	50	4.3	0.31	3.0	5.0
Tannins (mg CE/g)	50	0.577	0.339	0.050	1.560

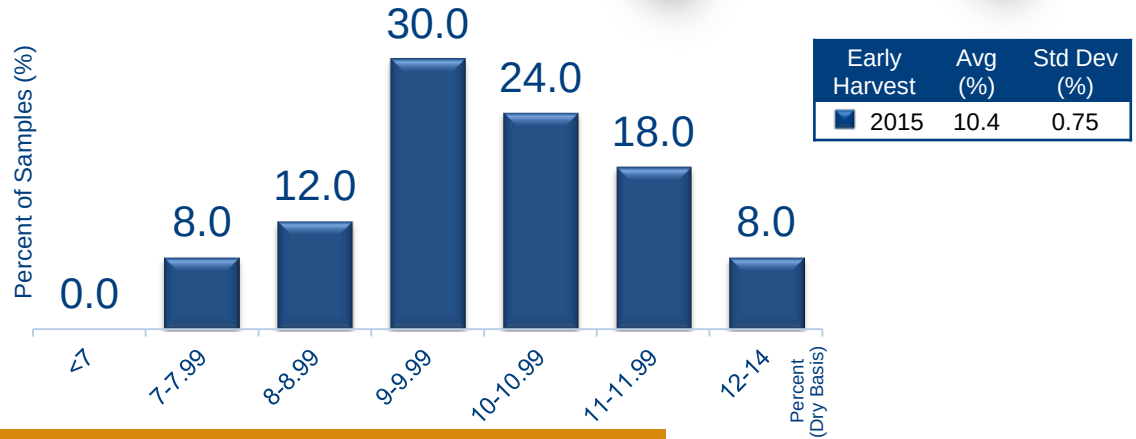
Protein (Dry basis %)

Early Harvest: 10.4%

- On the lower end of typical protein concentration values in literature for U.S. sorghum

Protein (%)
Harvest Area Average





Early Harvest	Avg (%)	Std Dev (%)
2015	10.4	0.75

U.S. GRAINS COUNCIL

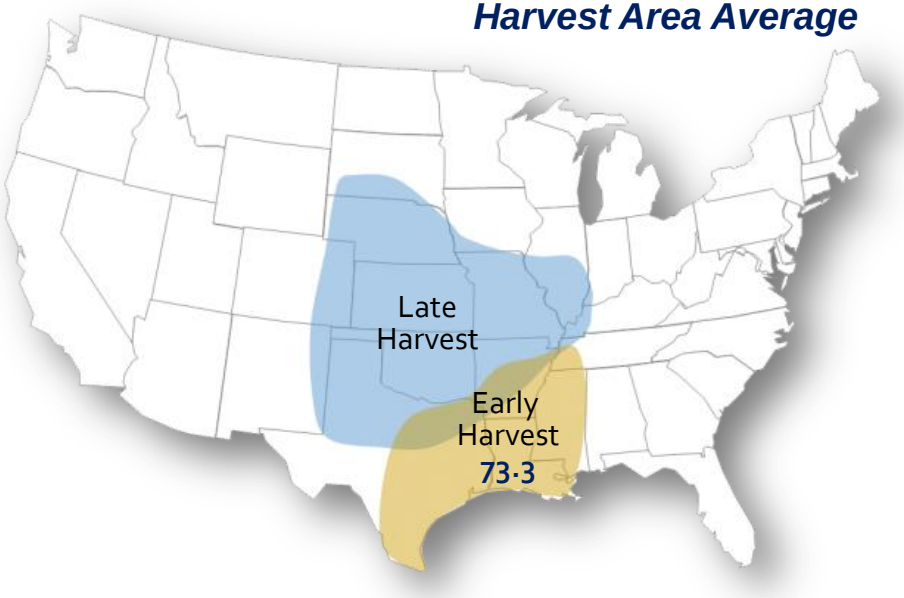
Starch (Dry basis %)

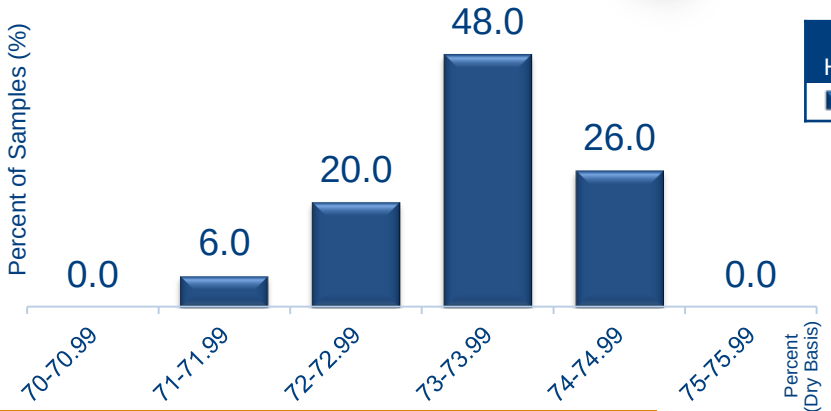
2015/2016 Sorghum
Early Harvest Quality Report

Early Harvest: 73.3%

- Typical level for any sorghum crop

Starch (%)
Harvest Area Average





Early Harvest	Avg (%)	Std Dev (%)
2015	73.3	0.69

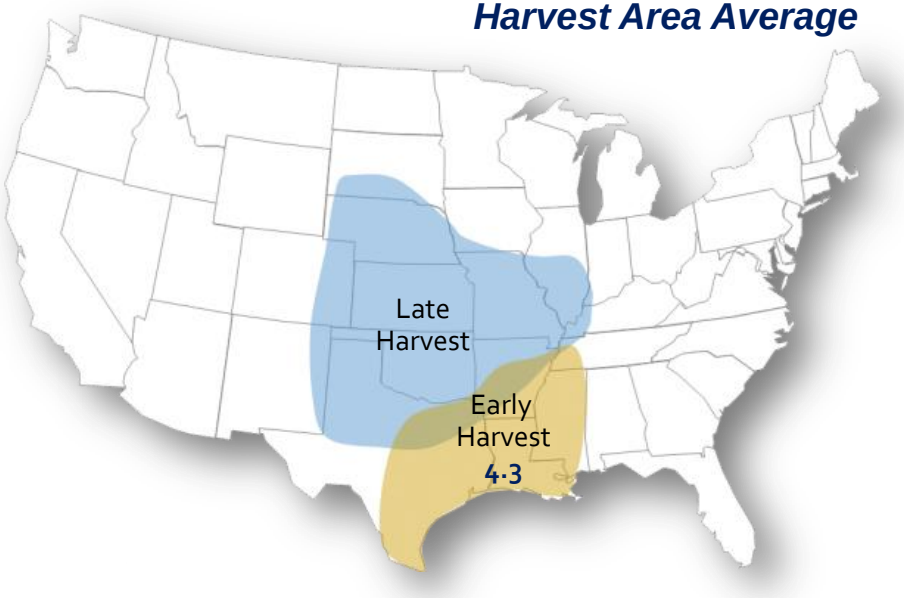
U.S. GRAINS COUNCIL

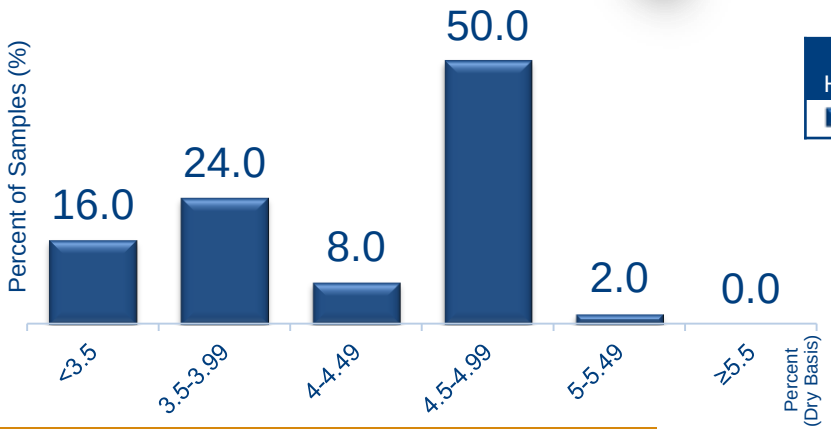
Oil (Dry basis %)

Early Harvest: 4.3%

- On the higher end of typical oil concentration values in literature for U.S. sorghum

Oil (%)
Harvest Area Average



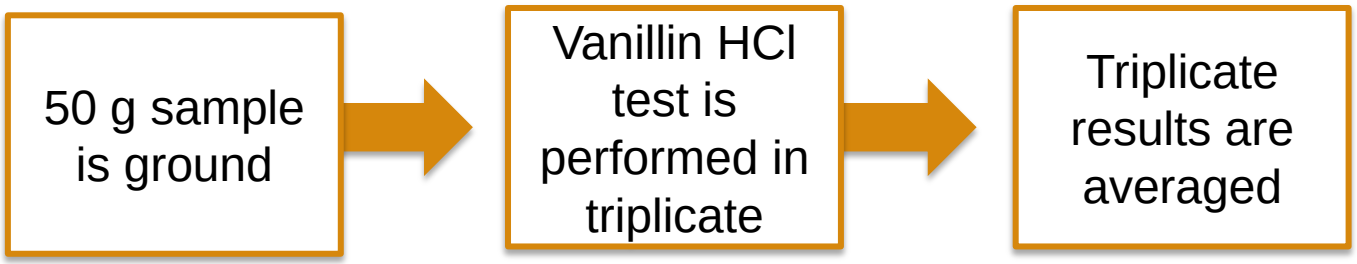


Early Harvest	Avg (%)	Std Dev (%)
2015	4.3	0.31

U.S. GRAINS COUNCIL

Tannins Testing

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

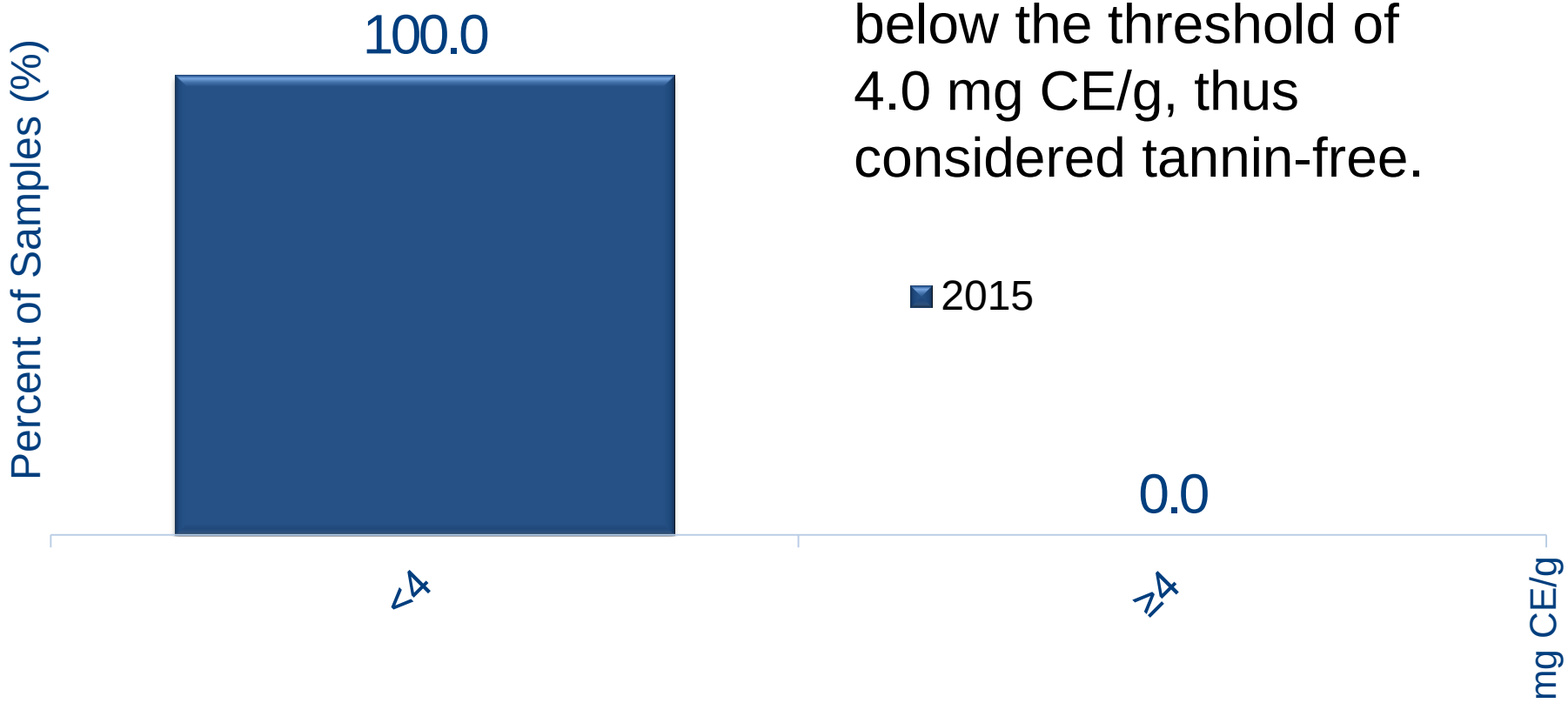


- Values near or below 4.0 mg catechin equivalents (CE) per one g sample by this method generally imply absence of condensed tannins.[1,2]
- Type III tannin sorghums usually have values greater than 8.0 mg CE/g.

[1] Awika, J.M., L.W. Rooney, 2004. Sorghum phytochemicals and their potential impact on human health. Phytochemistry 65, 1199-1221.
[2] Price, 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 Early Harvest sorghum samples were below the threshold of 4.0 mg CE/g, thus considered tannin-free.



U.S. GRAINS COUNCIL

Physical Factors

U.S. GRAINS COUNCIL

Physical Factors – Overview

Related to processing characteristics, storability and potential for breakage

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

Physical Factors

2015/2016 Sorghum
Early Harvest Quality Report

	No. of Samples	Avg.	Std. Dev.	Min.	Max.
Kernel Diameter (mm)	50	2.54	0.10	2.20	2.90
1000-Kernel Weight (g)	50	25.97	2.32	19.5	32.10
Kernel Volume (mm^3)	50	19.22	1.61	14.56	23.46
True Density (g/cm^3)	50	1.350	0.015	1.295	1.382
Kernel Hardness Index	50	68.5	6.9	37.1	84.0

Kernel Weight, Volume, Density

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

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

- 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

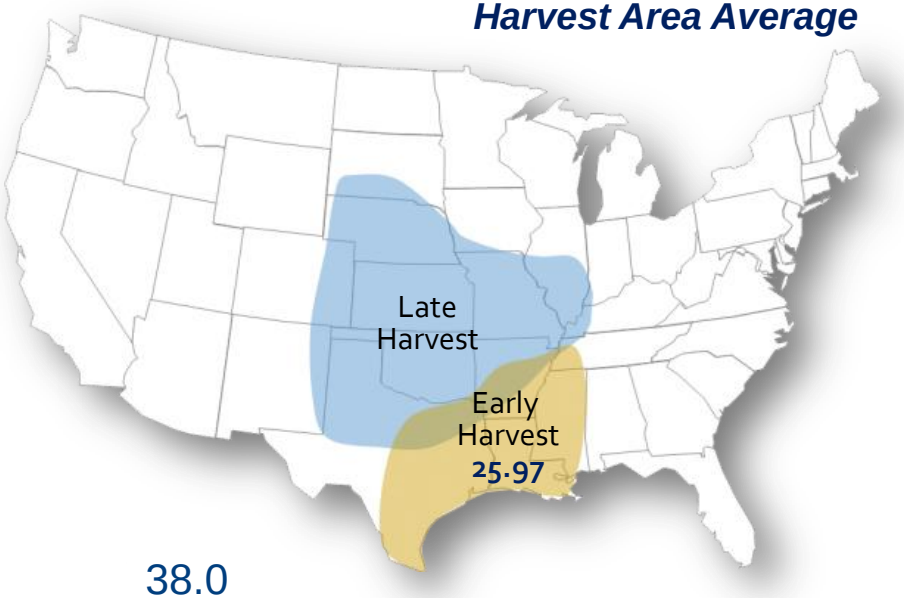
1000-kernel (1000-k) Weight (g)

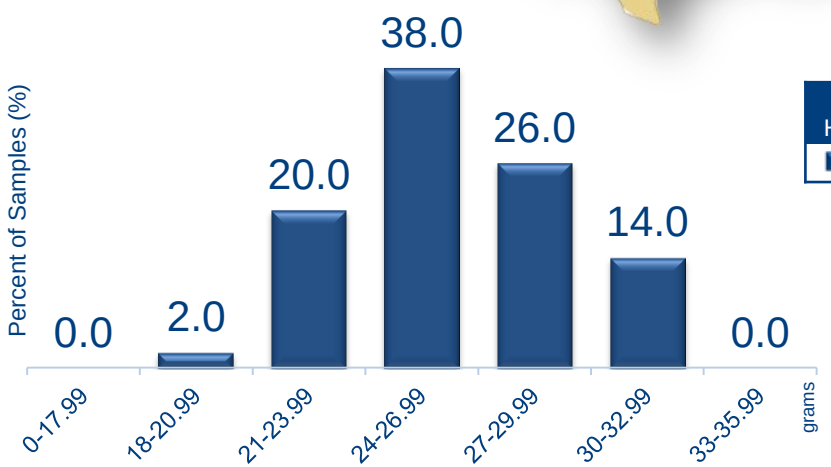
2015/2016 Sorghum
Early Harvest Quality Report

Early Harvest:
25.97 g

- On the lower end of typical levels in literature for U.S. sorghum

1000-Kernel Weight (g)
Harvest Area Average





Early Harvest	Avg (g)	Std Dev (g)
2015	25.97	2.32

U.S. GRAINS COUNCIL

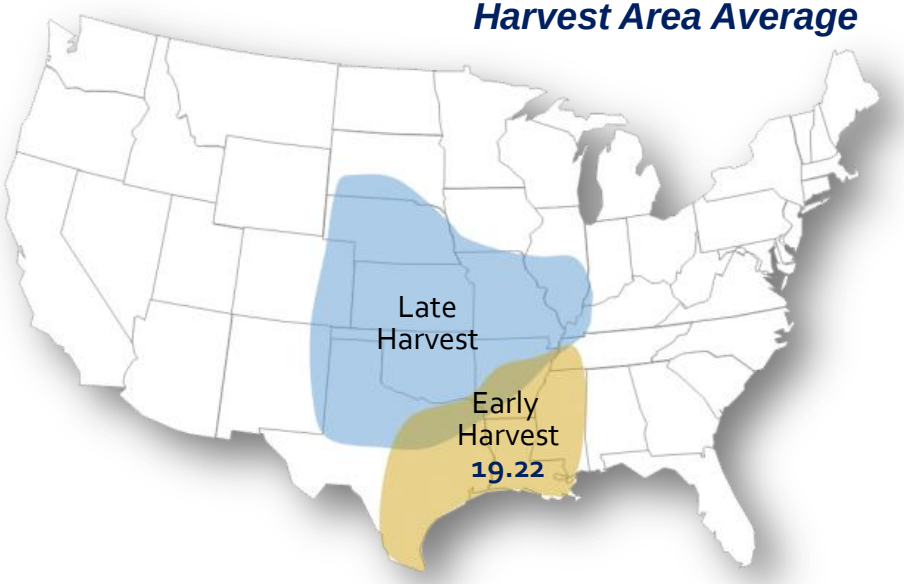
Kernel Volume (mm³)

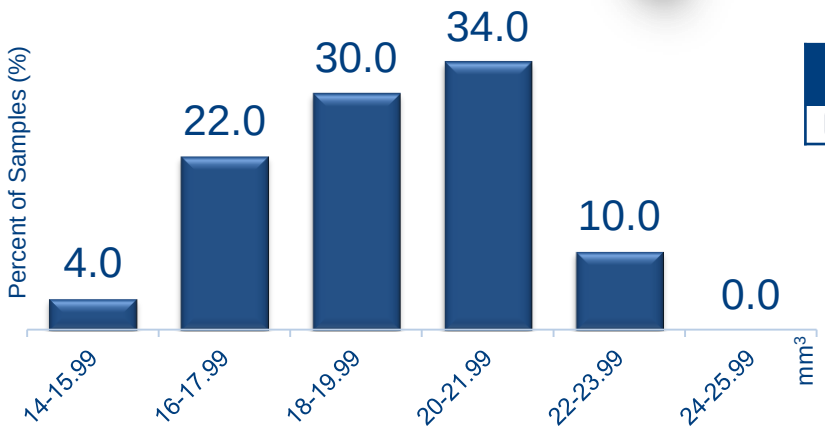
2015/2016 Sorghum
Early Harvest Quality Report

Early Harvest: 19.22 mm³

- Typical values for kernels from any sorghum crop

Kernel Volume (mm³) Harvest Area Average





Early Harvest	Avg (mm³)	Std Dev (mm³)
2015	19.22	1.61

U.S. GRAINS COUNCIL

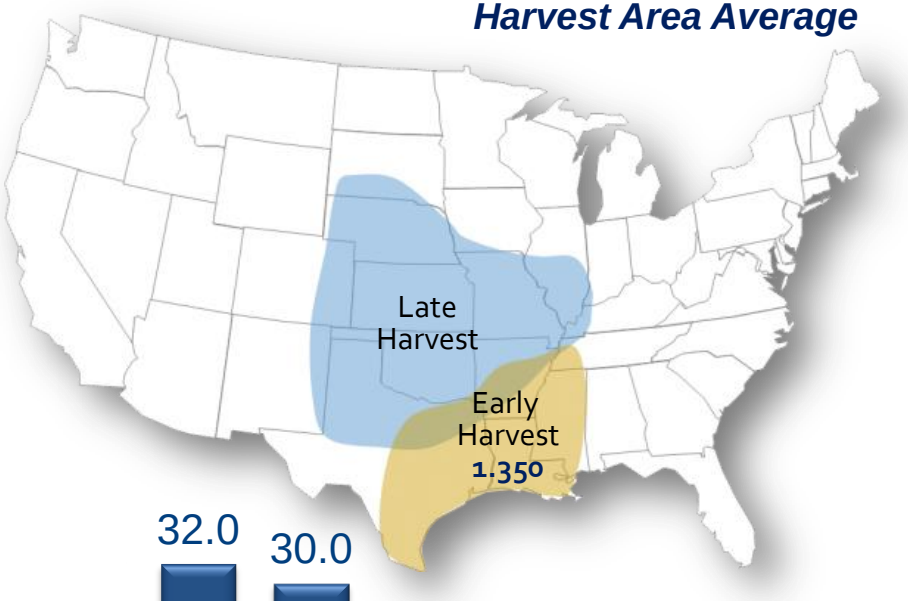
Kernel True Density (g/cm³)

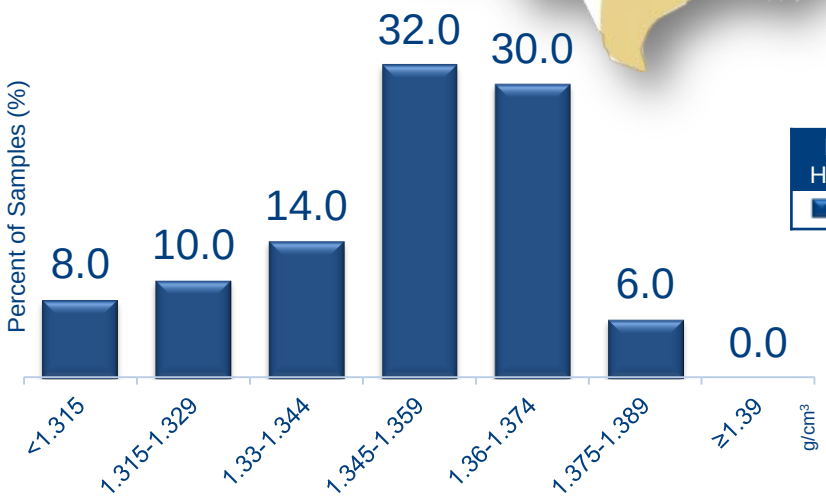
2015/2016 Sorghum
Early Harvest Quality Report

Early Harvest: 1.350 g/cm³

- Typical values for kernels from any sorghum crop
- Average within range of feed sorghum

Kernel True Density (g/cm³)
Harvest Area Average





Early Harvest	Avg (g/cm³)	Std Dev (g/cm³)
2015	1.350	0.015

U.S. GRAINS COUNCIL

Other Physical Properties

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

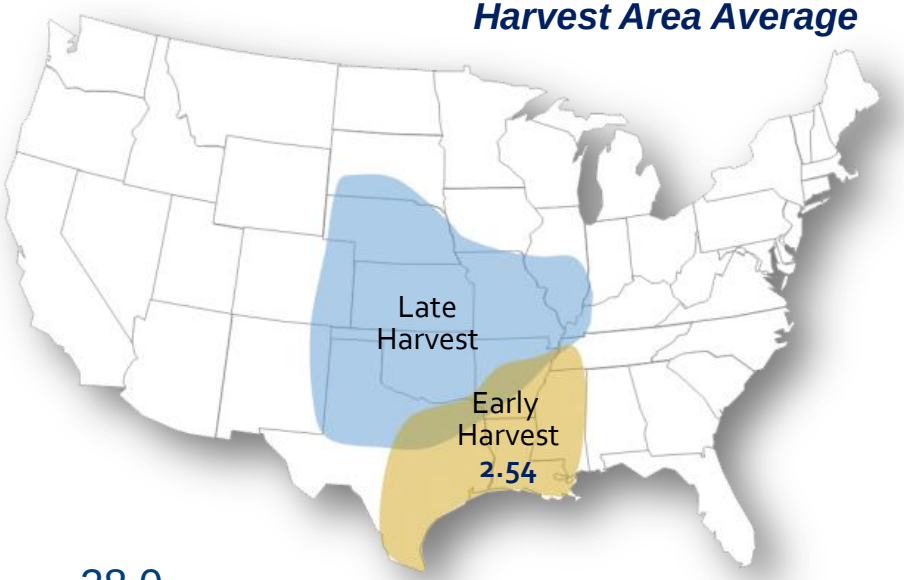
Kernel Diameter (mm)

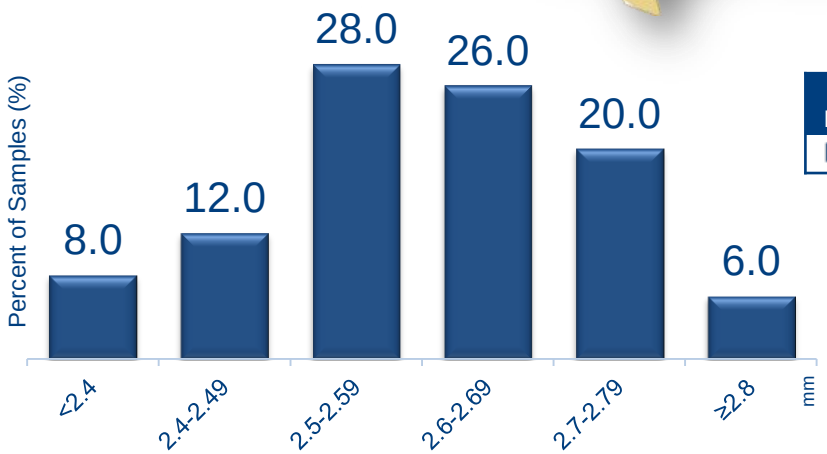
2015/2016 Sorghum
Early Harvest Quality Report

Early Harvest:
2.54 mm

- Typical values for kernels from any sorghum crop

Kernel Diameter (mm)
Harvest Area Average





Early Harvest	Avg (mm)	Std Dev (mm)
2015	2.54	0.10

U.S. GRAINS COUNCIL

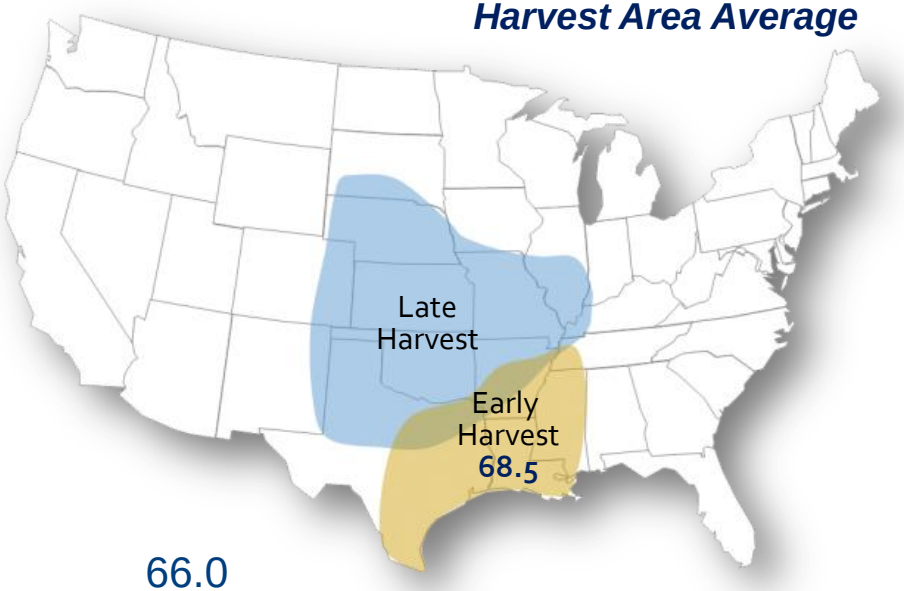
Kernel Hardness Index (KHI)

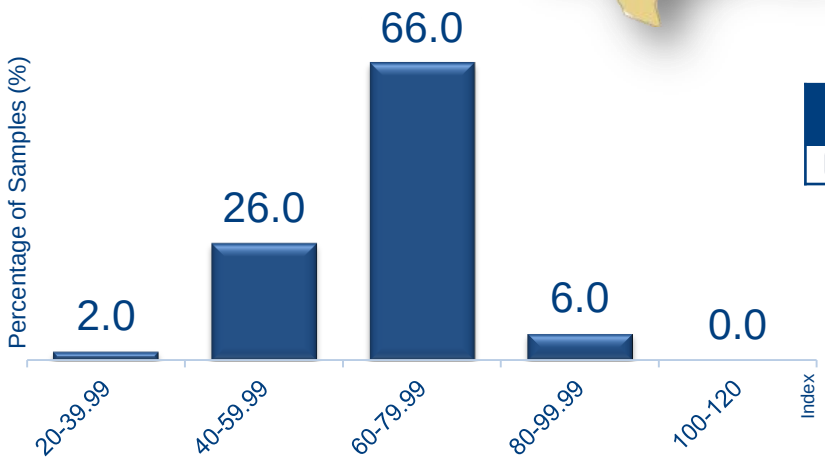
2015/2016 Sorghum
Early Harvest Quality Report

Early Harvest:
68.5

- Average is a typical value for any sorghum crop

Kernel Hardness Index(KHI)
Harvest Area Average





Early Harvest	Avg	Std Dev
2015	68.5	6.9

U.S. GRAINS COUNCIL

Tool for Better Decision Making

2015/2016 Sorghum
Early Harvest Quality Report

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
Annual Series	Provides information for evaluating patterns in quality across geographies, how weather affects quality, and changes in quality between harvest and export
2015/ 2016	*2015/2016 Sorghum Harvest and Export Cargo Quality Report* in December 2015 or early January 2016 will report U.S. sorghum quality from entire harvest area and samples at export points early in the marketing year

Building a Tradition: Thank You!

U.S. GRAINS COUNCIL

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