Forage Production for the Dairy Industry

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ANIMAL SCIENCE
TEXAS A&M UNIVERSITY

TEXAS A&M AGRILIFE EXTENSION

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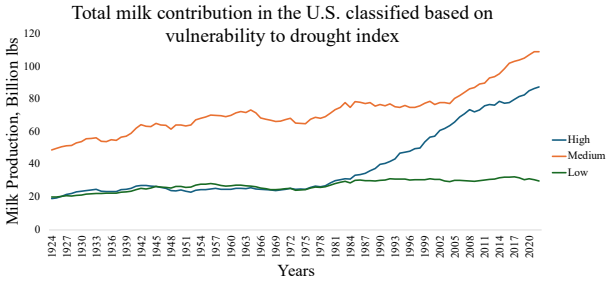
Introduction



Adapted from: USDA/NASS 2023; NOAA, climate.gov and Engström et al. 2020.

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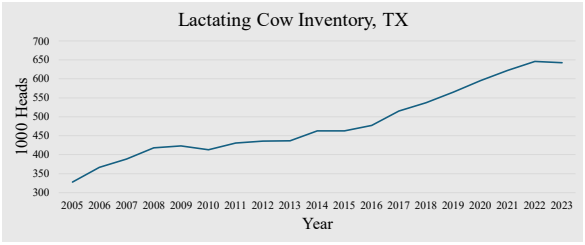
Introduction



Adapted from: USDA-ERS 2024

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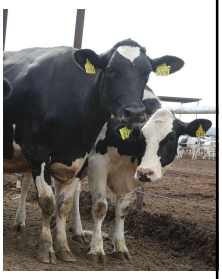
Energy requirement for dairy

	Lactating	Dry	Heifer
Total NEl, Mcal/d	40	19	11.6
DMI, lb/d	55	30	18
Min. dietary NEl Mcal/lb	0.72	0.63	0.64
Feed Intake, lb AF/d	122	60	36



NASEM 2021

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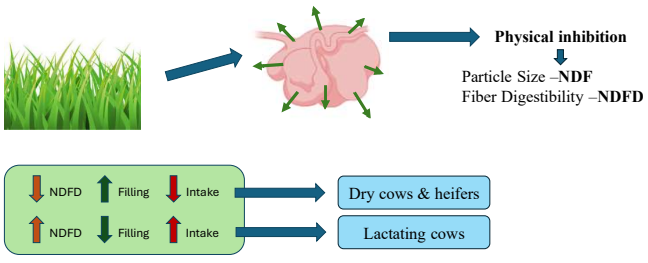
Intake regulation in Dairy Cattle



Allen M.S. 2014.

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Roughages

- Is a bulky feedstuff with a higher fiber content (CF>18%)
  - Silages → Fermented forages
    - Corn silage; Sorghum silage; and Winter crop silage
  - Hay → Dry forage (> 90% of DM)
    - Alfalfa and grass hay
  - Crop residues → Leftover parts of planted crops that remain after the main product is processed or harvested.
    - Wheat straw; Corn Stalks; Peanut Hay

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How Much Forage?

	Lactating	Dry	Heifers
Estimated heads (Panhandle)	450,000	80,000	500,000
DMI, lb	55	30	18
% Roughage	40%	70%	74%
Roughage DMI, lb	22	21	13
Silage, DM/cow/d	19.8	10.1	5.7
Hay, DM/cow/d	2.2	2.0	1.5
Crop residues, DM/cow/d	.	8.0	6.1
Roughage intake, tons of DM/year	1,807,000	307,000	1,215,000

Dallas Market, 2024; NASEM 2021; Pineiro 2020

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How Much Forage?

	Lactating	Dry	Heifers
Silage, tons of DM	1,626,000	147,000	519,000

Total Silage (TX panhandle) + 10% shrink = 2,546,000

Total Silage Production in TX, 2023
Corn = 1,865,000 tons of DM
Sorghum = 842,000 tons of DM
Total = 2,707,000 tons of DM

Dallas Market; NASEM 2021; Pineiro 2020; NASS-USDA 2023

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How Much Water?

	Corn	Sorghum	Winter
Lactating cows, Mi tons of DM per year	1.2	0.08	0.33
Dry Cows, Mi tons of DM per year	0.4	0.2	0.2
Heifer, Mi tons of DM per year	0	0.05	0.4
Total, Mi tons of DM per year	1.6	0.33	0.75
Acres/year	254,000	70,000	284,000
Irrigation, Bi gal	110	19	62

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Desired Characteristic of Forages for Dairy Cattle

- High yield
- Highly digestible fiber (NDFD)
- Highly digestible starch (isSD) & Sugars (%)
- **Drought and heat resistant and low water requirement**

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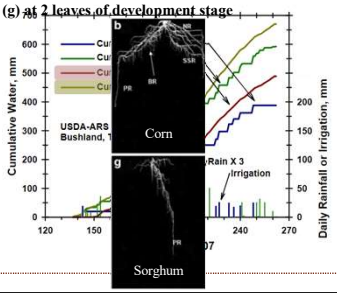
Why Sorghum?

Root development of Corn (b) and sorghum (g) at 2 leaves of development stage



- More drought tolerant
- **1-** ~73 % of evapotranspiration of corn.
- **2-** Sorghum roots grow deeper faster than corn.
- **3-** Sorghum uses water in deeper soil.
- **30% less water requirement than corn**

Howel et al., 2008; Singh et al., 2010; Schittenhelm and Schroetter, 2014; Bhatterai 2019

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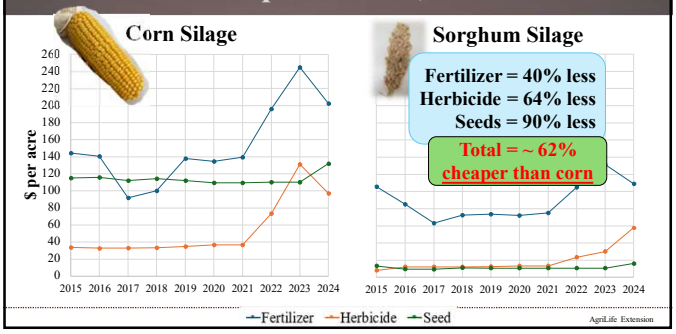
Variable cost of production, $/acre



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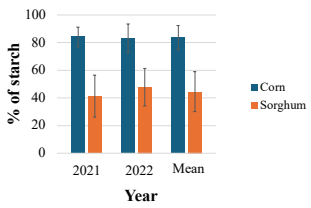
Drawbacks

	Corn	Sorghum
CP, % DM	8.68	7.52
ADF, % DM	25.7	33.7
aNDF, % DM	39.3	48.1
Lignin, % DM	3.42	4.69
Starch, % DM	25.3	15.8
NDFD48, % NDF	54.4	50.4
RFQ	209.0	136.0
DM yield, ton/ac	7.55	8.28



Bell et al. 2015-2023; Raver et al. 2022; Dias Junior et al., 2016; Rock River Laboratory Report West Region, 2022-2023.

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Sorghum Fiber Digestibility

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Sorghum Fiber Digestibility

J. Dairy Sci. 105:5776–5786
https://doi.org/10.3168/jds.2021-21706

Effects of season, variety type, and trait on dry matter yield, nutrient composition, and predicted intake and milk yield of whole-plant sorghum forage

M. R. Pupo,[1] M. O. Wallau,[2] and L. F. Ferraretto[1]*
[1]Department of Animal and Dairy Sciences, University of Wisconsin, Madison 53706
[2]Agronomy Department, University of Florida, Gainesville 32603

n = 24 trials, 437 hybrids, (2008-19)

Season	Spring				Summer				
Variety type	Forage Sorghum		Sorghum-sudangrass		Forage Sorghum		Sorghum-sudangrass		SEM
Trait	BMR	n-BMR	BMR	n-BMR	BMR	n-BMR	BMR	n-BMR	
NDFD30, % NDF	52.1	45.8	49.0	42.2	49.7	46.0	48.4	44.1	1.68
%-points diff	6.3		6.8		3.7		4.3		
% difference	14%		16%		8%		10%		

NDFD30 ~↑ 5%-points → ↑2 lbs DMI ↑3 lbs Milk

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Sorghum Fiber Digestibility

Texas A&M AgriLife Research | Extension

2021 Texas A&M AgriLife Bushland Forage Sorghum Silage Trial
Jourdan Bell, Carla Naylor, Kevin Heflin, Preston Sirmon, Nick Porter, Ronnie Schnell, and Katrina Horn

n = 4 trials, 268 hybrids, (2018-21)

Variety type	Forage Sorghum and Sorghum Sudangrass combined, Mean and (SD)		
Trait	BMR	non-BMR	%-point difference
NDFD48, % NDF	55.9 (6.3)	51.3 (7.4)	4.6
Lignin	2.71 (0.94)	3.35 (0.88)	-0.64

Lignin ~↓19% | NDFD48 ~↑8%

Bell et al., 2018-2021

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BMR Sorghum (BMRSS) Vs. Conv. Sorghum (CSS)

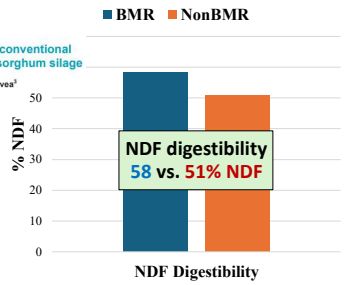
J. Dairy Sci. 102:419–425
https://doi.org/10.3168/jds.2018-14552

Short communication: Meta-analysis of dairy cows fed conventional sorghum or corn silages compared with brown midrib sorghum silage

J. I. Sánchez-Duarte,[1]* K. F. Kalscheur,[1]† A. D. García,[1] and F. E. Contreras-Govea[2]

n = 9 studies (1984-2015)

*↑1.8 lb DMI, ** ↑3.6 lb Milk



Adapted from: Sanchez-Duarte et al, 2019.

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BMR Sorghum (BMRSS) & Conv. Corn (CCS)

J. Dairy Sci. 102:419–425
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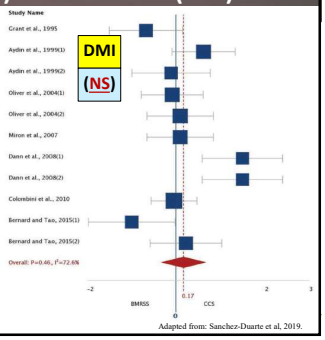
Short communication: Meta-analysis of dairy cows fed conventional sorghum or corn silages compared with brown midrib sorghum silage

J. I. Sánchez-Duarte,[1]* K. F. Kalscheur,[2]† A. D. Garcia,[3] and F. E. Contreras-Govea[3]
[1]Dairy and Food Science Department, South Dakota State University, Brookings 57007
[2]US Dairy Forage Research Center, USDA-Agricultural Research Service, Madison, WI 53706
[3]Department of Dairy Science, University of Wisconsin, Madison 53706

Vs.

NDF digestibility
55 vs. 53%

↓0.35 lb Milk (NS)



DMI
(NS)

Adapted from: Sanchez-Duarte et al, 2019.

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Starch Digestibility

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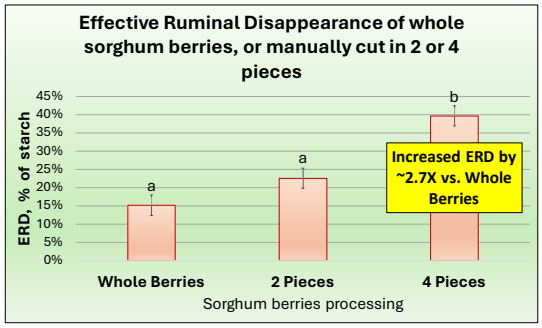

Adapted from McCary, 2019.

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Challenges

- Grain Size
  - Sorghum berry = <25 % of Corn Kernel size
  - Sorghum mean diameter = ~3mm & ~0.04g
  - Corn smallest dimension = ~ 4mm & ~0.3g

McCary, 2019; Ferreira and Mertens 2005; Kjak et al., 2020.

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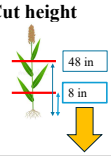
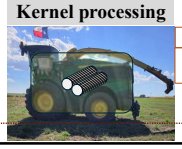
Sorghum Starch Digestibility

Cut height



Kernel processing



Without KP
With KP
0.5 mm

Harvest Settings
Low & +KP
Low & noKP
High & +KP

Ensiling storage time
0 Days - Fresh
90 Days - ensiled

Duhatschek et al 2024

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Management Strategies

	Low noKP		Low +KP		High +KP		SEM
	0 d	90 d	0 d	90 d	0 d	90 d	
DM, %	37.6	37.2	39.2	40.0	56.4	56.9	1.4
Starch, % DM	33.1	30.6	37.2	36.7	52.1	51.2	1.7
BPS, %	7.7	8.6	55.8	56.7	70.1	71.6	1.3

Harvest settings $P < 0.01$

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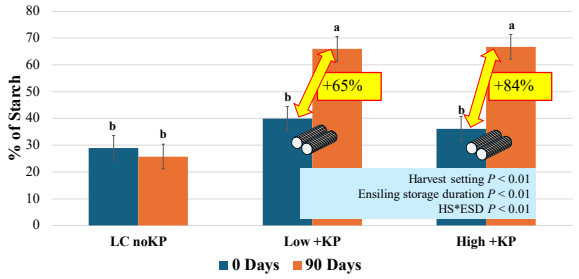
Starch Digestibility at 7h of ensiled sorghum



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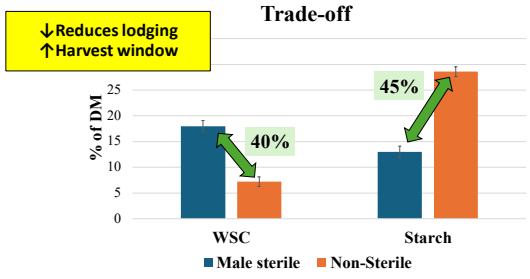
Why BMR male-sterile sorghum hybrids?



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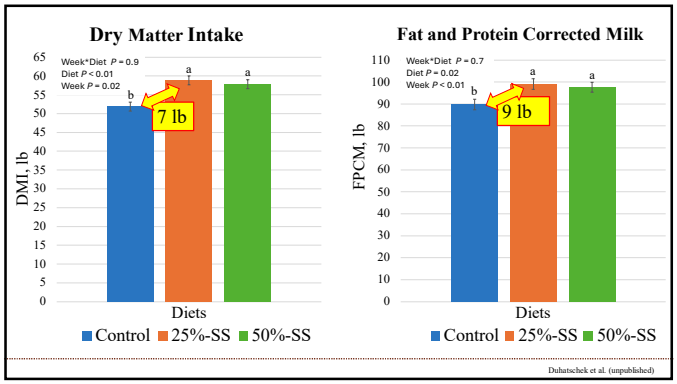

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Results:

Daily $ per Cow	Control	25%-SS	50%-SS
Milk Revenue	$ 19.98	$ 21.13	$ 21.33
Feed Cost	$ 7.37	[illegible]	$8.04
IOFC	$ 12.68	$ 13.92	$ 13.88

+ $ 1.21 / cow*day

+ $ 1.24 / cow*day

*Revenue based on component prices from August 2024 class III

Assumed OS = Ash + Lactose

Duhatschek et al. (unpublished)

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Take Home Message

- Dairy cattle inventory has been growing in the panhandle
  - Forage demand is growing in consequence
  - Majority of water used to produce silage for lactating dairy cows
- Increasing forage quality is key
  - Fiber and starch digestibility **NDFD & isSD**

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Questions?
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