



University of California
Agriculture and Natural Resources

Making a Difference for California

Sorghum as a California Dairy Forage

Jennifer Heguy – UC Cooperative Extension Farm Advisor
Merced, Stanislaus & San Joaquin Counties

Alfalfa & Forage Field Day, September 23, 2020, *Virtual*

Outline

- **Sorghum silage practices**
 - Dairy producer surveys
- **Sorghum silage quality**
 - Nutrient composition
 - Nutrient availability
 - Physical characteristics





University of California
Agriculture and Natural Resources

Making a Difference for California

Sorghum Silage Management Surveys

Farm Demographics

General Information; 16 dairies enrolled, 14 returned survey #1

- Locations:
 - Stanislaus (1); Merced (1); Madera (2); Fresno (1); Tulare (8); Kings (3)
- Herd size: 320 – 5,500 milking cows (median=2,013)
- Sorghum acres: 42 – 574 acres (median 188)
- Years growing sorghum (past 5 years)
 - Average: 2.8 years
 - 1st year growing sorghum for 4 producers

Yields - Dairy Fields

- **Self reported yields from 2016 survey (n=8)**
 - Average sorghum yield 17.8 tons/acre
 - Range: 8 – 25 tons/acre
- **Two fields tracked in 2016, no sugar cane aphid**
 - **Fresno County, 80 acres, grain variety**
 - 22.4 tons/acre @ 27.6% DM
 - Corrected: 20.6 tons/acre @ 30% DM
 - **Stanislaus County, 80 acres, forage variety**
 - 13 tons/acre @ 25.6% DM
 - Corrected: 11.1 tons/acre @ 30% DM



University of California
Agriculture and Natural Resources

Making a Difference for California

Sorghum Quality

Forage vs Grain

Summer/Fall 2016: Snapshot of sorghum grown for silage on California dairies.

- At harvest, 10 consecutive truckloads of chopped sorghum were sampled and composited
 - Sent off for wet chemistry analysis



Nutrient Analysis

Nutrient Composition of BMR Sorghum (n = 10)

	DM	CP	ADF	NDF	Ash	Starch	NDFD 30	NFC
Average	28.3	9.7	34.4	50.2	12.4	9.8	50.2	25.5
Median	28.3	9.7	34.7	50.4	11.7	9.6	51.2	26.4
Minimum	23.2	7.7	30.4	44.9	9.2	2.5	35.1	14.4
Maximum	34.6	11.4	39.3	55.3	21.5	22.3	60.3	32.9

NDFD 30:

Goal: 62.9 (85th percentile)

Average: 53.8

Minimum: 42.7 (15th percentile)

Based on population statistics from 4 years of data with 600k + US samples

Nutrient Analysis

Nutrient Composition of BMR Sorghum (n = 10)

	DM	CP	ADF	NDF	Ash	Starch	NDFD 30	NFC
Average	28.3	9.7	34.4	50.2	12.4	9.8	50.2	25.5
Median	28.3	9.7	34.7	50.4	11.7	9.6	51.2	26.4
Minimum	23.2	7.7	30.4	44.9	9.2	2.5	35.1	14.4
Maximum	34.6	11.4	39.3	55.3	21.5	22.3	60.3	32.9

NDFD 30:

Goal: 62.9 (85th percentile)

Average: 53.8

Minimum: 42.7 (15th percentile)

Based on population statistics from 4 years of data with 600k + US samples

Nutrient Analysis

Nutrient Composition of BMR Sorghum (n = 10)

	↓	↑	↑	↑	↑	↓	↓	↓
	DM	CP	ADF	NDF	Ash	Starch	NDFD 30	NFC
Average	28.3	9.7	34.4	50.2	12.4	9.8	50.2	25.5
Median	28.3	9.7	34.7	50.4	11.7	9.6	51.2	26.4
Minimum	23.2	7.7	30.4	44.9	9.2	2.5	35.1	14.4
Maximum	34.6	11.4	39.3	55.3	21.5	22.3	60.3	32.9

NDFD 30:

Goal: 62.9 (85th percentile)

Average: 53.8

Minimum: 42.7 (15th percentile)

Based on population statistics from 4 years of data with 600k + US samples

Nutrient Analysis

Nutrient Composition of BMR Sorghum (n = 10)

	↓	↑	↑	↑	↑	↓	↓	↓
	DM	CP	ADF	NDF	Ash	Starch	NDFD 30	NFC
Average	28.3	9.7	34.4	50.2	12.4	9.8	50.2	25.5
Median	28.3	9.7	34.7	50.4	11.7	9.6	51.2	26.4
Minimum	23.2	7.7	30.4	44.9	9.2	2.5	35.1	14.4
Maximum	34.6	11.4	39.3	55.3	21.5	22.3	60.3	32.9

NDFD 30:

Goal: 62.9 (85th percentile)

Average: 53.8

Minimum: 42.7 (15th percentile)

Based on population statistics from 4 years of data with 600k + US samples

Nutrient Analysis

Nutrient Composition of BMR Sorghum (n = 10)

	↓	↑	↑	↑	↑	↓	↓	↓
	DM	CP	ADF	NDF	Ash	Starch	NDFD 30	NFC
Average	28.3	9.7	34.4	50.2	12.4	9.8	50.2	25.5
Median	28.3	9.7	34.7	50.4	11.7	9.6	51.2	26.4
Minimum	23.2	7.7	30.4	44.9	9.2	2.5	35.1	14.4
Maximum	34.6	11.4	39.3	55.3	21.5	22.3	60.3	32.9

NDFD 30:

Goal: 62.9 (85th percentile)

Average: 53.8

Minimum: 42.7 (15th percentile)

Based on population statistics from 4 years of data with 600k + US samples

Nutrient Analysis

Nutrient Composition of Grain Sorghum (n = 5)

	DM	CP	ADF	NDF	Ash	Starch	NDFD 30	NFC
Average	28.6	9.8	34.7	48.2	11.9	13.6	43.4	27.8
Median	28.2	10.6	34.0	45.6	12.2	14.5	41.2	28.9
Minimum	25.3	7.5	30.5	44.9	9.5	1.9	39.7	18.8
Max	32.5	11.7	40.2	53.3	15.4	22.5	53.2	35.6

NDFD 30:

Goal: 62.9 (85th percentile)

Average: 53.8

Minimum: 42.7 (15th percentile)

Based on population statistics from 4 years of data with 600k + US samples

Nutrient Analysis

Nutrient Composition of Grain Sorghum (n = 5)

	↓	↑	↑	↑	↑	↓	↓	↓
	DM	CP	ADF	NDF	Ash	Starch	NDFD 30	NFC
Average	28.6	9.8	34.7	48.2	11.9	13.6	43.4	27.8
Median	28.2	10.6	34.0	45.6	12.2	14.5	41.2	28.9
Minimum	25.3	7.5	30.5	44.9	9.5	1.9	39.7	18.8
Max	32.5	11.7	40.2	53.3	15.4	22.5	53.2	35.6

NDFD 30:

Goal: 62.9 (85th percentile)

Average: 53.8

Minimum: 42.7 (15th percentile)

Based on population statistics from 4 years of data with 600k + US samples

Nutrient Analysis

Nutrient Composition of Grain Sorghum (n = 5)

	↓	↑	↑	↑	↑	↓	↓	↓
	DM	CP	ADF	NDF	Ash	Starch	NDFD 30	NFC
Average	28.6	9.8	34.7	48.2	11.9	13.6	43.4	27.8
Median	28.2	10.6	34.0	45.6	12.2	14.5	41.2	28.9
Minimum	25.3	7.5	30.5	44.9	9.5	1.9	39.7	18.8
Max	32.5	11.7	40.2	53.3	15.4	22.5	53.2	35.6

NDFD 30:

Goal: 62.9 (85th percentile)

Average: 53.8

Minimum: 42.7 (15th percentile)

Based on population statistics from 4 years of data with 600k + US samples

Nutrient Analysis

Nutrient Composition of Grain Sorghum (n = 5)

	↓	↑	↑	↑	↑	↓	↓	↓
	DM	CP	ADF	NDF	Ash	Starch	NDFD 30	NFC
Average	28.6	9.8	34.7	48.2	11.9	13.6	43.4	27.8
Median	28.2	10.6	34.0	45.6	12.2	14.5	41.2	28.9
Minimum	25.3	7.5	30.5	44.9	9.5	1.9	39.7	18.8
Max	32.5	11.7	40.2	53.3	15.4	22.5	53.2	35.6

NDFD 30:

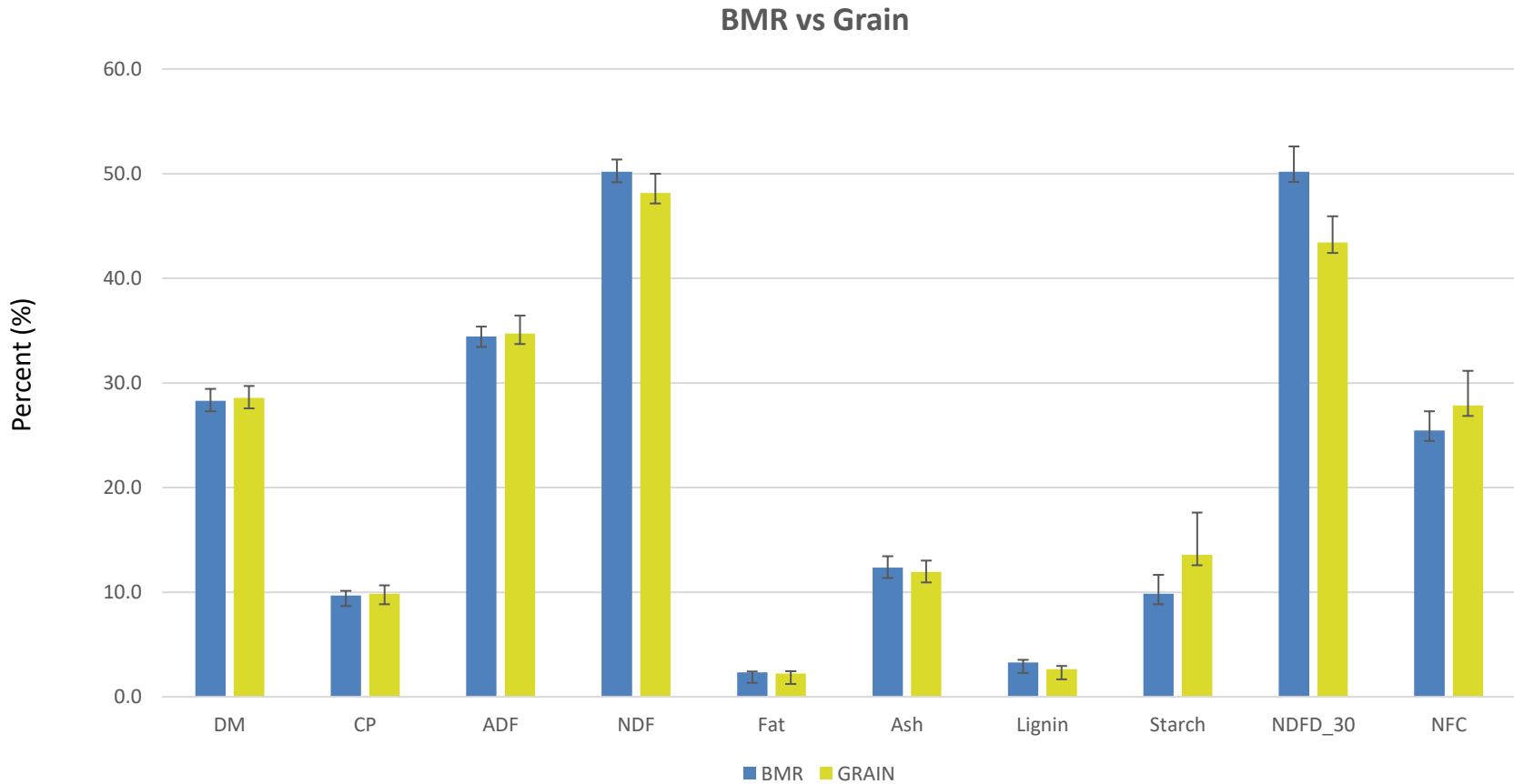
Goal: 62.9 (85th percentile)

Average: 53.8

Minimum: 42.7 (15th percentile)

Based on population statistics from 4 years of data with 600k + US samples

Nutrient Analysis

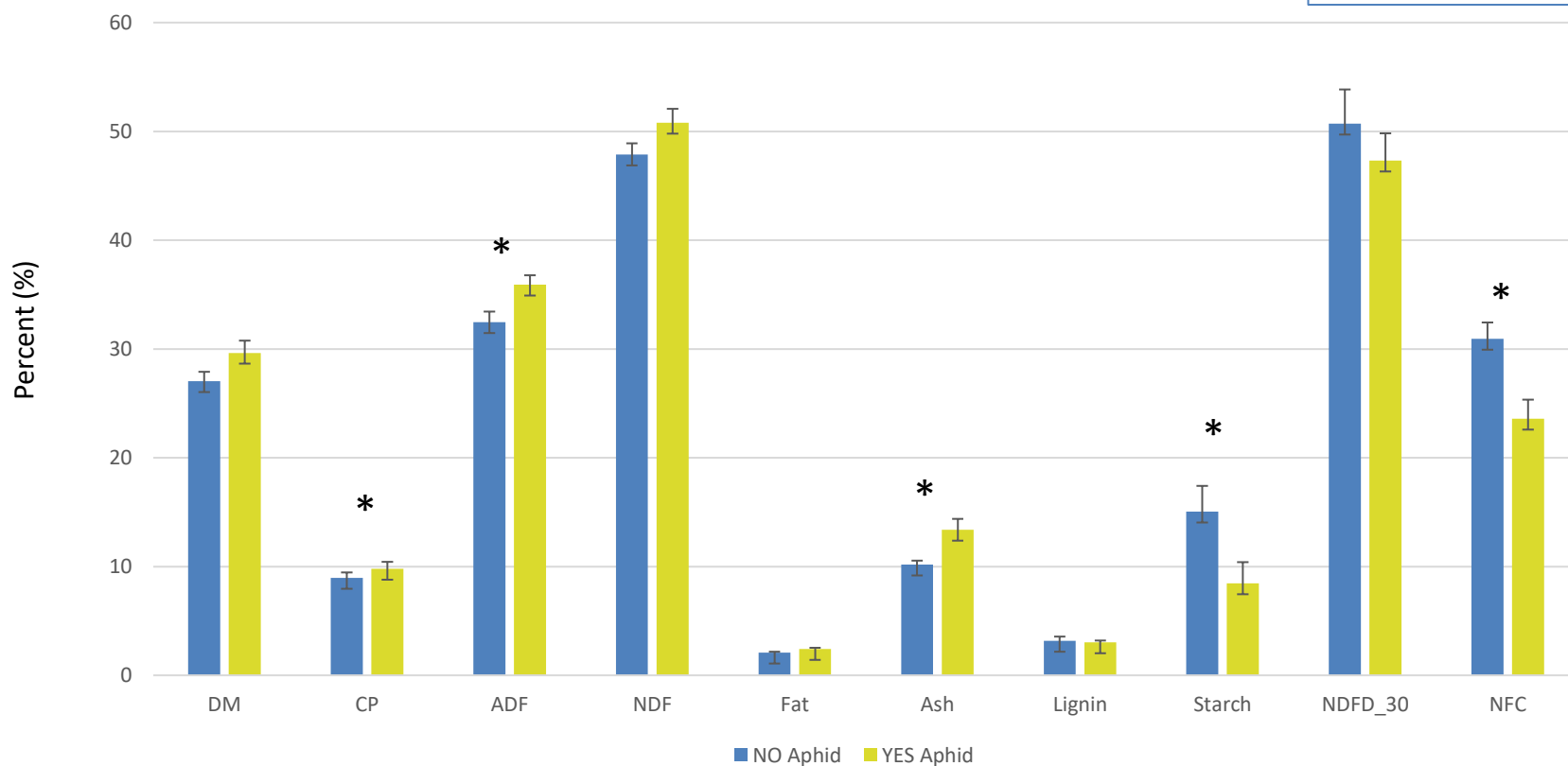


BMR & Grain samples not significantly different.

Nutrient Analysis

Aphid Effect on Nutrient Profile (All Samples)

NO Aphid (n=6)
YES Aphid (n=10)



* CP, ADF, Ash, Starch & NFC were significantly different.

Nutrient Composition

Nutrient composition of sorghum silage (n=15)

	% of DM							
	DM	CP	ADF	NDF	Starch	NFC	Asp	
Mean	29.3	8.5	33.9	49.1	12.0	37.5	10.9	48.9
Median	29.7	8.9	34.0	49.1	12.0	37.5	10.9	48.6
Minimum	22.0	7.0	30.0	45.0	1.4	15.3	8.9	32.2
Maximum	37.0	10.0	41.3	59.4	29.3	41.2	14.5	57.5

<http://sorghum.ucanr.edu>

Corn silage from the Western US*

Mean	37.4	7.8	24.7	40.5	31.2	45.1	5.4	57.4
SD	11.8	1.0	3.4	5.0	6.0	5.7	1.0	4.8

*2018 values from Rock River Laboratory (n=5,681)

Nutrient Composition

Nutrient composition of sorghum silage (n=15)

	% of DM							
	DM	CP	ADF	NDF	Starch	NFC	Ash	NDFD 30, %NDF
Mean	29.3	8.5	33.9	49.1	13.1	28.9	11.7	48.9
Median	29.7	8.9	34.2	47.7	10.1	29.3	10.9	48.6
Minimum	22.8	5.6	28.4	42.2	1.4	15.3	8.9	32.2
Maximum	35.2	11.8	41.3	59.4	29.3	41.2	14.5	57.5
Corn silage from the Western US*								
Mean	37.4	7.8	24.7	40.5	31.2	45.1	5.4	57.4
SD	11.8	1.0	3.4	5.0	6.0	5.7	1.0	4.8

*2018 values from Rock River Laboratory (n=5,681)

Nutrient Composition

Nutrient composition of sorghum silage (n=15)

	% of DM							
	DM	CP	ADF	NDF	Starch	NFC	Ash	NDFD 30, %NDF
Mean	29.3	8.5	33.9	49.1	13.1	28.9	11.7	48.9
Median	29.7	8.9	34.2	47.7	10.1	29.3	10.9	48.6
Minimum	22.8	5.6	28.4	42.2	1.4	15.3	8.9	32.2
Maximum	35.2	11.8	41.3	59.4	29.3	41.2	14.5	57.5
Corn silage from the Western US*								
Mean	37.4	7.8	24.7	40.5	31.2	45.1	5.4	57.4
SD	11.8	1.0	3.4	5.0	6.0	5.7	1.0	4.8

*2018 values from Rock River Laboratory (n=5,681)

Nutrient Composition

Nutrient composition of sorghum silage (n=15)

	% of DM							
	DM	CP	ADF	NDF	Starch	NFC	Ash	NDFD 30, %NDF
Mean	29.3	8.5	33.9	49.1	13.1	28.9	11.7	48.9
Median	29.7	8.9	34.2	47.7	10.1	29.3	10.9	48.6
Minimum	22.8	5.6	28.4	42.2	1.4	15.3	8.9	32.2
Maximum	35.2	11.8	41.3	59.4	29.3	41.2	14.5	57.5
Corn silage from the Western US*								
Mean	37.4	7.8	24.7	40.5	31.2	45.1	5.4	57.4
SD	11.8	1.0	3.4	5.0	6.0	5.7	1.0	4.8

*2018 values from Rock River Laboratory (n=5,681)

Nutrient Composition

Nutrient composition of sorghum silage (n=15)

	% of DM							
	DM	CP	ADF	NDF	Starch	NFC	Ash	NDFD 30, %NDF
Mean	29.3	8.5	33.9	49.1	13.1	28.9	11.7	48.9
Median	29.7	8.9	34.2	47.7	10.1	29.3	10.9	48.6
Minimum	22.8	5.6	28.4	42.2	1.4	15.3	8.9	32.2
Maximum	35.2	11.8	41.3	59.4	29.3	41.2	14.5	57.5
Corn silage from the Western US*								
Mean	37.4	7.8	24.7	40.5	31.2	45.1	5.4	57.4
SD	11.8	1.0	3.4	5.0	6.0	5.7	1.0	4.8

*2018 values from Rock River Laboratory (n=5,681)

Nutrient Composition

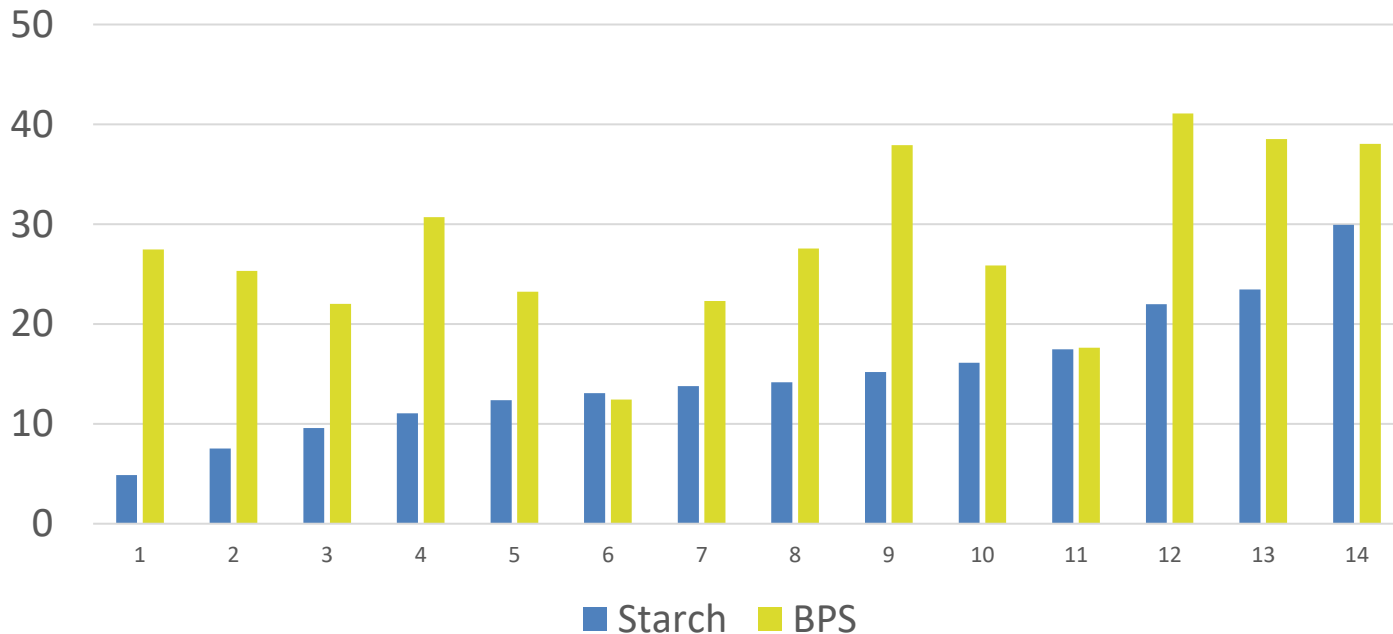
Nutrient composition of sorghum silage (n=15)

	% of DM							
	DM	CP	ADF	NDF	Starch	NFC	Ash	NDFD 30, %NDF
Mean	29.3	8.5	33.9	49.1	13.1	28.9	11.7	48.9
Median	29.7	8.9	34.2	47.7	10.1	29.3	10.9	48.6
Minimum	22.8	5.6	28.4	42.2	1.4	15.3	8.9	32.2
Maximum	35.2	11.8	41.3	59.4	29.3	41.2	14.5	57.5
Corn silage from the Western US*								
Mean	37.4	7.8	24.7	40.5	31.2	45.1	5.4	57.4
SD	11.8	1.0	3.4	5.0	6.0	5.7	1.0	4.8

*2018 values from Rock River Laboratory (n=5,681)

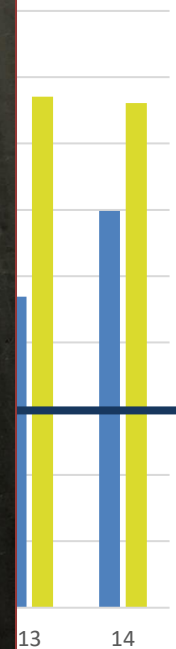
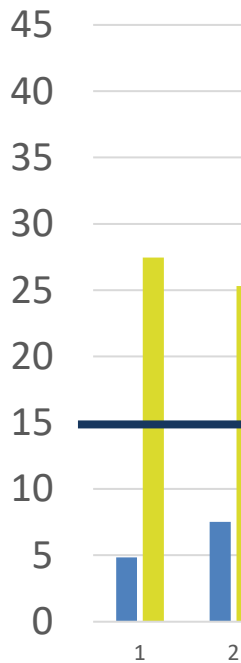
Starch Availability

Starch Content and Berry Processing Score (BPS)



- BPS, the % of starch passing a 1.18mm screen, averaged 28% (range = 12 - 41%).
- Variable BPS may justify recommendation of adjusting starch availability to zero when formulating rations

Starch Availability



- BPS, the % of starch passing a 1.18mm screen, averaged 28% (range = 12 - 41%).
- Variable BPS may justify recommendation of adjusting starch availability to zero when formulating rations

Particle Separator

- Measures particle size distribution
 - Can be monitored during harvest to look at particle size/cut length and processing
- Recommendations depend on formulated ration





Particle Separator

Screen	Pore Size (inches)	Particle Size (inches)	Corn Silage	Haylage
Upper Sieve	0.75	>0.75	3 to 8%	10 to 20%
Middle Sieve	0.31	0.31 to 0.75	45 to 65%	45 to 75%
Lower Sieve	0.05	0.07 to 0.31	30 to 40%	20 to 30%
Bottom Pan	.	<0.07	<5%	<5%



Particle Separator

Screen	Sorghum Average	Range	Corn Silage	Haylage
Upper Sieve	25%	2 – 56%	3 to 8%	10 to 20%
Middle Sieve	52%	15 – 72%	45 to 65%	45 to 75%
Lower Sieve	10%	7 – 13%	30 to 40%	20 to 30%
Bottom Pan	13%	9 – 19%	<5%	<5%

Why is there so much material in tray 1?

Greater chop length? Harder to chop?

Why is there so little material in tray 3?

Lack of grain?

Particle Separator

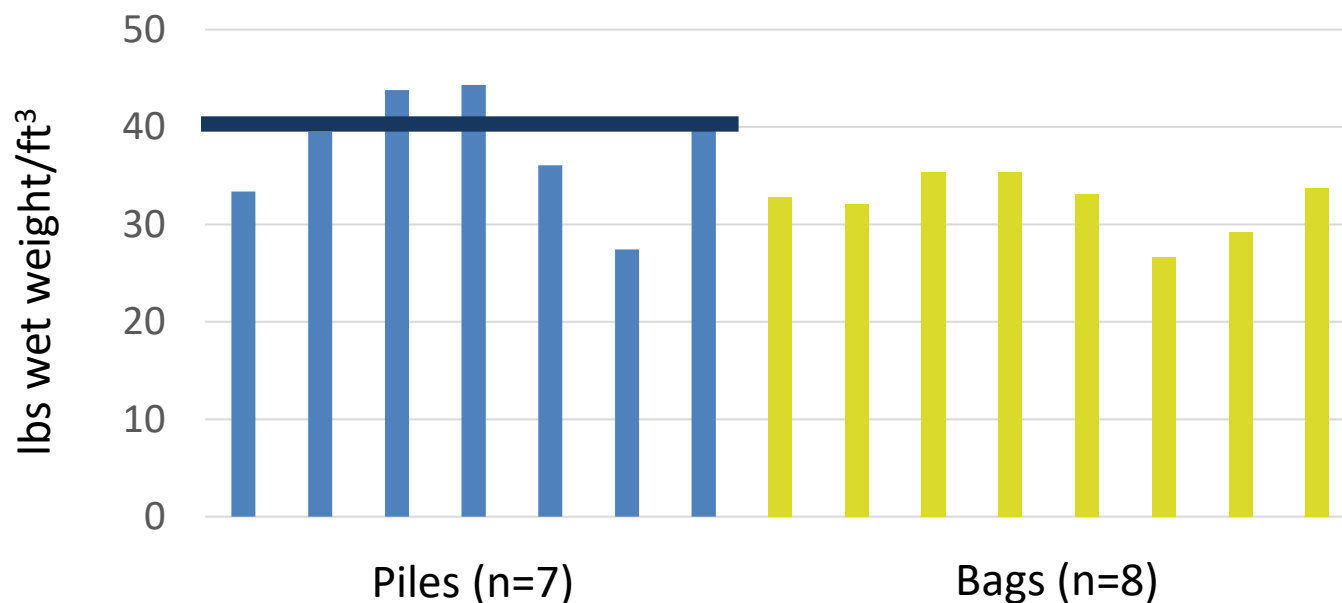
Screen	Sorghum Average	Range	Corn Silage	Haylage
Upper Sieve	25%	2 – 56%	3 to 8%	10 to 20%
Middle Sieve	52%	15 – 72%	45 to 65%	45 to 75%
Lower Sieve	10%	7 – 13%	30 to 40%	20 to 30%
Bottom Pan	13%	9 – 19%	<5%	<5%

Why is there so much material in tray 1?
Greater chop length? Harder to chop?

Why is there so little material in tray 3?
Lack of grain?

Physical Characteristics

Density of sorghum structures in California
(2018)



- Average density of piles was 38 lbs wet weight/ft³ (range = 27 – 44 lbs wet weight/ft³).
- Average density of bags was 32 lbs wet weight/ft³ (range – 27-35 lbs wet weight/ft³).

Final Thoughts

- **Sorghum quality**
 - **Work with your nutritionist on variety selection**
 - **May be wise to focus on fiber digestibility rather than starch**
 - **Management important for silage quality**

Project Team

Jennifer Heguy

Deanne Meyer

Nicholas Clark

Jeff Dahlberg

Bob Hutmacher

J.P. Martins

Patricia Price

Thank you to the
cooperating dairy
producers, custom
harvesters and
nutritionists!





University of California
Agriculture and Natural Resources

Making a Difference for California

Thank You!

Jennifer Heguy

jmheguy@ucdavis.edu

(209)525-6800



Alfalfa & Forage Field Day, September 23, 2020, *Virtual*

Survey Results

- Crop prior to sorghum
 - 1 corn silage
- Planting dates (n=14)
 - April (2); May (6); June (5); July (1)
- Sorghum type:
 - Brown midrib = 10
 - Grain = 5
 - Unknown = 1



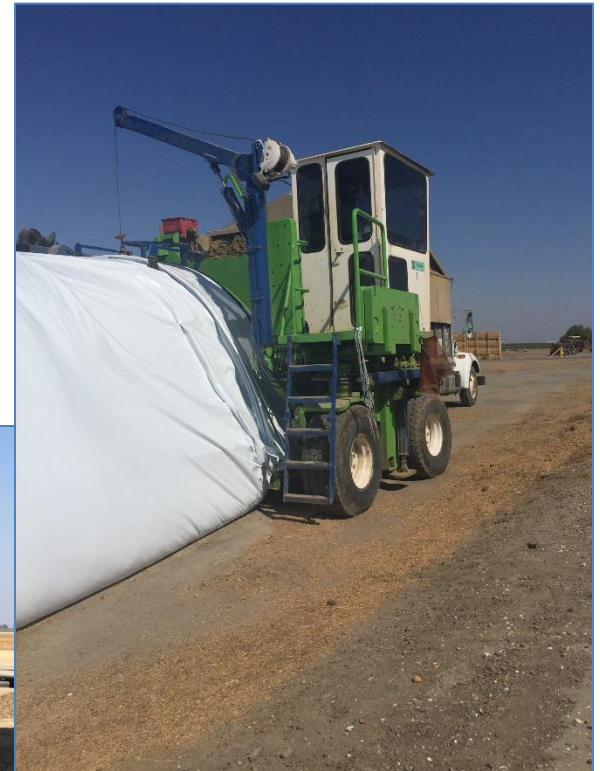
Survey Results

– Structure type:

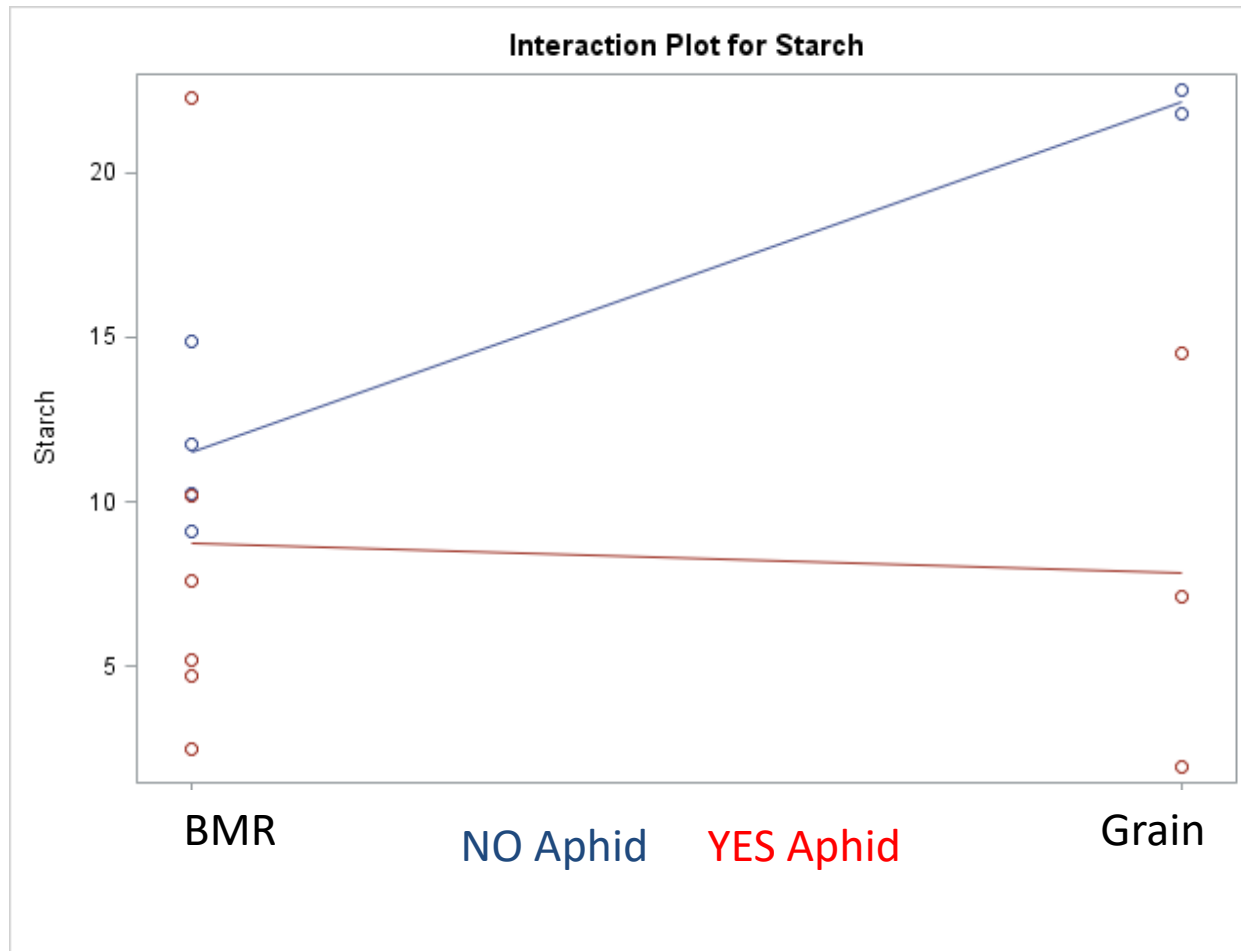
- Piles = 12
 - One pile (n=7), two piles (n=3) or three piles (n=2)
- Bags = 4
 - All ≥ 5 bags

– Silage surface:

- 50% on dirt
- 50% on concrete/gravel



Nutrient Analysis



Very small data set, but indicates that SCA affected starch in grain type

Fermentation Characteristics

Fermentation characteristics of sorghum silage (n=15)

	% of DM				
	Lactic Acid	Acetic Acid	Propionic Acid	Butyric Acid	pH
Mean	5.7	2.1	0.0	0.2	3.9
Median	6.4	1.6	0.0	0.0	3.8
Minimum	0.6	0.8	0.0	0.0	3.5
Maximum	8.9	4.9	0.5	2.6	4.7
Corn silage from the Western US*					
Mean	3.8	2.1	0.0	0.0	3.9
SD	2.2	1.1	0.1	0.1	0.2

*2018 values from Rock River Laboratory (n=5,681)