# The Impact of Limited Water on Silage Production

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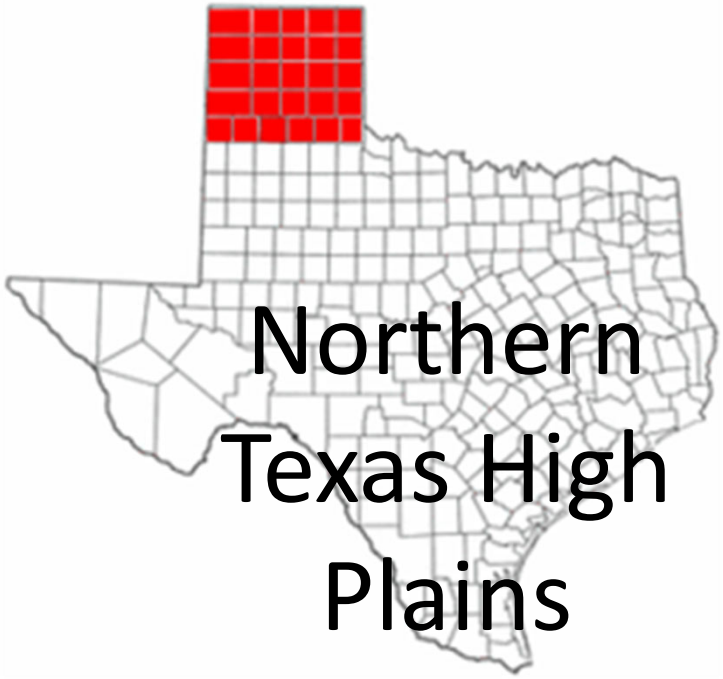
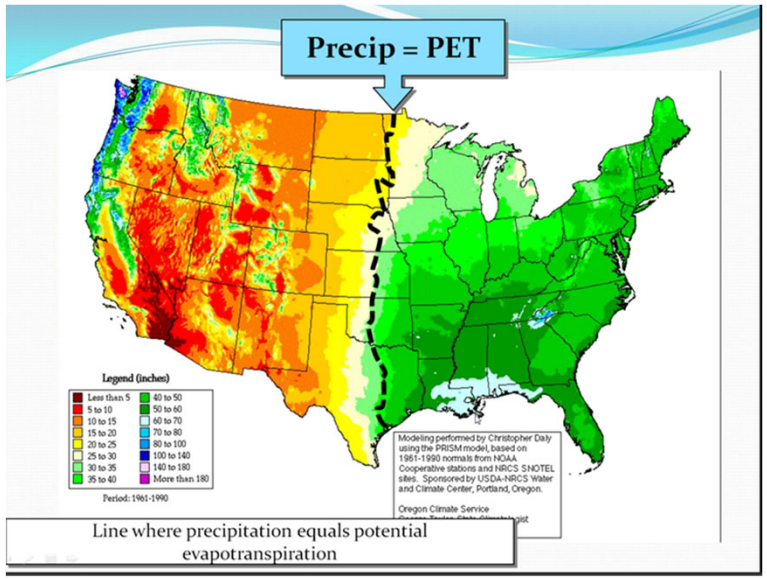


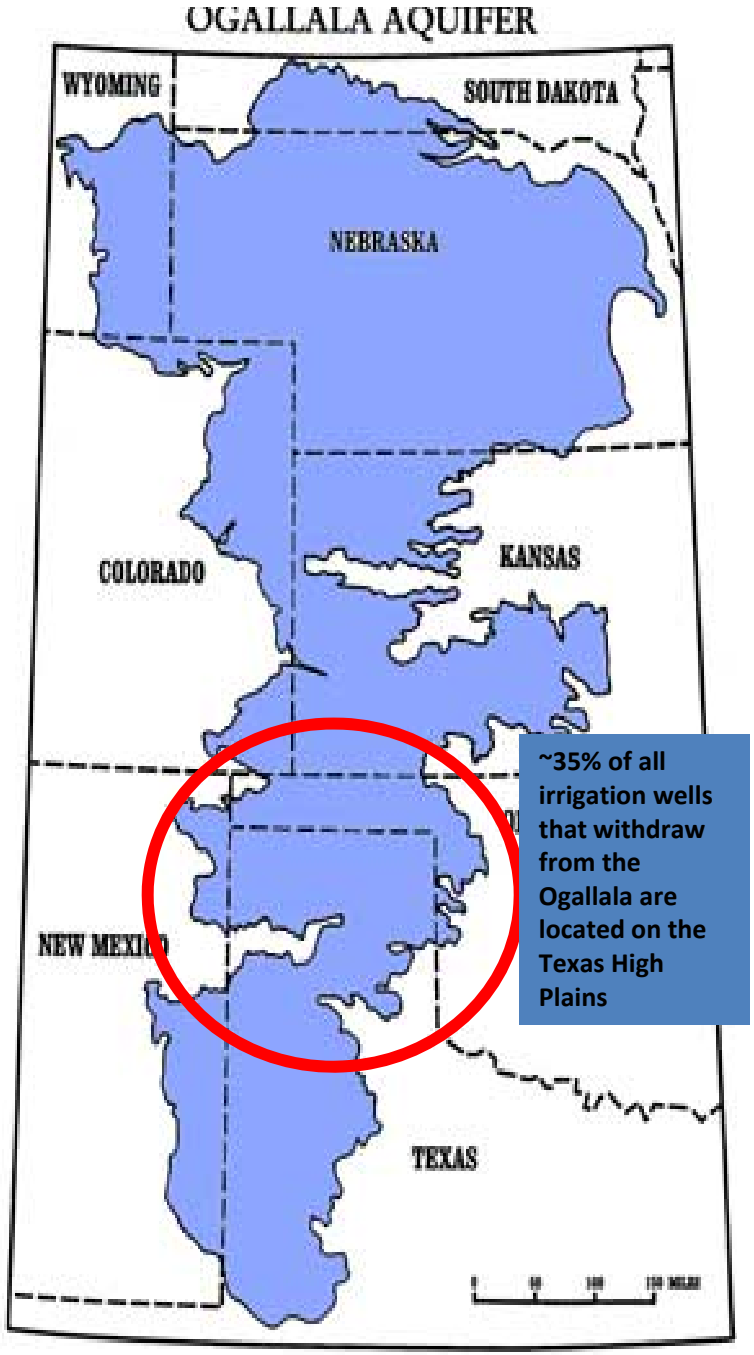
# Northern Texas High Plains


- 78% of Texas fed beef production
- 60% of Texas dairy cows
- 94% of Texas hog production
- 60% of Texas corn production
- 42% of Texas wheat production
- 23% of Texas sorghum production
- 12% of Texas cotton production
- 64% of Texas Silage production

# Challenges

- **WATER**
- Declining Ogallala Aquifer
- Both crop and livestock production dependent on Ogallala
  - Nominal recharge in this region
  - Well capacities <50 (SW) to 1000+ (NE) gpm
- Climate



# Considerations for Quality Silage

- Who is the end user?
  - Quality Concerns
- Herbicides
- Seed Costs
  - Fertility needs do not greatly differ between corn and sorghum silage
- Will you scout for Sugarcane Aphids?
- Planting Window
- Harvest Window
- Silage Pit Management
- How much water do you have?

# Corn Silage Favored Because….

- Corn Silage is high in energy.
  - Grain content AND stover digestibility affect energy level
- It is believed that BMR plant traits enhance the value of corn silage as a nutrient source
  - lower lignin concentration and higher fiber digestibility than conventional corn silage but…..
- If water is not limited, corn silage quality is relatively consistent.

# Corn vs. Sorghum Silage

## Corn Silage

- Often the silage of choice
  - Nutritional content of corn silage is generally consistent
  - Under water stress, corn silage quality is reduced
    - Corn silage quality is dependent on the amount of grain produced
- Higher Yield potential
  - 27 to 32 tons/ac
- More herbicide options
  - Glyphosate and Glufosinate tolerance
  - Increased post emergent options
- SCA not an issue
- Bt Hybrids provide insect protection
  - Rootworm and Earworm protection

## Sorghum Silage

# Corn for Silage

1. Corn Planted for Silage
2. Failed Corn
   - Hail Damage
   - Drought Stress

*Important to remember*:

POOR QUALITY FORAGE =
POOR QUALITY SILAGE

# Corn vs. Sorghum Silage

## Corn Silage

## Sorghum Silage

- Significant variability between sorghum silage hybrids – quality and yield
- Forage sorghums are more drought tolerant and able to maintain yield and quality under moderate water stress
- Yield potential
  - 20 to 27 tons/ac
- Cheaper seed cost (~$18/ac for forage sorghums vs. ~$110/ac for corn silage)
- Limited SCA tolerant sorghum hybrids on market


In reality, it is all about the water…..

# Drought Damaged Corn Silage

- Poor ear development
- Decreased tonnage
- Increased shrinkage in the silage pit due to high DM

# Improper DM and Shrink

- Shrink is important because you do not want to run out of silage
- Shrink results from fermentation and spoilage losses as well as scale and DM errors at delivery
- % Shrink = (lb delivered – lb fed)/ lb delivered

Example: 20,000 lb delivered and 16,000 lb fed

(20,000-16,000)/20,000 = 20% Shrink

You paid for pounds delivered not pounds fed!

# Drought Damaged Corn Silage

- Poor ear development
- Decreased tonnage
- Increased shrinkage in the silage pit due to high DM
- Decreased starch and TDN
  - Normal corn TDN=90
  - Drought damaged corn TDN reduced by 60% (Mader et al.)

**If there is a risk for drought damaged corn, consider forage sorghums.**

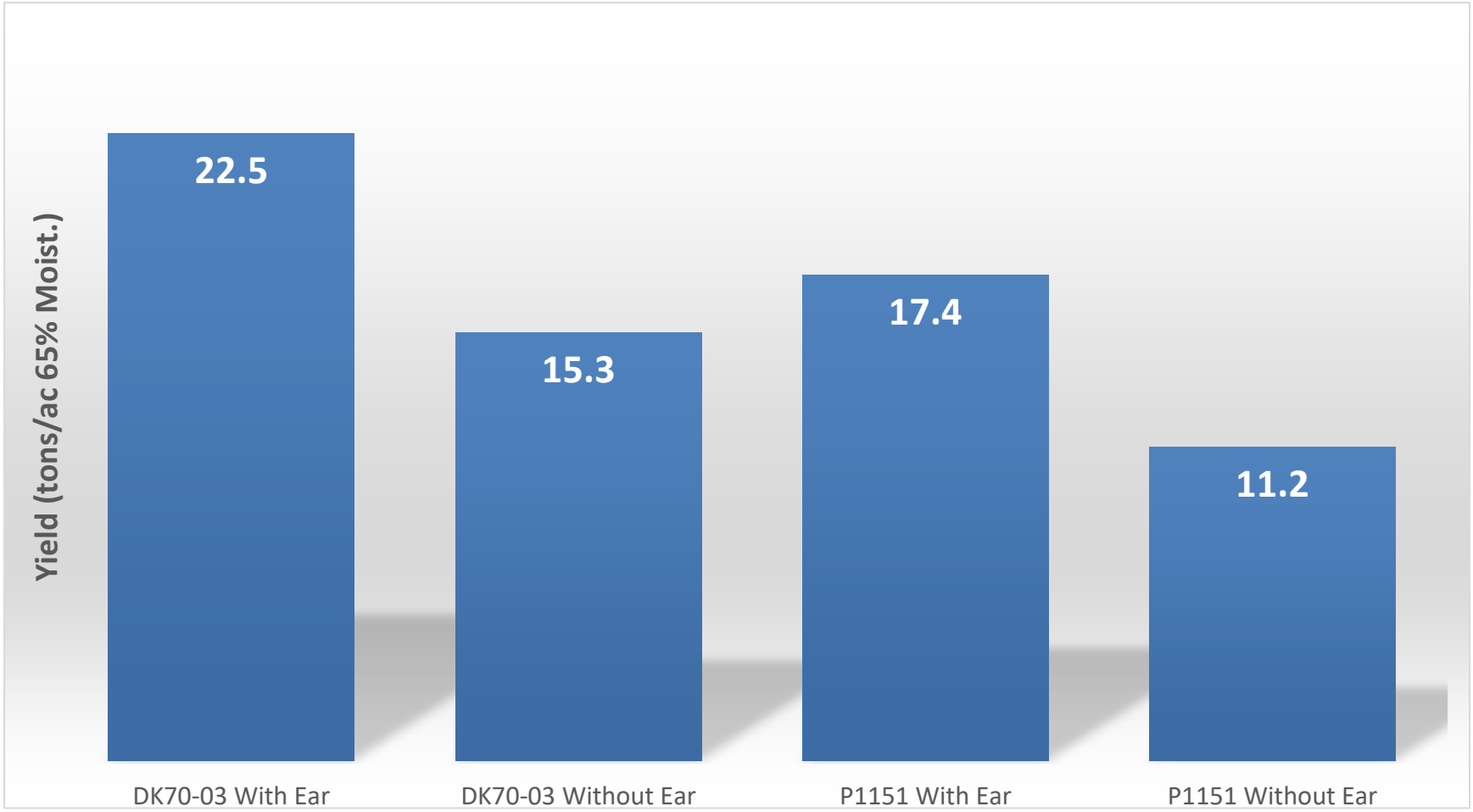
# 2017 Corn Silage Plots: Value of the Ear

- Extreme example because we do not have cobs or any grain
- Silage RFQ decreases by ~330% without grain

| Hybrid | RFQ | TDN | Milk/ ton | Yield (tons/ac) 65% Moist. |
|---|---|---|---|---|
| Corn Check: P1151 w/ ear | 92 | 53 | 2962 | 27.5 |
| Corn Check: P1151 w/o ear | 28 | 30 | 1588 | 20.7 |
| Corn Check: 55VP77 w/ ear | 133 | 62 | 3467 | 25.5 |
| Corn Check: 55VP77 w/o ear | 37 | 34 | 1759 | 18.9 |

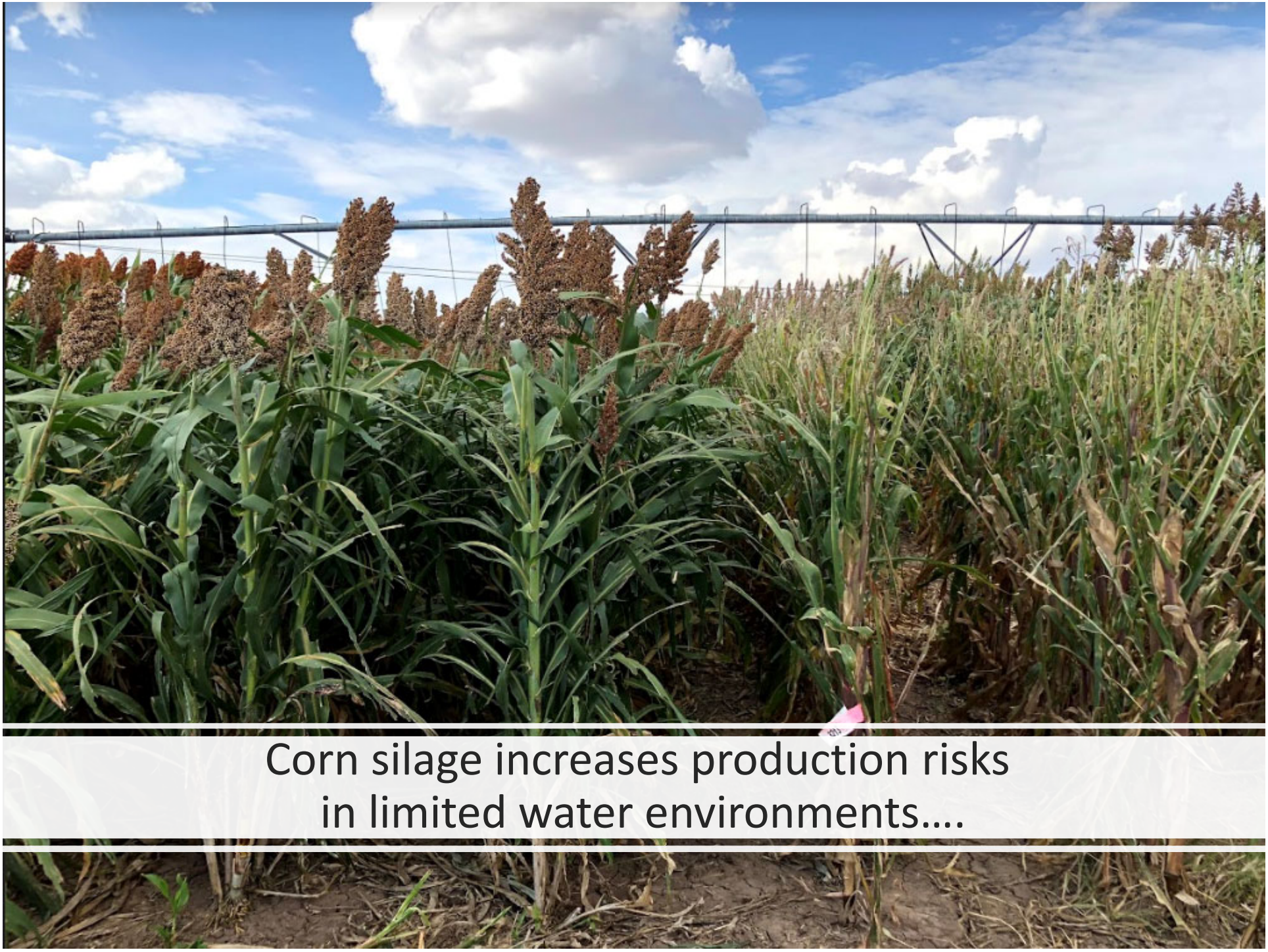
**For quality corn silage, you need grain.**

# 2018 Corn Silage Plots:
# Value of the Ear



# 2018 Corn Silage Plots: Value of the Ear

| Hybrid | %Starch | TDN | Milk/Ton | Avg. Yield (tons/ac) 65% Moist. |
|---|---|---|---|---|
| Corn Check: P1151 w/ ear | 25.0 | 70.3 | 2919.7 | 17.4 |
| Corn Check: P1151 w/out ear | 3.7 | 62.8 | 1642.7 | 11.2 |
| Corn Check: DK70-03 w/ ear | 22.1 | 67.7 | 2896.0 | 22.5 |
| Corn Check: DK70-03 w/out ear | 4.5 | 60.4 | 1620.0 | 15.3 |



Corn silage increases production risks
in limited water environments….

# Considerations for Optimum Forage Production ($) With Limited Water

- Crop and Variety Selection
- Precipitation
- Well Capacities

**How much water you have before you plant?!**

- How much risk can you afford to take?

or

# Do you have the water supply….

| Irrigation Application (inches/day) | ---------- System efficiency (percent)---------- | | | |
|---|---|---|---|---|
| | 70 | 80 | 90 | 100 |
| | ----------gpm/acre---------- | | | |
| 0.10 | 2.7 | 2.4 | 2.0 | 1.9 |
| 0.15 | 4.0 | 3.5 | 3.1 | 2.8 |
| 0.20 | 5.4 | 4.7 | 4.2 | 3.8 |
| 0.25 | 6.7 | 5.9 | 5.2 | 4.7 |
| 0.30 | 8.1 | 7.1 | 6.3 | 5.7 |
| 0.35 | 9.4 | 8.3 | 7.3 | 6.6 |
| 0.40 | 10.8 | 9.4 | 8.4 | 7.5 |
| 0.45 | 12.1 | 10.6 | 9.4 | 8.5 |
| 0.50 | 13.5 | 11.8 | 10.5 | 9.4 |

# Will the system capacity meet the crop demand?

Assuming ET demand is ~ 0.35 in./day or ~ 2.45 in./week and you operate at 90% efficiency (depending on environmental conditions)

To irrigate 120 acres a….

- 3 gpm/acre pump capacity = 0.15 in./day or ~1.0 in./week
- 5 gpm/acre pump capacity = 0.23 in./day or ~1.6 in./week
- **7.3 gpm/acre pump capacity = 0.35 in./day or 2.45 in./week**
  - On 120 acres, you need ~ 876 gpm to meet this demand if your system is 90% efficient!
  - If system is only 80% efficient, you need ~**1000 gpm** to meet this demand on 120 acres!

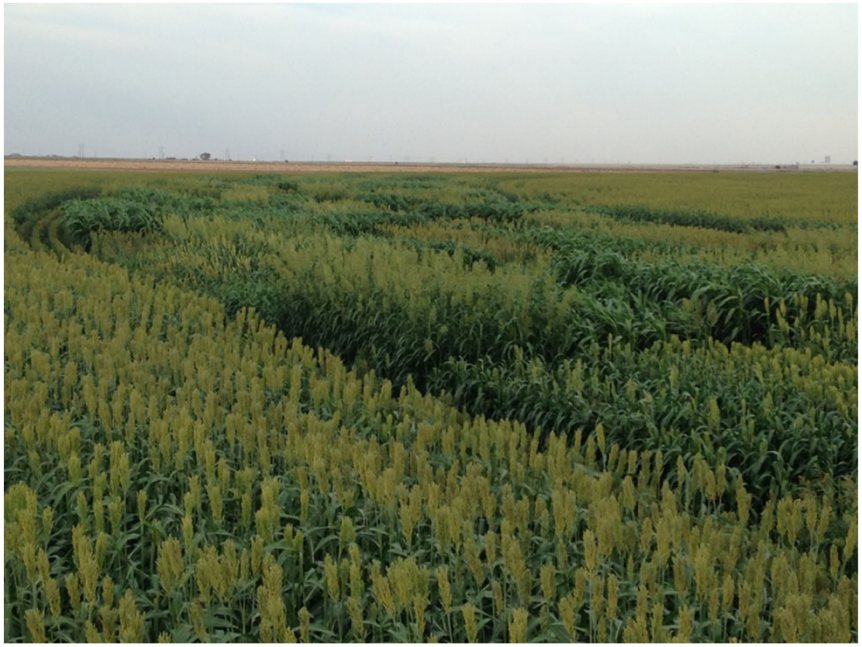
# Drought Damaged Corn

- Poor ear/grain development
- Decreased tonnage
- Increased shrinkage in the silage pit due to high DM
- Decreased starch and TDN
  - Normal corn TDN=90
  - Drought damaged corn TDN reduced by 60% (Mader et al.)

**If there is a risk for drought damaged corn, consider forage sorghums.**

# Quality Forage Sorghum Silage Begins With Hybrid Selection

1. Not all sorghum equal
   - Evaluate variety trials from multiple locations
2. Hybrid should match production system and end-user goals
   - Later maturity class hybrids have greater yield potential, but do you have the water to meet the demand?
   - Late season hybrids more prone to lodging under late season moisture
   - Choose hybrid based on hybrid specific characteristics not forage type



# Forage Sorghum Types

- Conventional Forage Sorghums (Dual Purpose)
- Brown Midrib (BMR)
  - Decreased Lignin
  - Increased Digestibility
  - Nutritive analysis similar to corn silage
- Photoperiod Sensitive
  - Flowering regulated by Daylength
    - Tall, high biomass hybrids
    - Do not flower until daylength <12 hrs
    - Delayed flowering slows decline in forage quality

**Conventional**

**BMR**

# Forage Sorghum Hybrids cont.

- Brachytic Dwarf
  - Reduced internode length
  - Shorter, leafier hybrid
  - Reduced lodging

| Hybrid Characteristics | | | | | | | | Harvest Date, Lodging, Moisture and Yield | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Entry | Hybrid | Company | Sorghum Type | Mat - urity | BMR | Brach - ytic | Male Sterile | Harvest Date | % Lodge | % Moist. at Harvest | Yield (tons/ac) 65% Moisture[§] |
| 39 | 52845X | Scott Seed | FS | L | No | Yes | No | 10/5/2018 | 0 | 57.6 | 25.9 ± 3.0 |
| 1 | AF7401 | Advanta Seeds | FS | ML | Yes | Yes | No | 9/26/2018 | 0 | 65.9 | 25.7 ± 5.3 |
| 50 | SP3808SB BMR | Sorghum Partners | FS | F | Yes | Yes | No | 10/1/2018 | 30 | 60.0 | 24.8 ± 2.6 |
| 24 | H-BMR85-HF | Heartland Genetics | FS | M | Yes | Yes | No | 9/27/2018 | 0 | 63.0 | 24.4 ± 2.0 |
| 20 | F76FS77 BMR | DynaGro Seed | FS | MF | Yes | Yes | No | 9/28/2018 | 0 | 71.7 | 24.3 ± 5.6 |
| 37 | 506/10 | Scott Seed | FS | L | Yes | Yes | No | 9/26/2018 | 23 | 69.7 | 24.3 ± 3.5 |
| 4 | ADV XF372 | Advanta Seeds | FS | M | Yes | Yes | No | 9/28/2018 | 0 | 63.6 | 24.0 ± 5.1 |
| 46 | 55210X | Scott Seed | FS | L | No | Yes | No | 10/7/2018 | 0 | 70.3 | 22.8 ± 3.5 |
| 43 | 50651X | Scott Seed | SS | M | Yes | Yes | No | 9/26/2018 | 0 | 64.5 | 22.5 ± 2.2 |
| 25 | OPAL | MOJO Seed Enterprises | FS | M | No | Yes | No | 9/12/2018 | 0 | 67.4 | 22.0 ± 4.5 |
| 49 | SPX56216 | Sorghum Partners | FS | F | Yes | Yes | No | 9/29/2018 | 0 | 65.7 | 20.2 ± 2.8 |
| 44 | 50652X | Scott Seed | SS | PS | Yes | Yes | No | 10/24/2018 | 0 | 69.9 | 20.1 ± 5.4 |
| 6 | ADV XF378 | Advanta Seeds | FS | M | Yes | Yes | No | 9/27/2018 | 0 | 64.8 | 17.3 ± 3.5 |

# 2018 Bushland Forage Sorghum Trial

58 Sorghum Hybrids and 2 Corn Hybrids

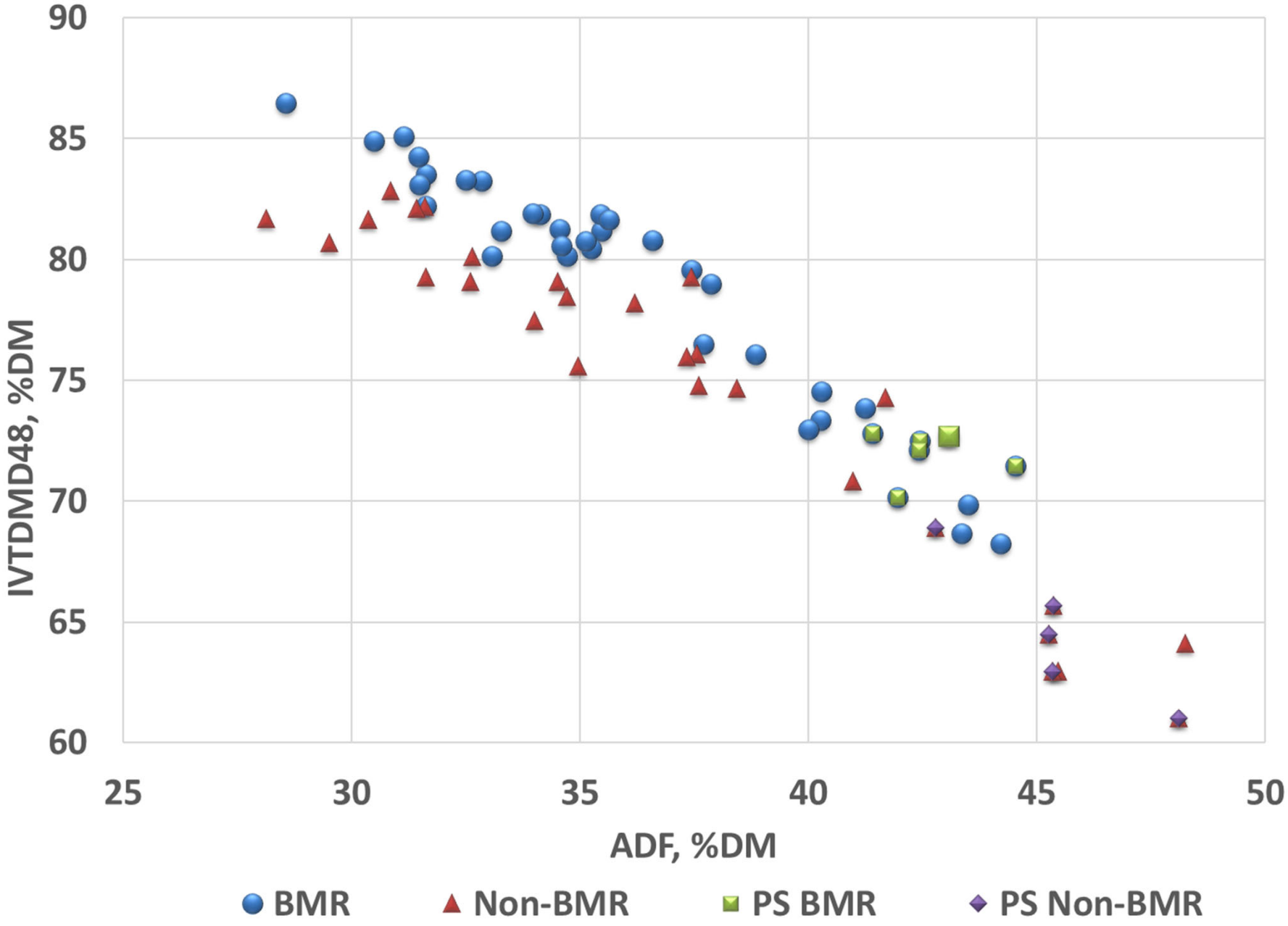
**Table 1.** 2018 Summary of yield, lodging, and quality (DM basis) by forage type. The number in parentheses represents the nu

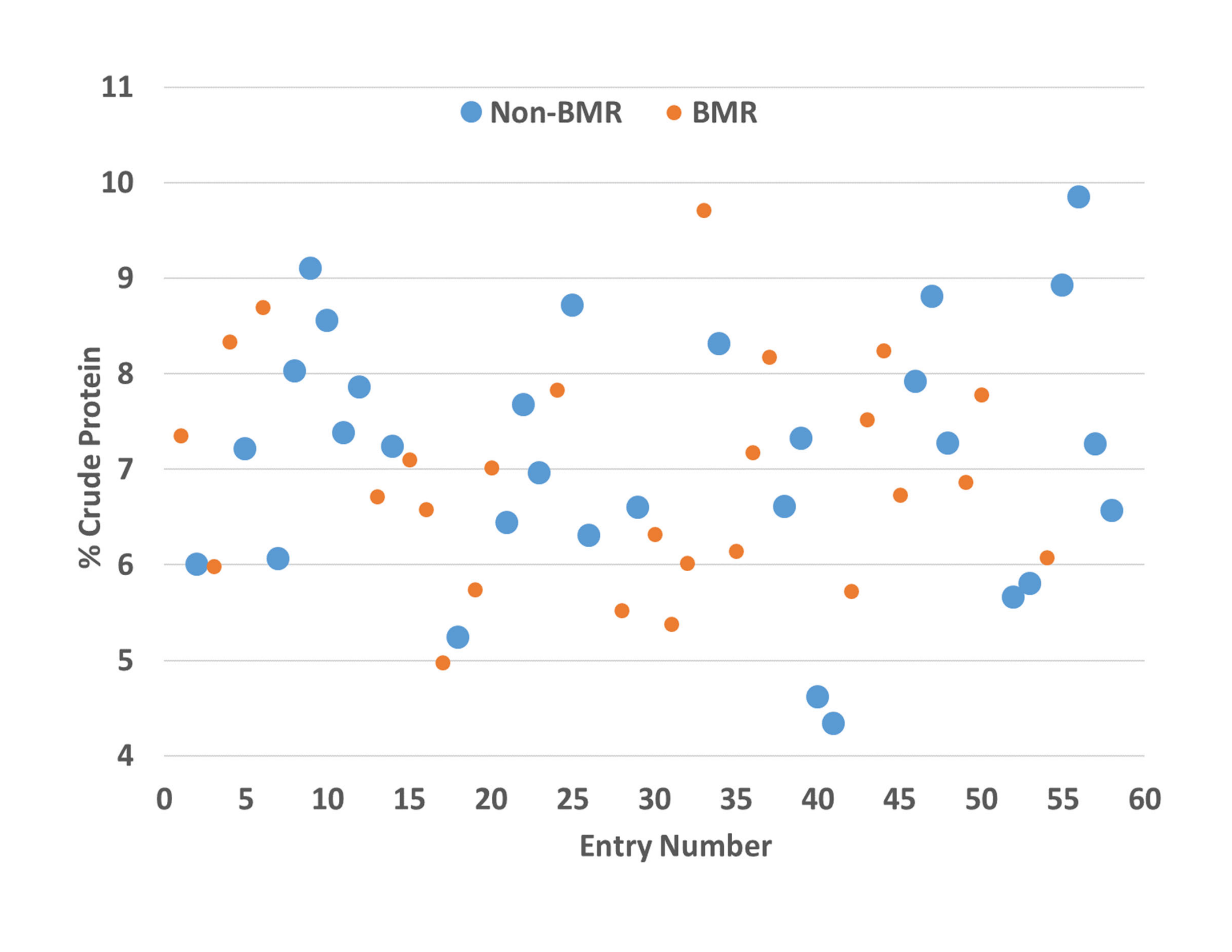
| Sorghum Type | % Lodging at Harvest | %Moisture at Harvest | Avg. Yield (tons/ac) 65% Moist. | %CP | %ADF | %aNDF | %Lignin | %Starch |
|---|---|---|---|---|---|---|---|---|
| BMR (26) | 12.6 | 68.6 | 22.3 | 6.9 | 34.4 | 50.5 | 3.5 | 13.4 |
| Non-BMR (30) | 7.9 | 68.2 | 23.1 | 7.2 | 32.3 | 47.7 | 4.1 | 20.2 |
| Test Average† | 10.1 | 68.4 | 22.4 | 7.0 | 33.3 | 49.0 | 3.8 | 17.0 |
| **by Photoperiod Response** | | | | | | | | |
| Photoperiod Sensitive (9) | 37.4 | 72.9 | 21.3 | 6.3 | 42.2 | 61.4 | 4.0 | 1.5 |
| Non-Photoperiod Sensitive (47) | 4.9 | 67.5 | 23.0 | 7.1 | 32.2 | 47.5 | 3.8 | 19.2 |
| **by Brachytic Trait** | | | | | | | | |
| Brachytic (13) | 4.1 | 65.7 | 22.9 | 7.8 | 31.3 | 45.4 | 3.5 | 21.5 |
| Non-Brachytic (43) | 11.9 | 69.2 | 22.6 | 6.8 | 33.9 | 50.1 | 3.9 | 15.7 |
| **Grain Sorghum and Corn Checks** | | | | | | | | |
| Grain Sorghum Checks (2) | 0.0 | 69.0 | 17.7 | 9.5 | 26.9 | 39.5 | 4.0 | 30.3 |
| Corn with Ears (2)‡ | 0.0 | 67.2 | 19.9 | 8.2 | 25.5 | 39.6 | 3.1 | 23.6 |
| Corn without Ears (2) | 0.0 | 71.9 | 13.3 | 7.1 | 34.1 | 51.3 | 3.9 | 4.1 |

†The test average is the average of the forage entries not including the grain sorghum or corn checks.

‡Corn samples were processed from all replicaitons with and without the ear for both hybrids.

2017 Bushland Forage Sorghum Silage Trial
Bell, Bynum, McCollum, and Schnell




Non-BMR
BMR
% Crude Protein
Entry Number
11
10
9
8
7
6
5
4
0
5
10
15
20
25
30
35
40
45
50
55
60

# What about Grain Sorghum for Silage?

- Shorter plant stature (<4.5')
- Permits better SCA control
- Reduced lodging
- Potentially earlier harvest date

| Hybrid | Company | Maturity | RFQ | TDN | Milk/ton | tons/ac 65% Moist. |
|---|---|---|---|---|---|---|
| W7051 | Warner Seeds | ML | 137 | 62 | 3470 | 23.5 |
| W7706 | Warner Seeds | ML | 142 | 62 | 3498 | 22.3 |
| W9501 | Warner Seeds | L | 121 | 59 | 3312 | 22.6 |
| W9506 | Warner Seeds | L | 123 | 60 | 3342 | 20.9 |
| Check 1 (84G62) | | ML | 149 | 63 | 3563 | 19.7 |
| Check 2 (DKS37-07) | | ME | 144 | 63 | 3539 | 18.4 |

# 2018 Grain Sorghum Hybrids

| Hybrid | Company | Sorghum Type | Mat - urity | Harvest Date | % Lodge | % Moist. at Harvest | Yield (tons/ac) 65% Moisture[§] |
|---|---|---|---|---|---|---|---|
| GX16921 | DynaGro Seed | FS Dual | MF | 9/4/2018 | 0 | 62.9 | 20.4 ± 3.3 |
| W7051 | Warner Seeds | GS | M | 9/1/2018 | 0 | 63.5 | 21.7 ± 3.1 |
| W7706-W | Warner Seeds | GS | M | 9/1/2018 | 0 | 67.2 | 20.1 ± 3.0 |
| 84G62 | Check 1 | GS | | 8/22/2018 | 0 | 67.2 | 17.2 ± 0.7 |
| DKS37-07 | Check 2 | GS | | 8/22/2018 | 0 | 70.8 | 18.2 ± 2.0 |

# In addition to hybrid selection, management is necessary to optimize sorghum silage quality:

1. Harvest early targeting soft-dough stage
2. Target dry matter at ~30-35%
3. Swath if necessary to obtain the correct moisture
4. Chop length about one-half inch.
5. How is it ensiled?

# Quality Silage

A function of

1. Agronomic and harvest management
2. End-user management (Pit/Pile/Bag)


# Sorghum Ensiling Duration Trial

Bell, McCollum, Jennings, Richeson, and Foster
WTAMU Graduate Student: Colton Robison

# Reality of Silage Harvest:

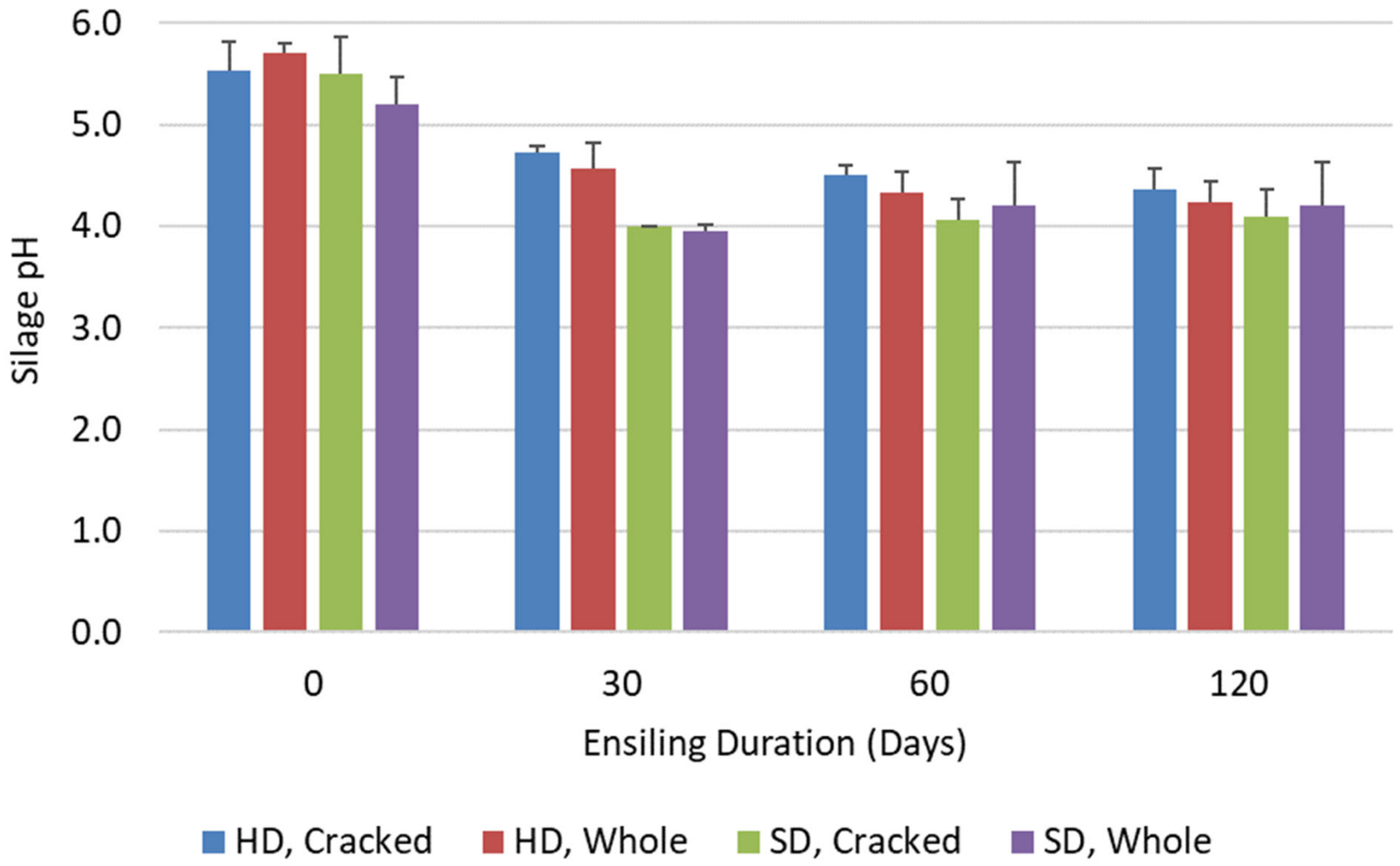
1. Often hard to coordinate silage chopper, weather and growth stage to optimize quality
2. Farmers get paid by the ton and do not receive a premium for quality
3. Can we optimize quality with ensiling?

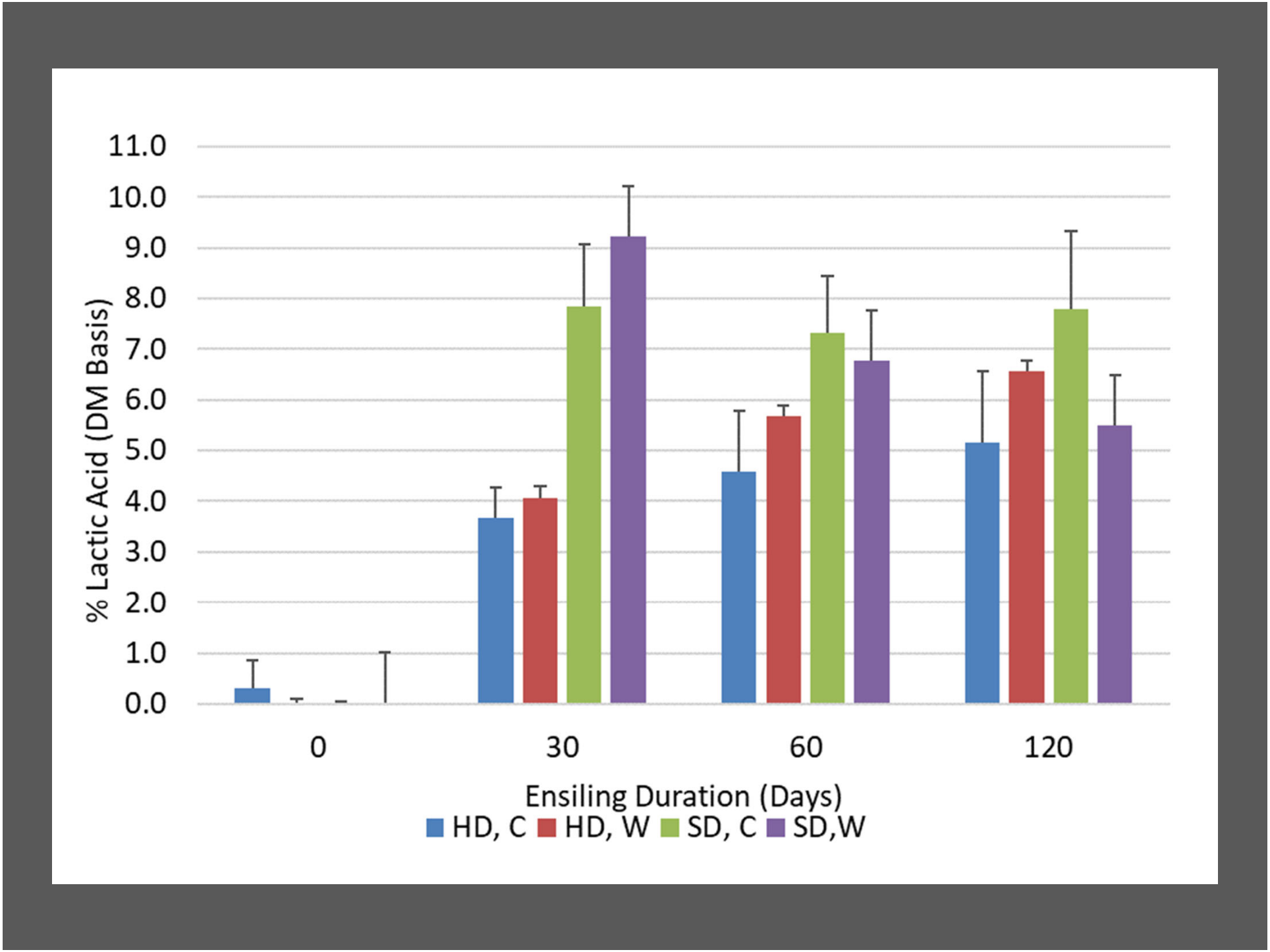
# Ensiling Trial:

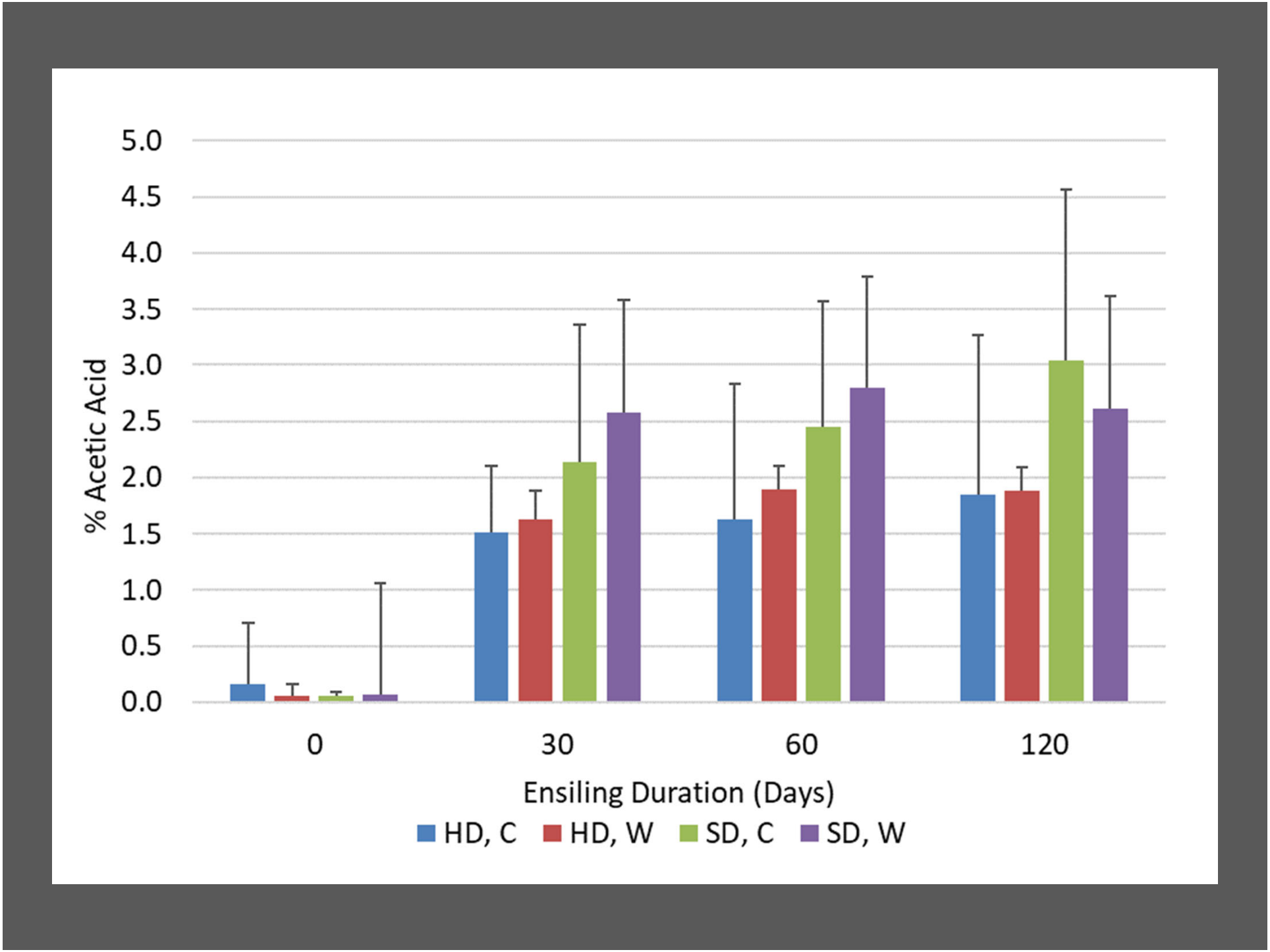
1. Harvest Stage and Kernel Processing
2. Ensiling Duration
3. Starch Availability and Digestibility from Ruminally Cannulated Steers

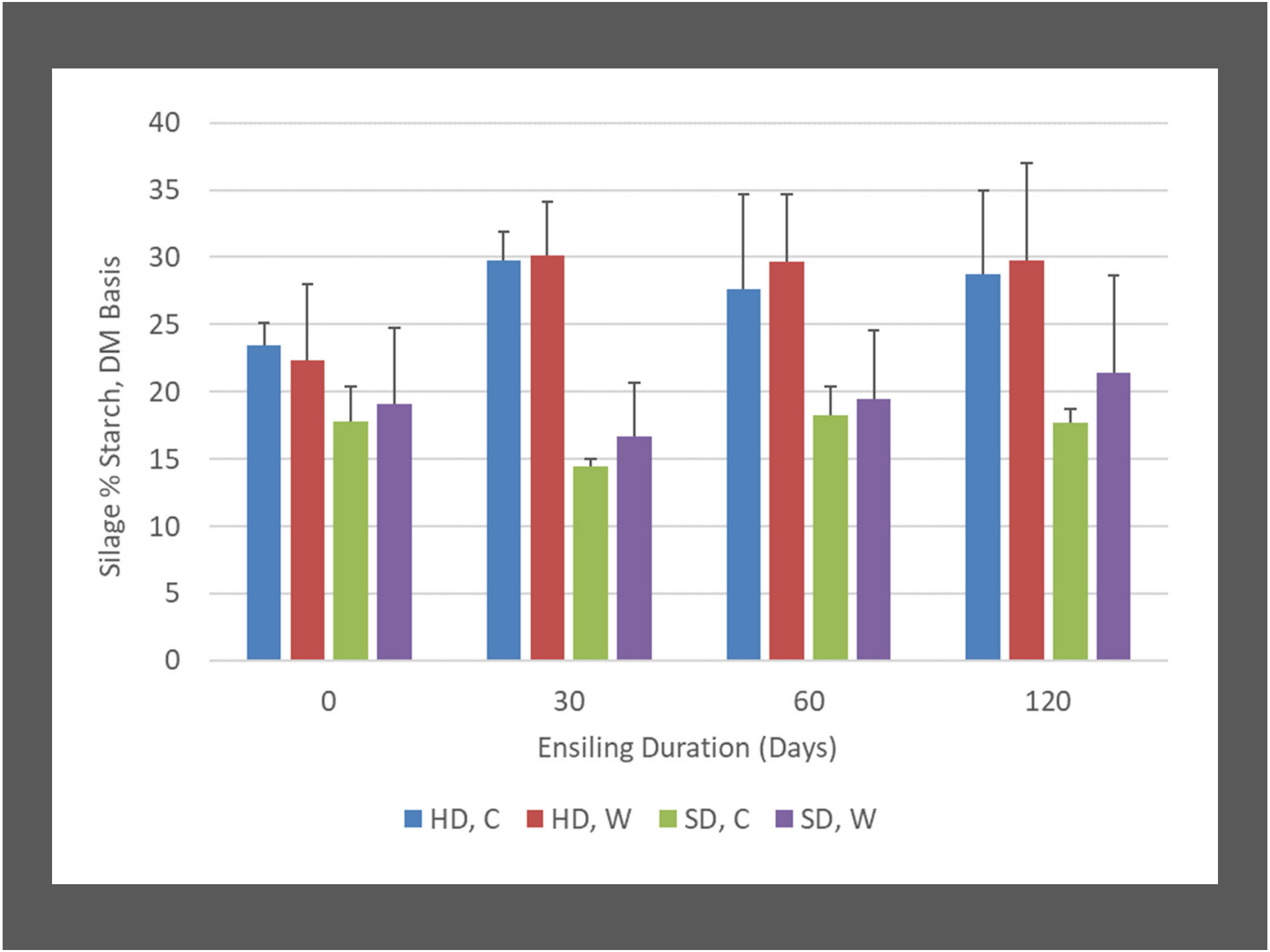
# Silage Fermentation Analysis
# Ideal Silage

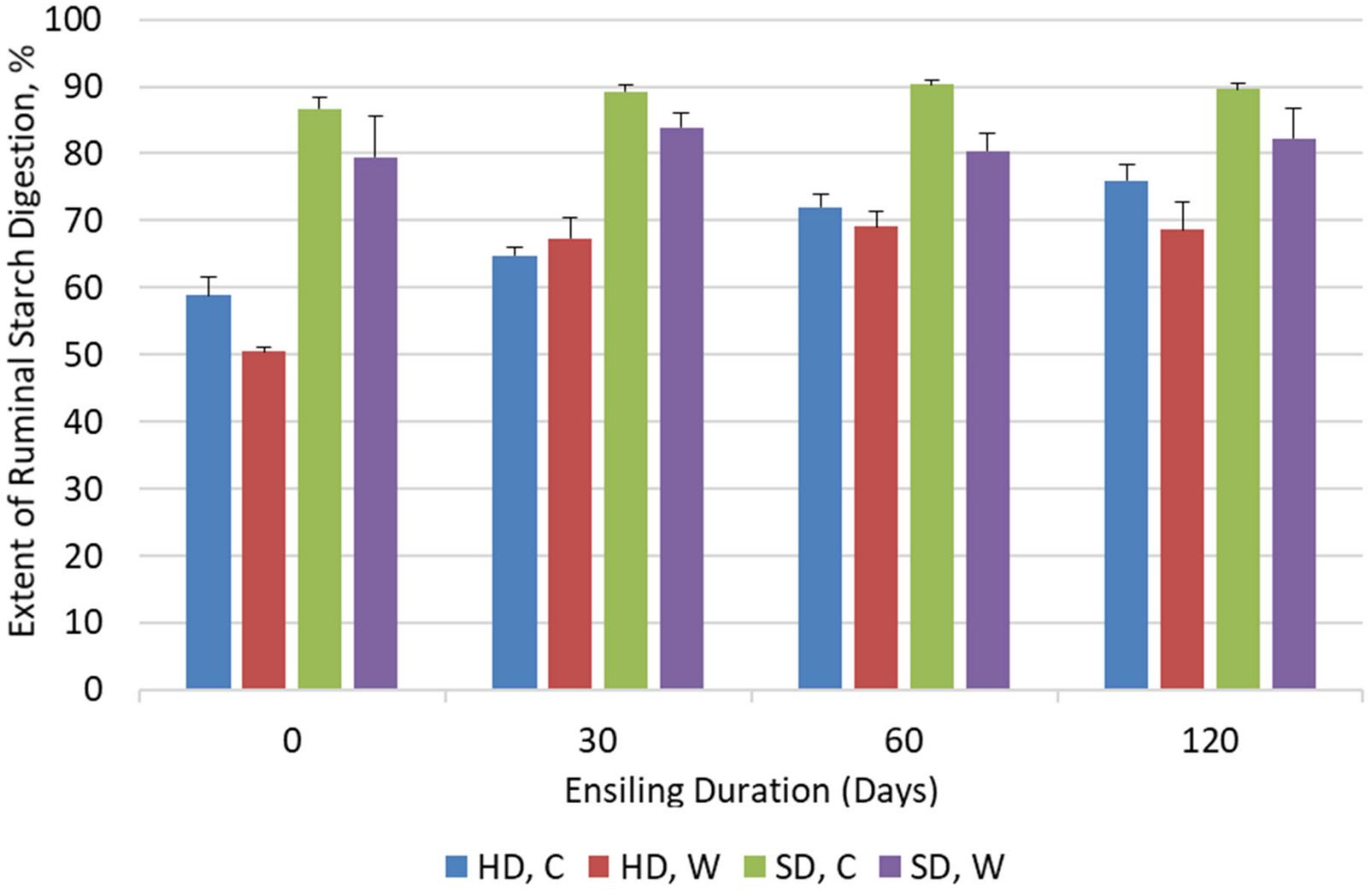
- pH: 3.6-4.2
- Lactic acid: 4-8% of DM
- Acetic Acid: <2%
- Butyric Acid: <0.1%
- Nitrogen Fractions:
  - Ammonia-Nitrogen <5% of total N


6.0
5.0
4.0
3.0
2.0
1.0
0.0
Silage pH
0
30
60
120
Ensiling Duration (Days)
HD, Cracked
HD, Whole
SD, Cracked
SD, Whole


11.0
10.0
9.0
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.0
% Lactic Acid (DM Basis)
0
30
60
120
Ensiling Duration (Days)
HD, C
HD, W
SD, C
SD,W

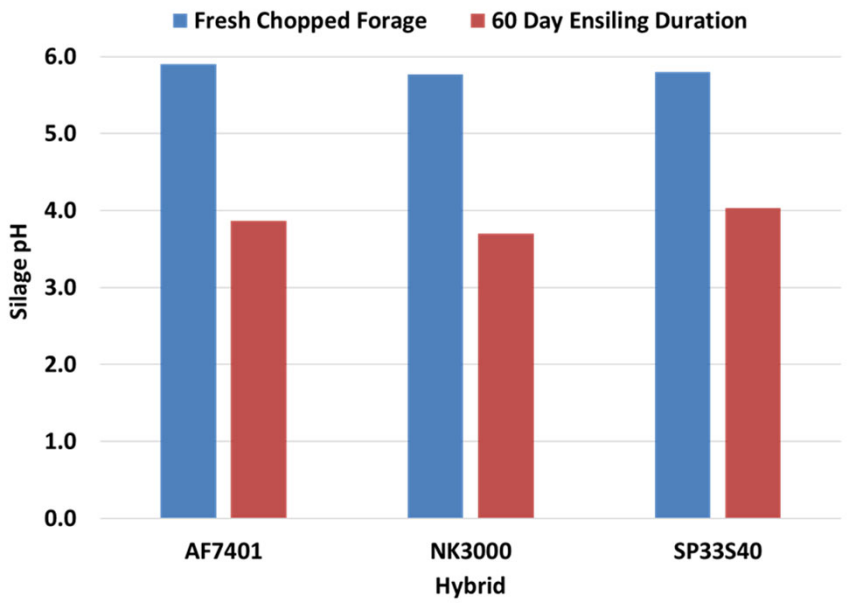

5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
% Acetic Acid
0
30
60
120
Ensiling Duration (Days)
HD, C
HD, W
SD, C
SD, W

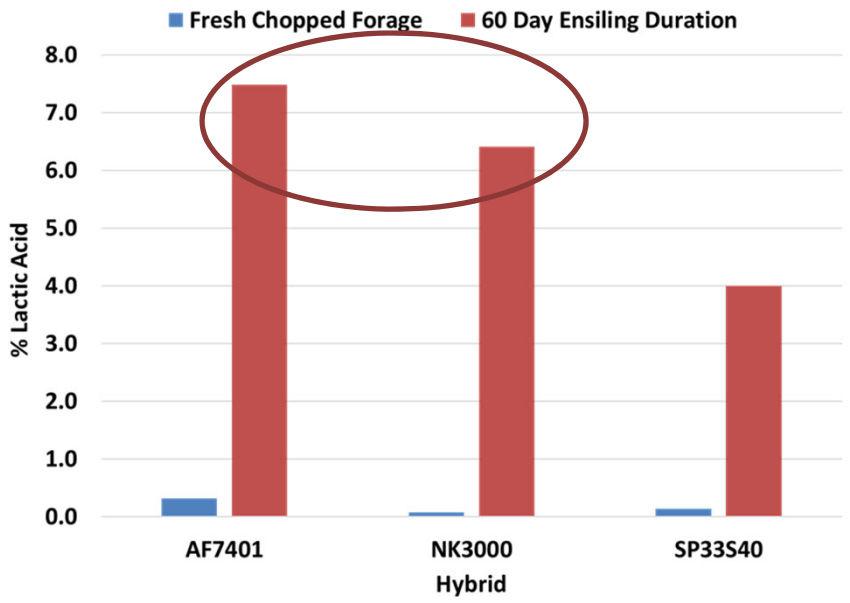

40
35
30
25
20
15
10
5
0
Silage % Starch, DM Basis
0
30
60
120
Ensiling Duration (Days)
HD, C
HD, W
SD, C
SD, W


Extent of Ruminal Starch Digestion, %
100
90
80
70
60
50
40
30
20
10
0
0
30
60
120
Ensiling Duration (Days)
HD, C
HD, W
SD, C
SD, W

Is this consistent with different sorghum?

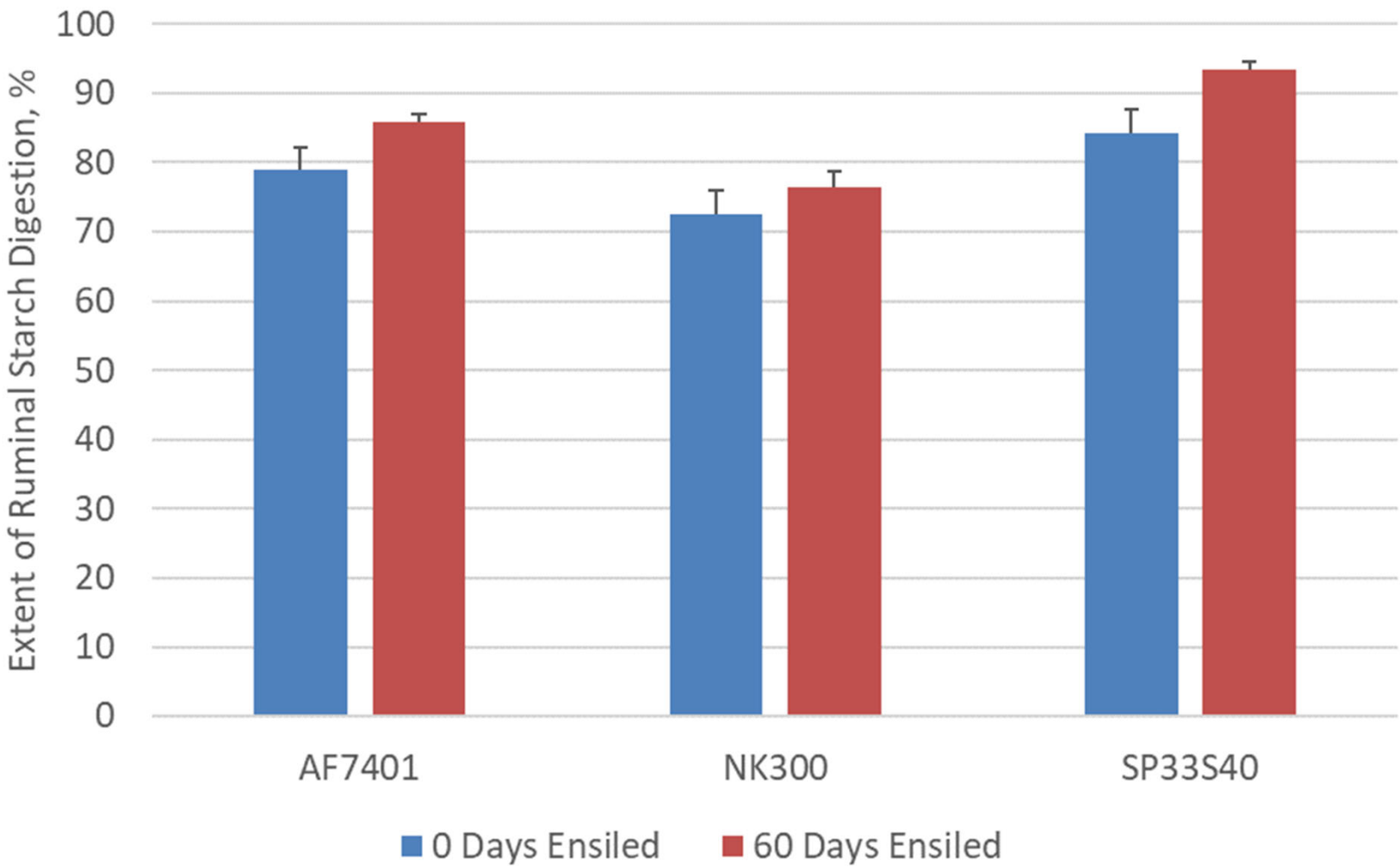
| Year | Hybrid | Harvest Stage | Yield (tons/ac) 65% Moist. |
|---|---|---|---|
| 2016 | AF7401 | SD | 23.1 |
| 2016 | AF7401 | HD | 25.6 |
| 2017 | AF7401 | SD | 22.7 |
| 2017 | NK3000 | SD | 19.8 |
| 2017 | SP33S40 | SD | 16.7 |




Variable but within acceptable range 4-8%
- maybe DM SP33S40 40%

# 2017 Comparison of Forages Chopped at SD with Processed Kernels and Ensiled for 60 days


Extent of Ruminal Starch Digestion, %
100
90
80
70
60
50
40
30
20
10
0
AF7401
NK300
SP33S40
0 Days Ensiled
60 Days Ensiled

- Sorghum Silage is Good Option
- Silage only as Good as the Forage but Silage must also be managed at the pit
- Available Water?
- Harvest Timing and Ensiling duration
  - SD, Cracked, 30d
  - HD, Whole, >120d?

# QUALITY Forage and Water Use

- Sorghum silage is an alternative to corn silage due to drought tolerance but to produce comparable tonnage, you NEED water.
- **If drought stressed, sorghum will "shut down" at peak water demand periods.**
- **If corn is tasseling and you don't meet the water demand, you lose quality more quickly with corn than with sorghum.**
- Corn uses more water than forage sorghums, but seasonal water use will depend on maturity class and environmental conditions
  - PS forage sorghum will use more water than an earlier maturing corn hybrid


Questions?
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