HIGH PLAINS DAIRY CONFERENCE

2026

PROCEEDINGS



Nutritional Mitigation of Heat Stress-Induced Leaky Gut: The Role of DCAD and Dietary Buffer



UNIVERSITY OF SASKATCHEWAN

Claire Bertens[1], Clayton Stoffel[2], and Greg Penner[1]

[1]Department of Animal and Poultry Science, University of Saskatchewan

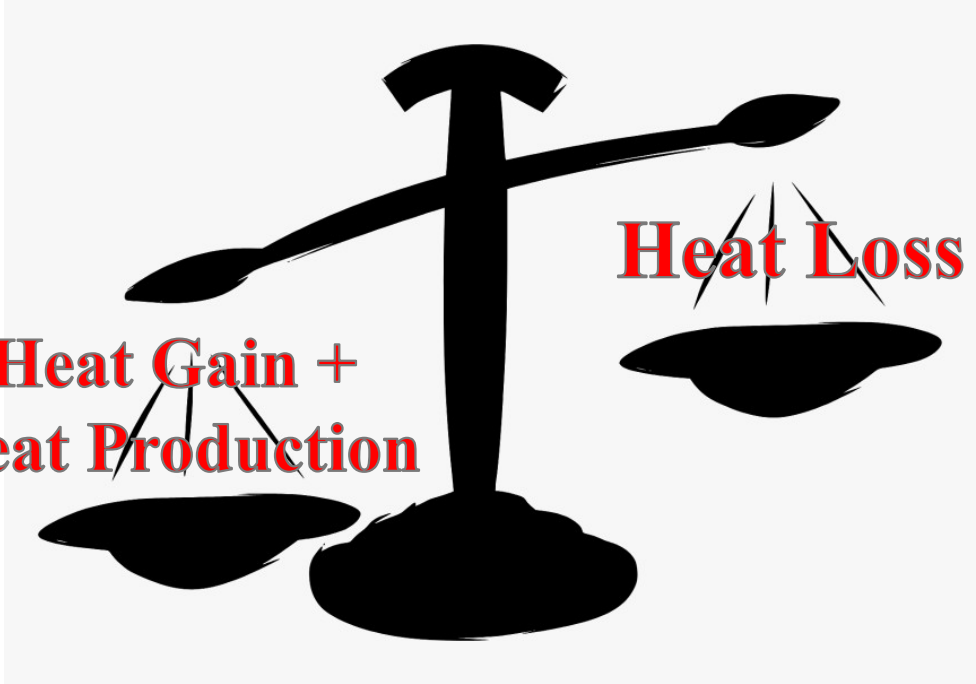
[2]Papillon Agriculture Company, Easton, MD

www.usask.ca

Economic impact of heat stress

- Cost: Decreased milk yield, reproduction, and increased mortality and culling
  a) American Dairy Industry: $900 million (St-Pierre et al., 2003)
  b) Canadian Dairy Industry: $42.4 million/year losses in production alone
     - Western Canada experiences heat stress 40% of summer days (Ouellet et al., 2019)
  c) Europe: 2.8% reduction in milk yield, 5.4% of monthly income (Hempel et al., 2019)
     - 1/3 of days are heat stress conditions
     - Limitations in barn cooling (natural ventilation), extensive production (solar heat)
     - Environmental and welfare concerns

What is heat stress?



- Temperature-Humidity Index (THI): (NRC 1971 and West 1994)

  $THI = (T_{db}) - (0.55–0.55 * RH) \times (T_{db} – 58)$

  - THI < 68 = Comfortable
  - THI 68-78 = Mild-Moderate Heat Stress
  - THI > 78 = Severe Heat Stress

T_{db} = dry bulb Temperature (° F)
RH=relative humidity

Heat stress decreases productivity

- Decreased milk yields by up to 35-40% (West 2003)
- Decrease of 0.27 kg milk per unit THI above 68 (Bernabucci et al., 2010)
- Projected to continue to decline 174 ± 7 kg/cow per decade (Gunn et al., 2019)
- Changes to milk composition are inconsistent (Bandaranayaka and Holmes 1976; Rhoads et al., 2009; Carabaño et al., 2016)

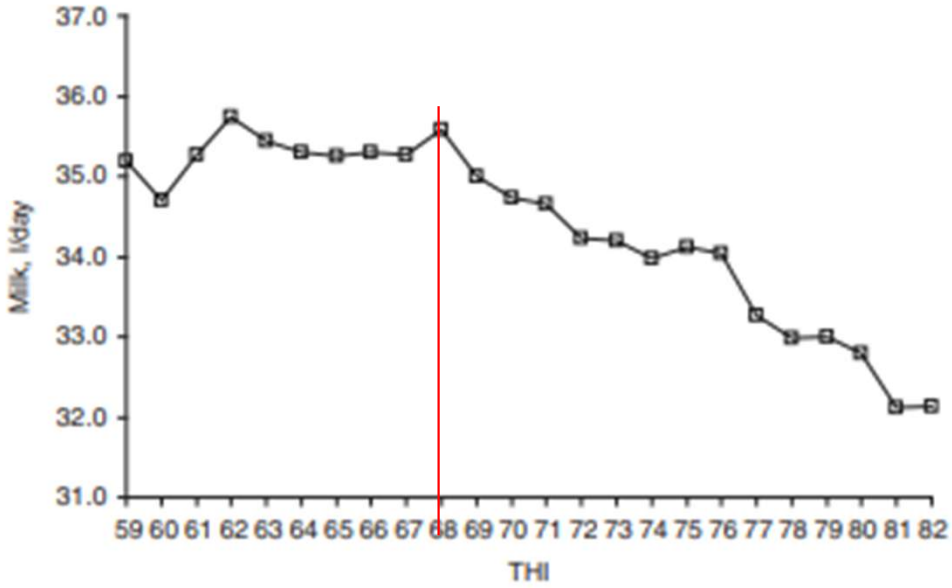


Figure 4 Temperature–humidity index on milk production in Holstein cows.

(Bernabucci et al., 2010)

Why does heat stress reduce productivity?

1. Reduced feed intake (Beede and Collier 1986, West 2003)
   - ~35-50% of decrease in milk yield (Baumgard and Rhoads, 2013)
2. Increase heat dissipation mechanisms
   - Sweating
   - Increased respiration rate/panting (Mcdowell et al 1976)
     - Respiratory alkalosis and compensatory metabolic acidosis
   - Vasodilation to periphery (Kadzere et al., 2002)
3. Altered endocrine status (Rhoads et al., 2009)
4. Reduced rumen health
   - Decreased rumination (Tapk and Sahin, 2006), salivary buffering, and ruminal pH (Kadzere et al., 2002)
5. Leaky gut (Baumgard and Rhoads, 2013; Fontoura et al., 2022)
   - Systemic inflammation (Kvidera et al., 2018)

Positive DCAD vs. dietary buffer during heat stress

DCAD

- Heat stress = acidogenic process
- Provides more Na and K (Strong Ion Theory)
  a) ↑ Blood buffering (panting = ↓ pCO_2 and ↑ urinary HCO_3
  b) Replace lost electrolytes
     - K in sweat
     - Na in urine (low aldosterone)
     - Na in saliva (drooling)
  c) ↑ Water intake (stimulate DMI)
  d) ↑ Water intake and urine volume (heat transfer)

Buffer

- Heat stress: reduces DMI, rumination, salivary buffering, reduced blood flow to the gut
- Predisposes cows to ruminal acidosis and hindgut acidosis
- Dietary buffers help stabilize rumen pH, prevent milk fat depression

Burhans et al., 2022
Kadzere et al., 2002

Objectives

J. Dairy Sci. 107:10851–10868
https://doi.org/10.3168/jds.2024-25225
© 2024, The Authors. Published by Elsevier Inc. on behalf of the American Dairy Science Association®.
This is an open access article under the CC BY license (https://creativecommons.org/licenses/by/4.0/).

The effects of dietary cation-anion difference and dietary buffer for lactating dairy cattle under mild heat stress with night cooling

C. A. Bertens,[1] C. Stoffel,[2] M. B. Crombie,[2] P. Vahmani,[3] and G. B. Penner[1]*
[1]Department of Animal and Poultry Science, University of Saskatchewan, Saskatoon, SK S7N 5A8, Canada
[2]Papillon Agricultural Company and MIN-AD Inc., Easton, MD 21601
[3]Department of Animal Science, UC Davis, Davis, CA 95616

1. To determine whether DCAD and dietary buffer supply interact during exposure to heat stress to affect feed intake, ruminal fermentation, paracellular permeability of the gastrointestinal tract, mineral excretion, systemic inflammation, and milk and milk component yield in lactating dairy cattle.

2. To evaluate the role of ruminal sodium supply on SCFA absorption across the reticulo-rumen in vivo and ex vivo.

Experimental design

- 16 lactating Holsteins
  - 8 cannulated primiparous (80 ± 19.2 DIM)
  - 8 non-cannulated multiparous (136 ± 38.8 DIM)
- Replicated 4 × 4 Latin square
  - Blocked into squares by parity (multiparous vs. primiparous) and DIM
  - 21-day periods



Measured variables (last 7 d of each period)

- Dry matter intake, milk yield and milk components
- Feeding behavior
- Ruminal fermentation: ruminal pH & temperature, SCFA, ammonia and mineral concentrations
- Nutrient absorption across the rumen and saliva production
  a) Isolated and washed reticulo-rumen technique
- Nutrient digestibility and mineral balance
- Blood mineral and metabolites: insulin, glucose, systemic inflammation markers, BHBA, NEFA
- Total and post-ruminal gastrointestinal tract barrier function
  a) Ruminal dose of Cr-EDTA and omasal dose Co-EDTA
  b) Total urine collection
- Urine production and mineral excretion

Dietary treatments

Dietary Cation-Anion Difference (DCAD) vs. Dietary Buffer

- DCAD was adjusted using NH_4Cl (Animate) and Na-acetate
  - LOW= 10 mEq/100g DM HIGH= 30 mEq/100g DM
- High buffer diets (HB) included $CaMg(CO_3)_2$

	Low Buffer		**High Buffer**	
	Low DCAD	High DCAD	Low DCAD	High DCAD
Abbreviation used	LB-LD	LB-HD	HB-LD	HB-HD
Buffer inclusion	None	None	$CaMg(CO_3)_2$	$CaMg(CO_3)_2$
DCAD	-	Na-acetate	Animate	High DCAD

Item, % DM	Treatment			
	LB-LD	LB-HD	HB-LD	HB-HD
Barley silage	46.0	46.0	46.0	46.0
Dry rolled barley grain	15.3	15.4	15.2	15.3
Steam flaked corn	13.29	13.08	13.29	13.25
Ground wheat	0.36	0.36	0.36	0.36
Soybean/canola meal blend	8.05	7.87	6.91	8.02
Soybean meal	6.53	6.42	6.53	6.51
Smartamine Methionine	0.05	0.05	0.05	0.05
Urea	0.02	0.08	-	0.02
Beet molasses	1.02	1.00	1.02	1.01
Beet pulp	0.89	-	1.96	0.90
Palmitic acid	0.89	0.88	0.89	0.89
Megalac	0.61	0.60	0.61	0.61
Limestone	**0.74**	**0.74**	**0.71**	**0.75**
Calcium propionate	**0.61**	**0.60**	**0.61**	**0.61**
Dicalcium phosphate	**0.86**	**0.91**	**0.03**	**0.06**
Magnesium sulfate	**0.75**	**0.75**	**0.00**	**0.24**
Min-AD	**-**	**-**	**0.84**	**0.84**
Sodium Acetate	**0.39**	**1.75**	**0.00**	**1.02**
White salt	**0.20**	**0.00**	**0.40**	**0.00**
Animate	**-**	**-**	**1.29**	**-**
Trace minerals and vitamins	0.024	0.020	0.020	0.020

Dietary treatments

Chemical composition[1]	Treatment			
	LB-LD	LB-HD	HB-LD	HB-HD
CP, % of DM	18.53 ± 0.63	18.23 ± 0.25	18.45 ± 0.61	18.42 ± 0.40
Starch, % of DM	24.06 ± 3.98	24.30 ± 2.33	23.94 ± 3.94	23.35 ± 3.38
Ether extract, % of DM	4.02 ± 0.85	4.05 ± 0.71	3.97 ± 0.57	4.20 ± 0.71
aNDFom, % of DM	29.03 ± 0.31	28.48 ± 0.31	29.37 ± 0.55	29.05 ± 0.52
ADF, % of DM	17.48 ± 0.55	16.86 ± 0.53	17.45 ± 0.25	17.12 ± 0.52
Ca, % of DM	1.00 ± 0.11	1.00 ± 0.11	1.11 ± 0.21	1.14 ± 0.07
P, % of DM	0.65 ± 0.01	0.69 ± 0.05	0.43 ± 0.01	0.47 ± 0.01
Mg, % of DM	0.30 ± 0.00	0.32 ± 0.00	0.45 ± 0.05	0.41 ± 0.02
K, % of DM	1.70 ± 0.06	1.69 ± 0.04	1.69 ± 0.06	1.71 ± 0.04
S, % of DM	0.32 ± 0.01	0.36 ± 0.00	0.30 ± 0.02	0.27 ± 0.00
Na, % of DM	0.35 ± 0.05	0.73 ± 0.07	0.36 ± 0.07	0.55 ± 0.03
Cl, % of DM	0.57 ± 0.05	0.43 ± 0.03	0.98 ± 0.15	0.43 ± 0.03
DCAD[2], mEq/100g	**22.7 ± 2.08**	**40.4 ± 4.06**	**12.4 ± 1.14**	**38.7 ± 1.60**
AACC[3], mEq H+/g	**20.0 ± 0.00**	**20.0 ± 0.00**	**41.5 ± 0.00**	**41.5 ± 0.00**

[1]mean value ± standard deviation

[2]Calculated as mEq (Na + K) – (Cl + S)/100 g of DM

[3]Added acid consuming capacity from $CaMg(CO_3)_2$ and $CaCO_3$

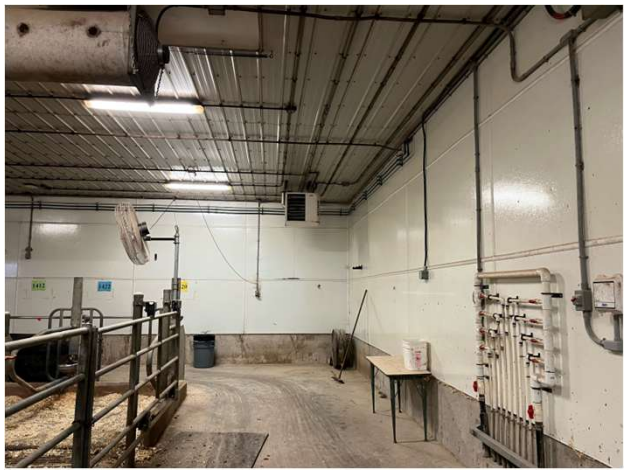
17.6 and 39.6 mEq/100 g

Induction of heat stress

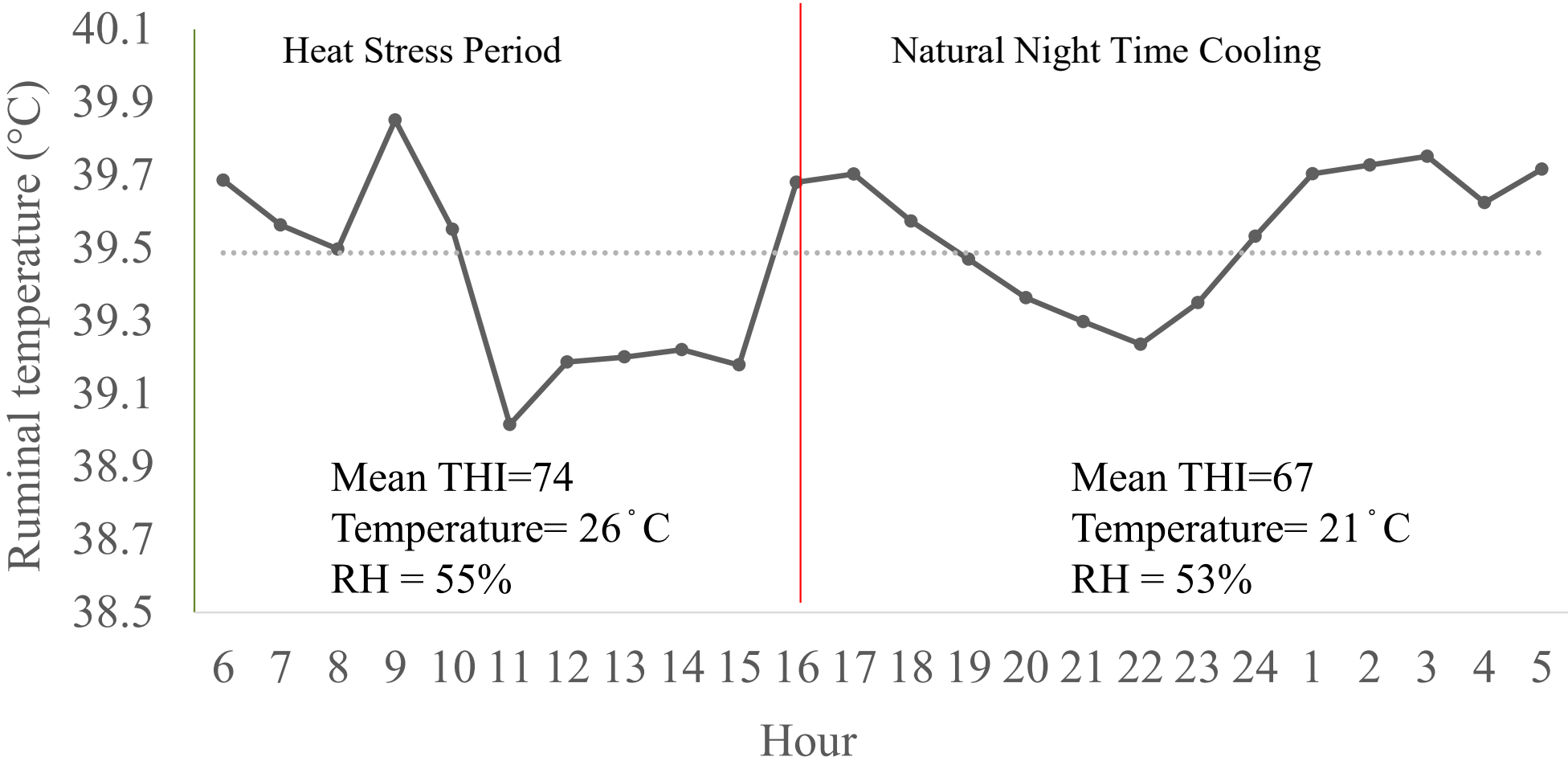
- Study occurred from July 2021-October 2021
- Housed in the tie-stall wing at the Rayner Dairy Research and Teaching Facility
  a) Barn manually programmed to maintain a THI of 68-72 between 0600 and 1600 h.
  b) 4 data-loggers used to monitor temperature and relative humidity throughout the barn







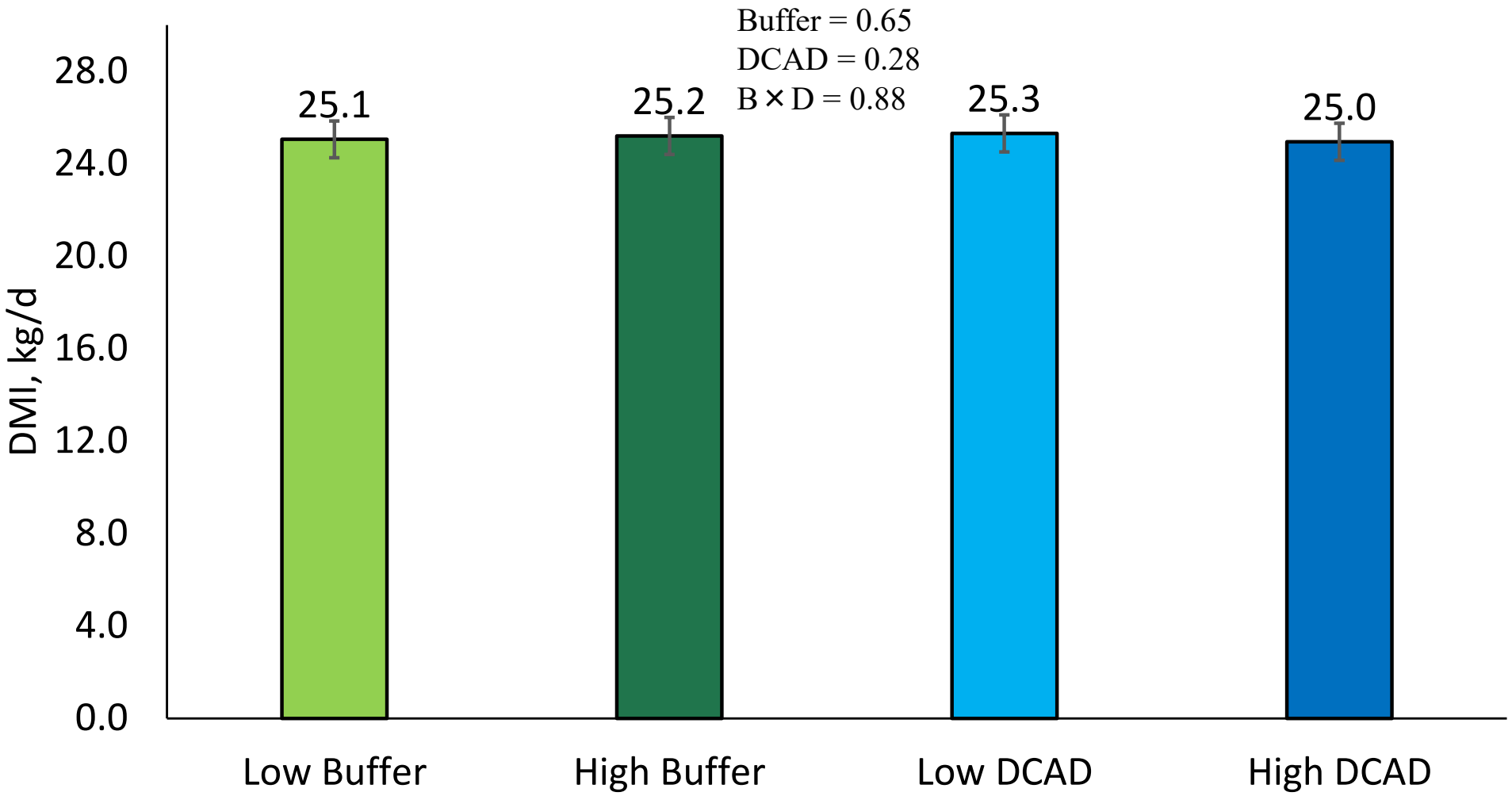
Ruminal temperature



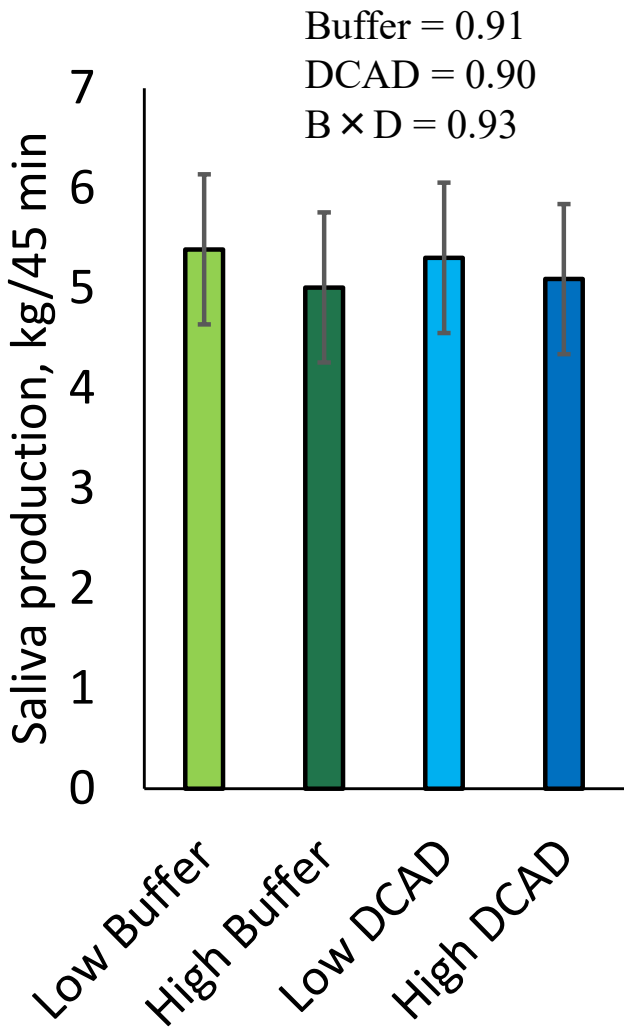
Average 15 h/d exposed to THI ≥ 68

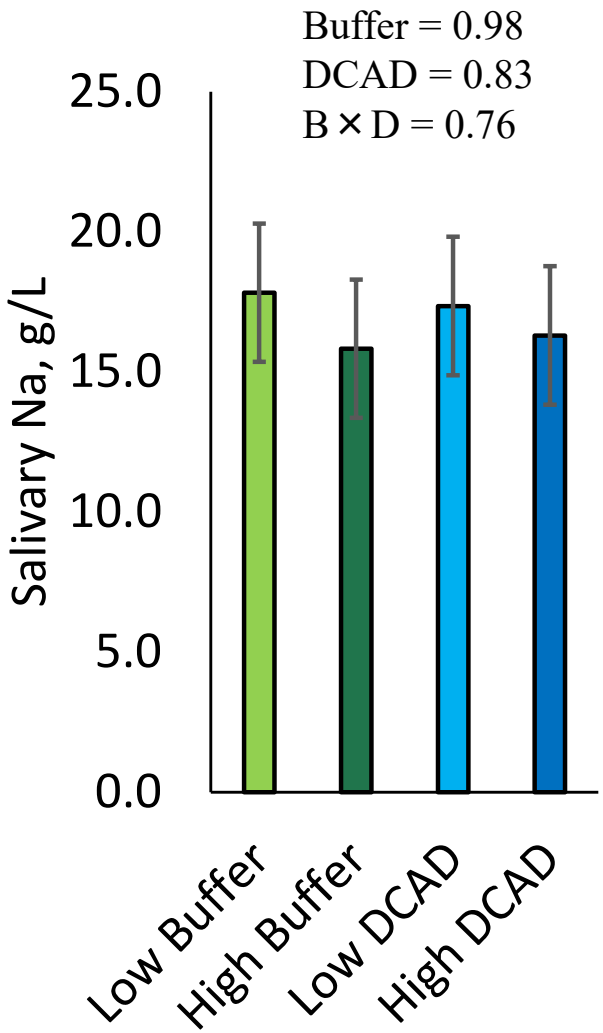
Average rectal temperatures (1530 h) = 39.1ºC

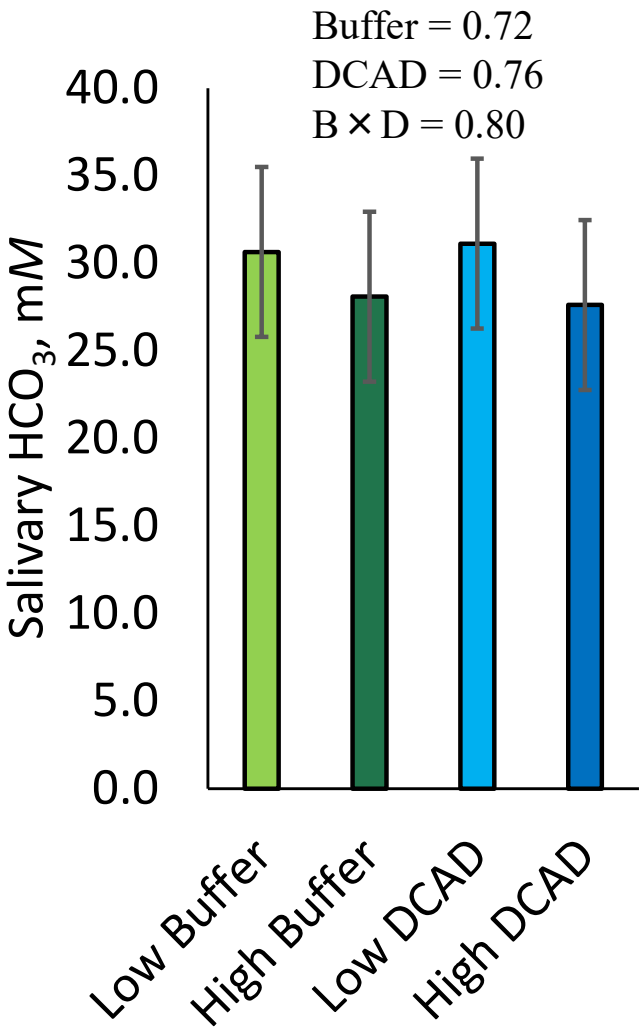
No effect of buffer or DCAD on DMI



Treatments did not affect salivary composition





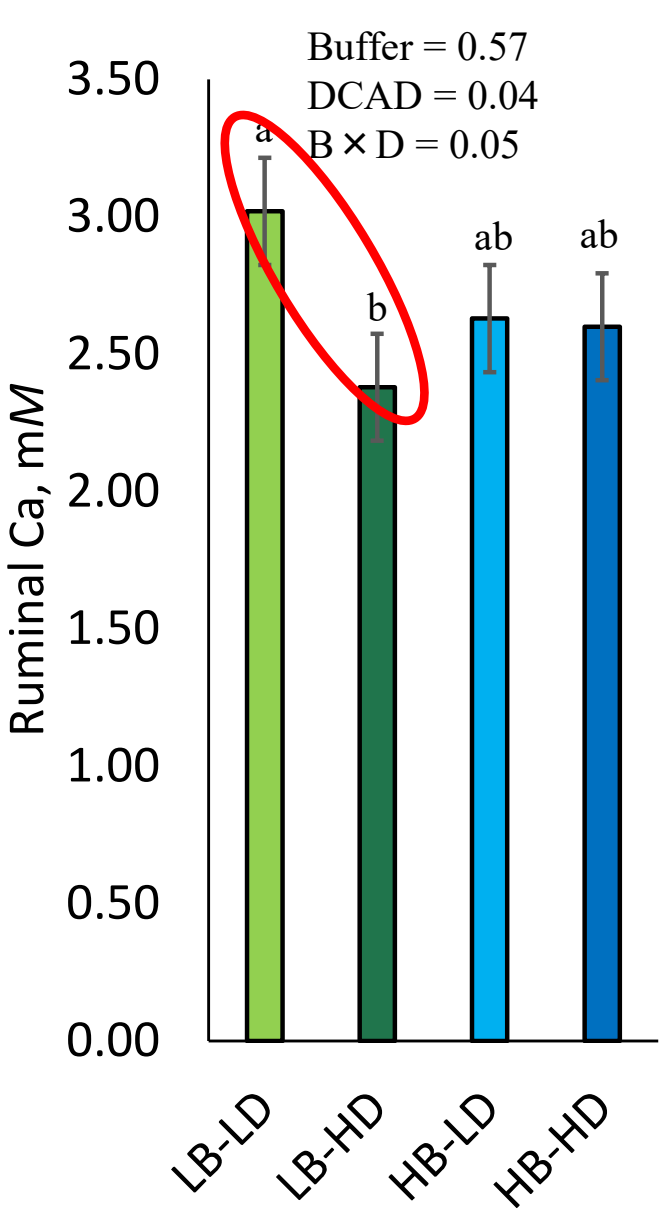


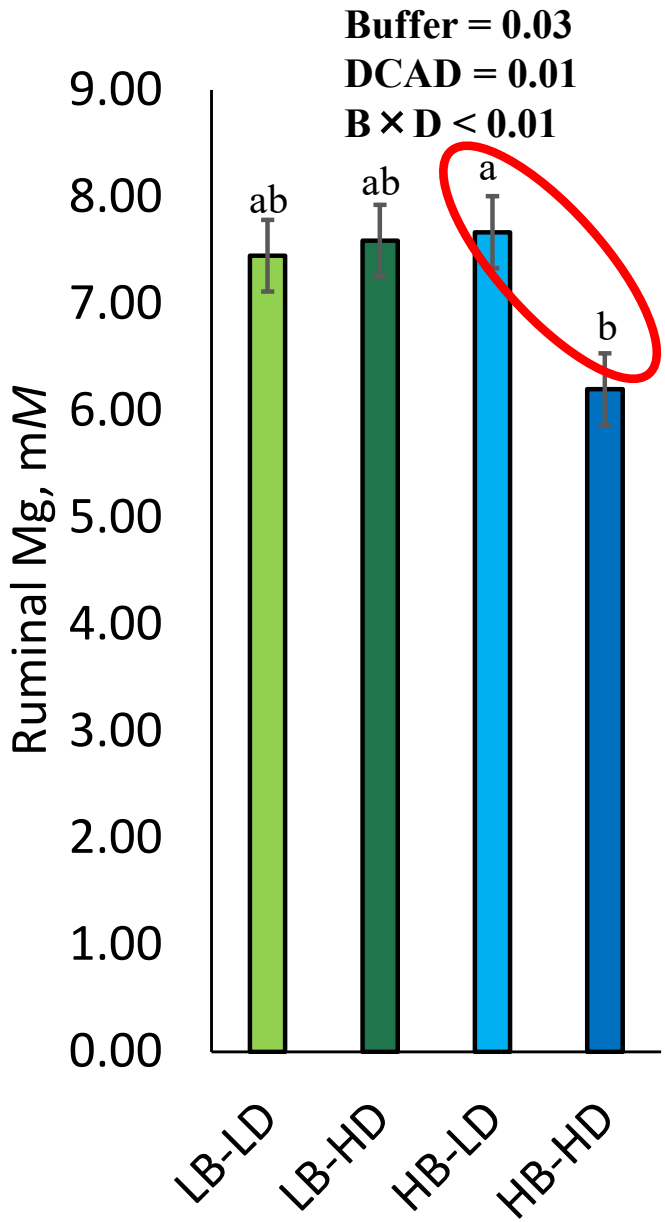
If extrapolated: ~166 L/d saliva

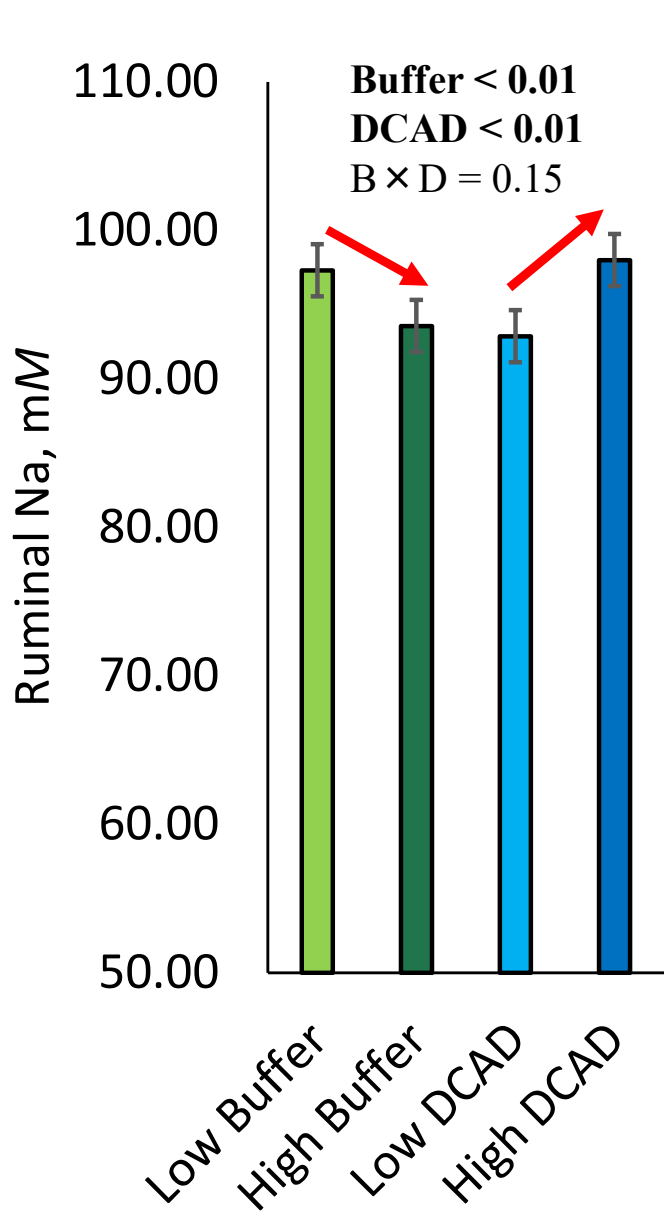
~538 g/d of Na

~928 g/d of HCO_3

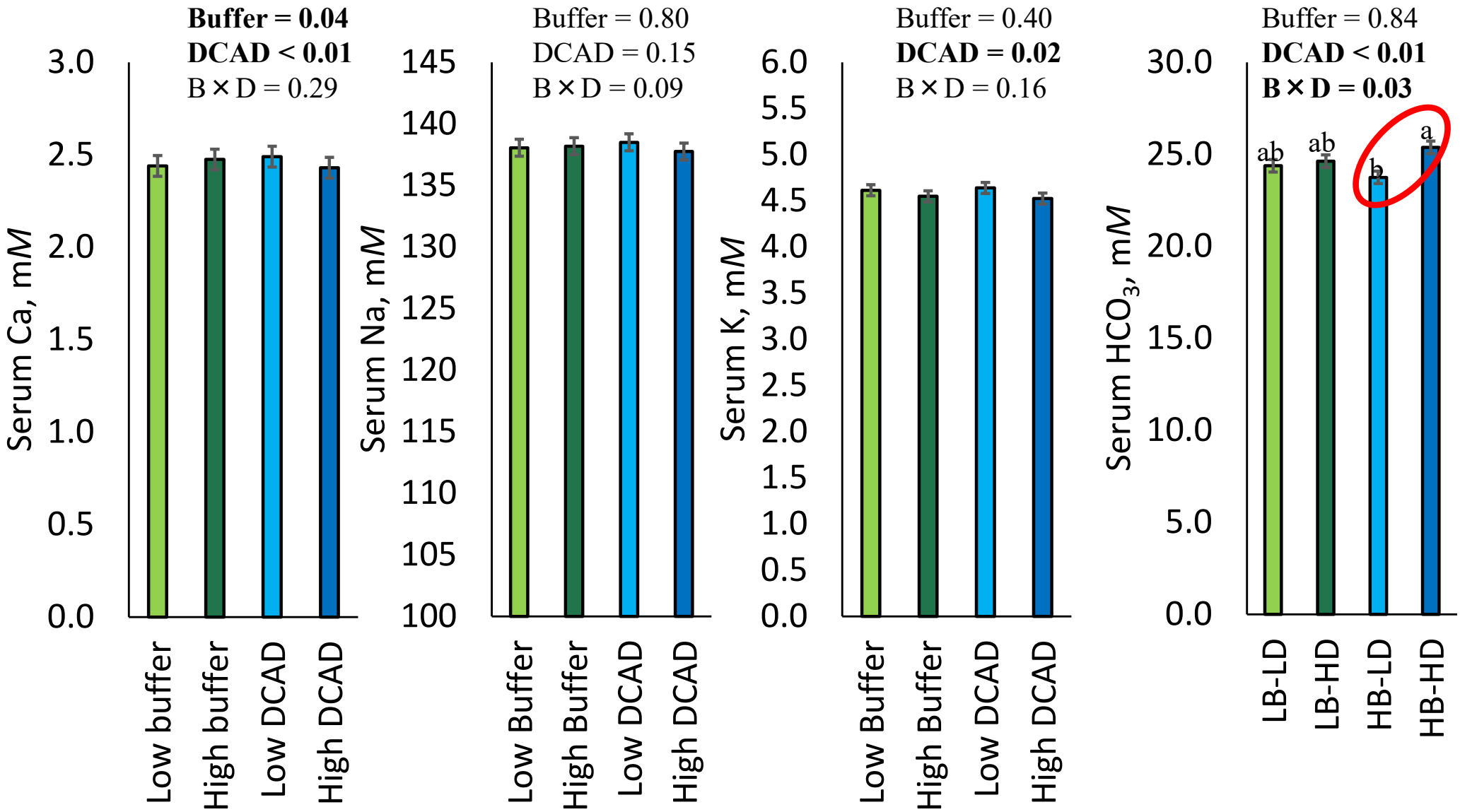
Alterations in ruminal digesta mineral concentrations



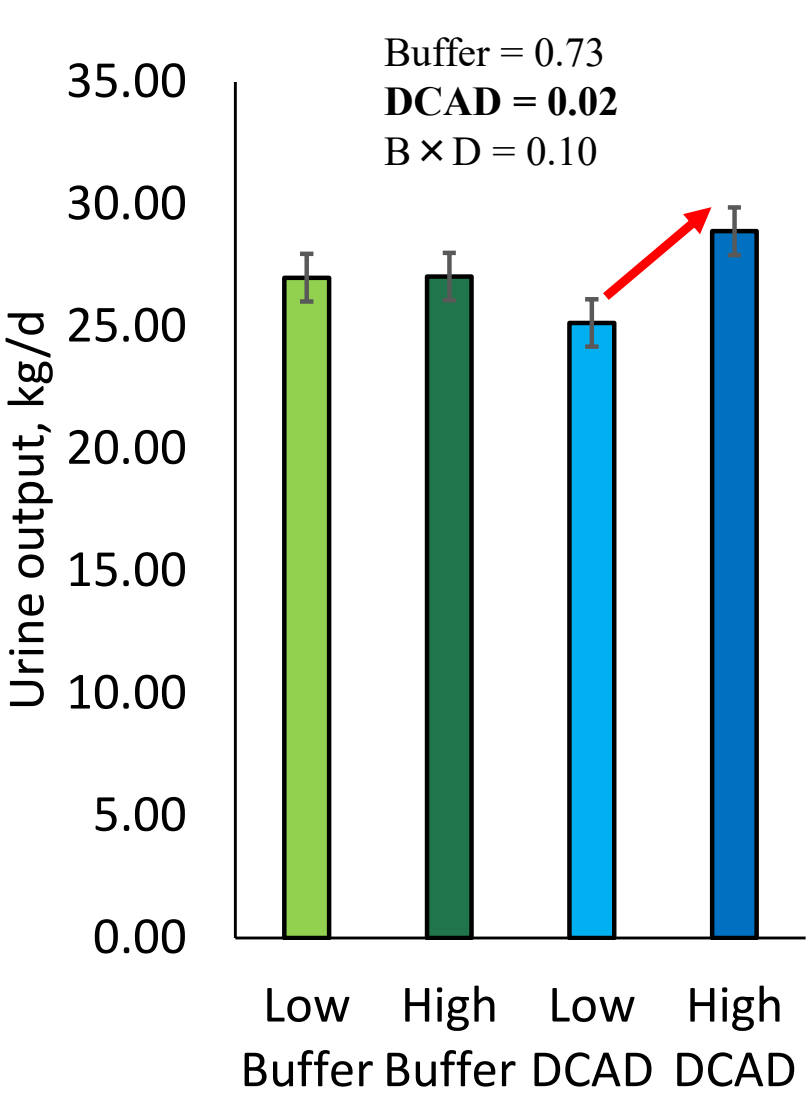


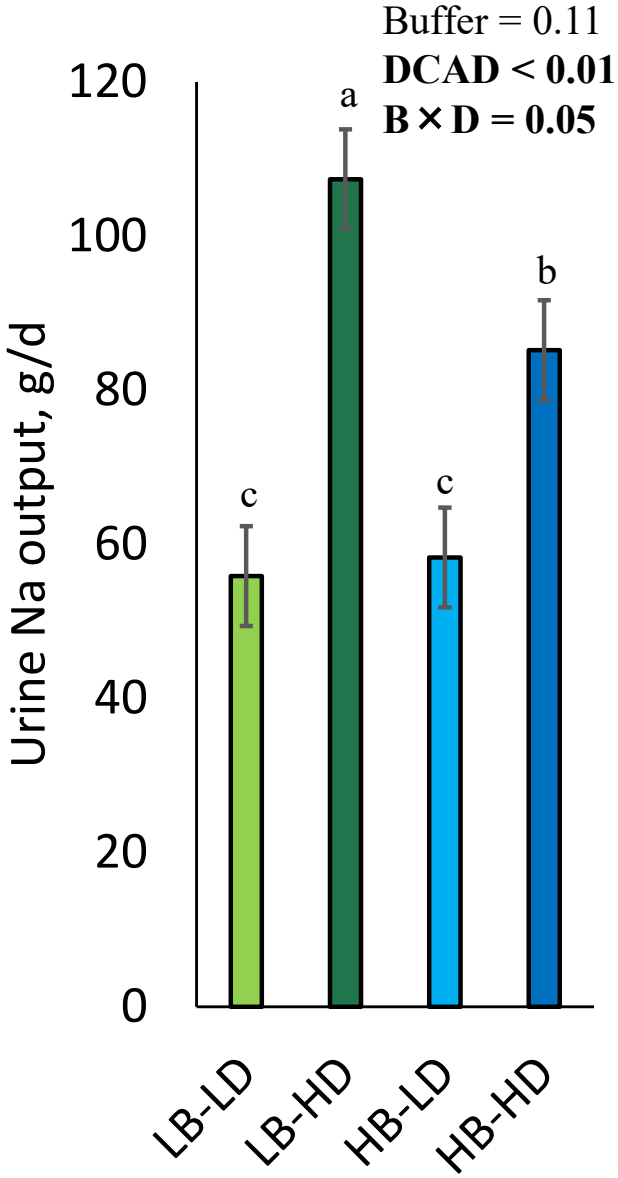


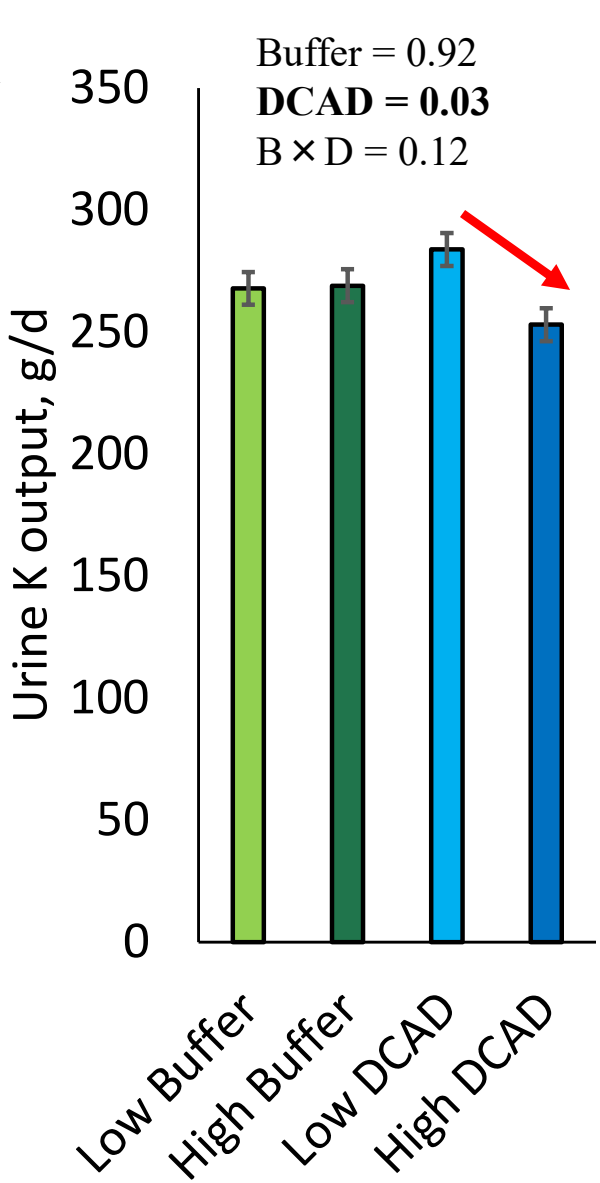
Interactive effect of buffer and DCAD on blood minerals



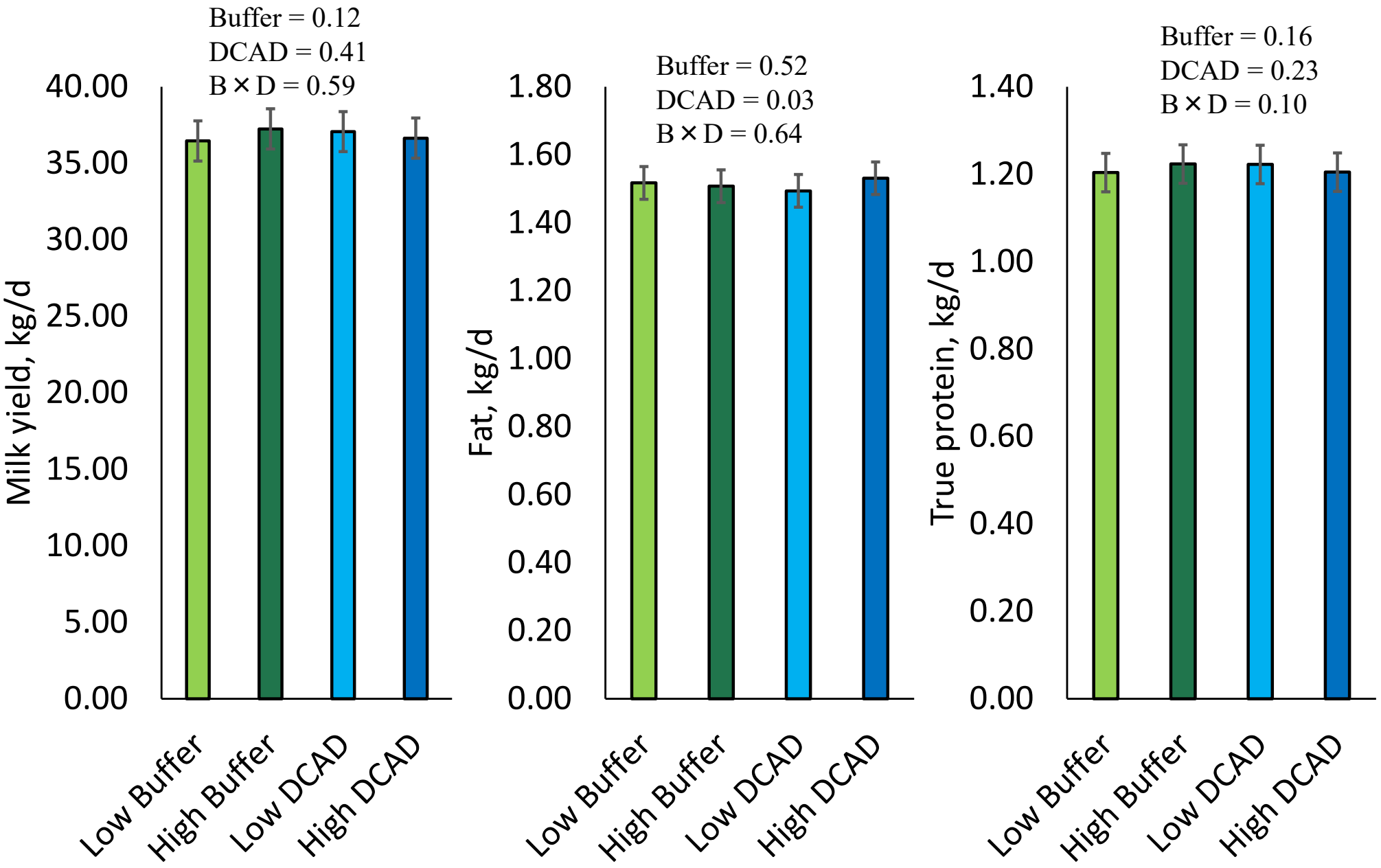
Increasing DCAD increased urine output, excretion of Na, and decreased K excretion



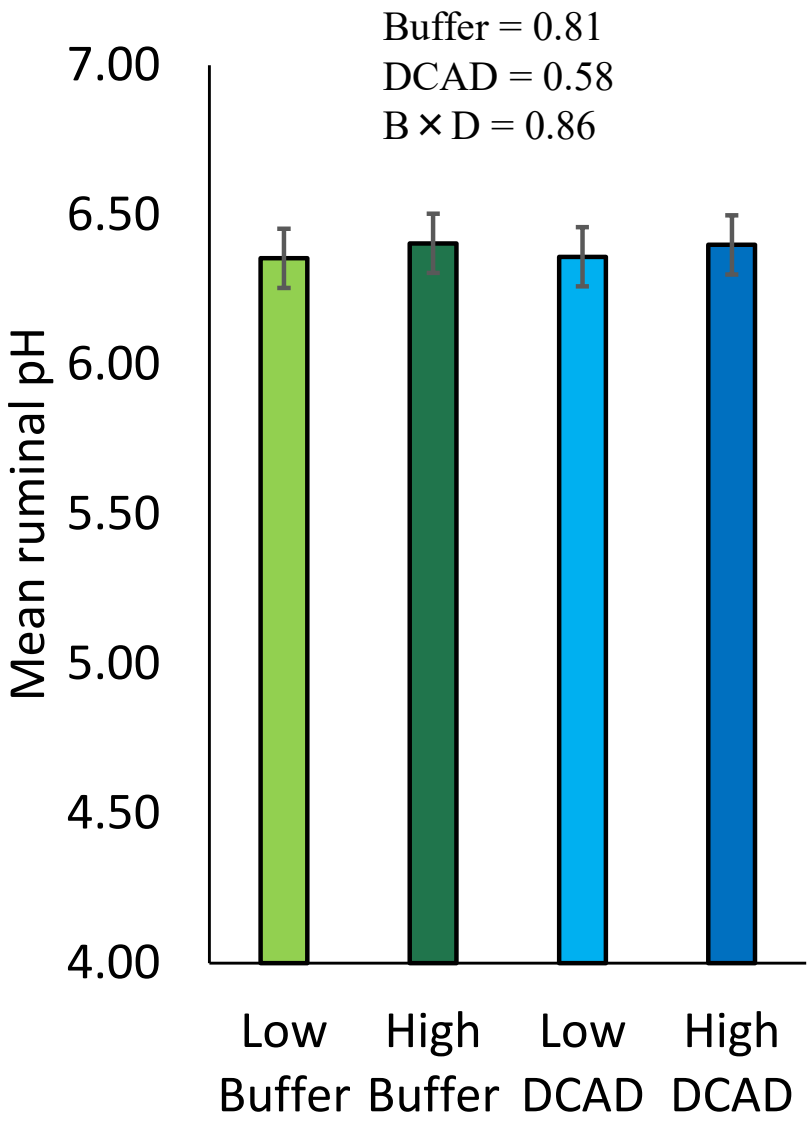


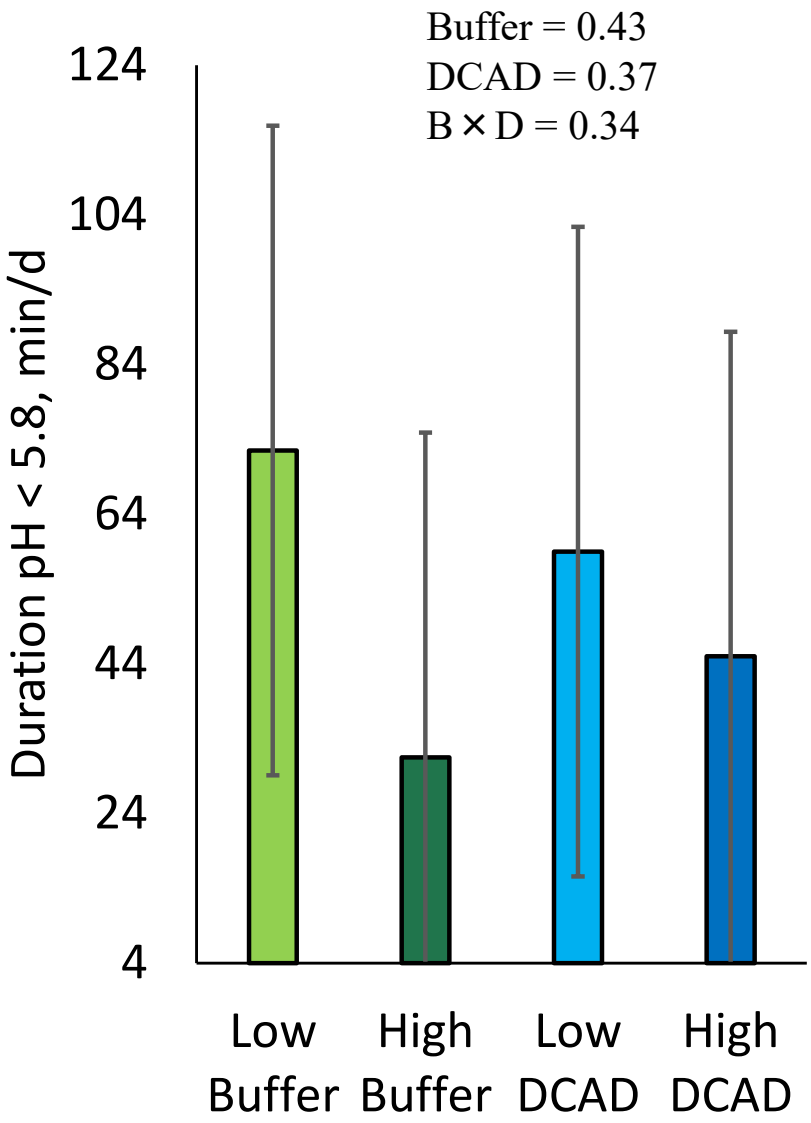


DCAD increase milk fat yield

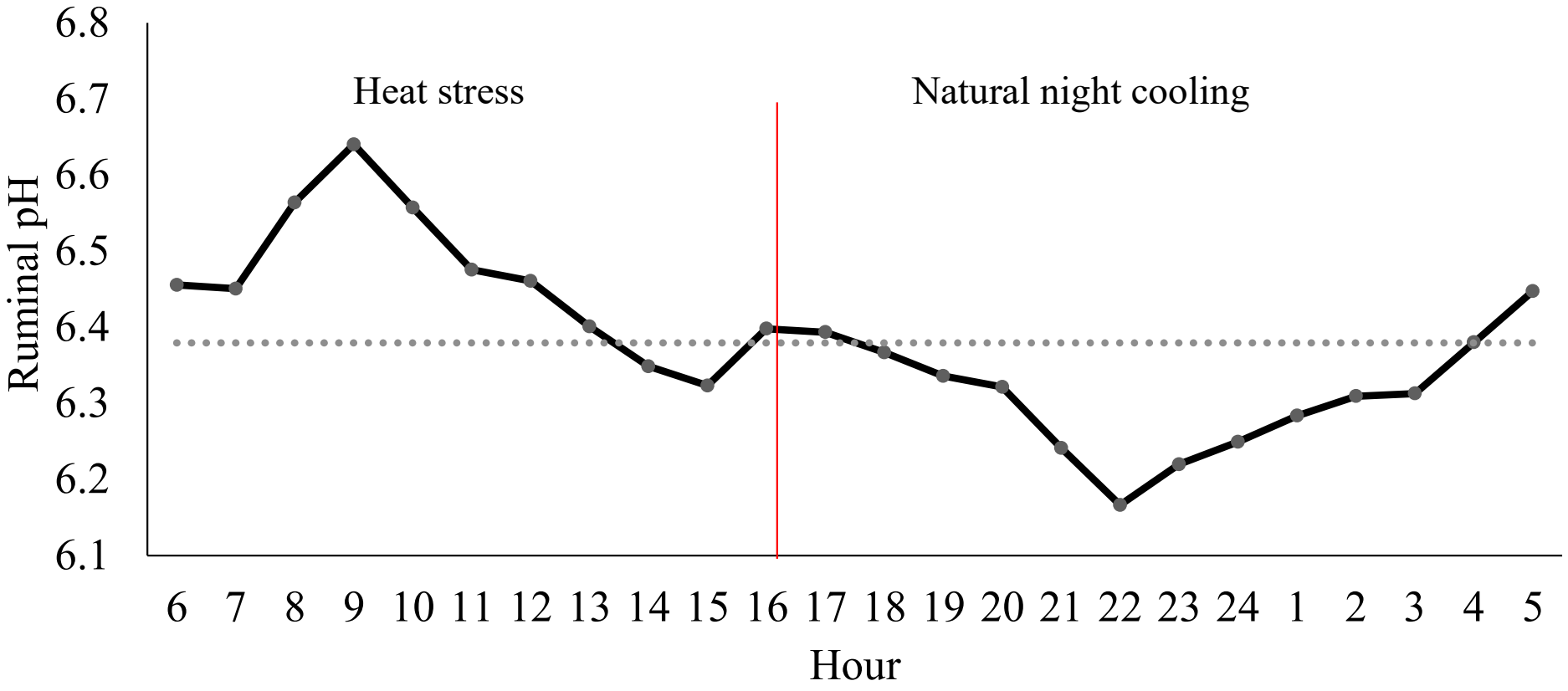


No effect of buffer or DCAD on ruminal pH

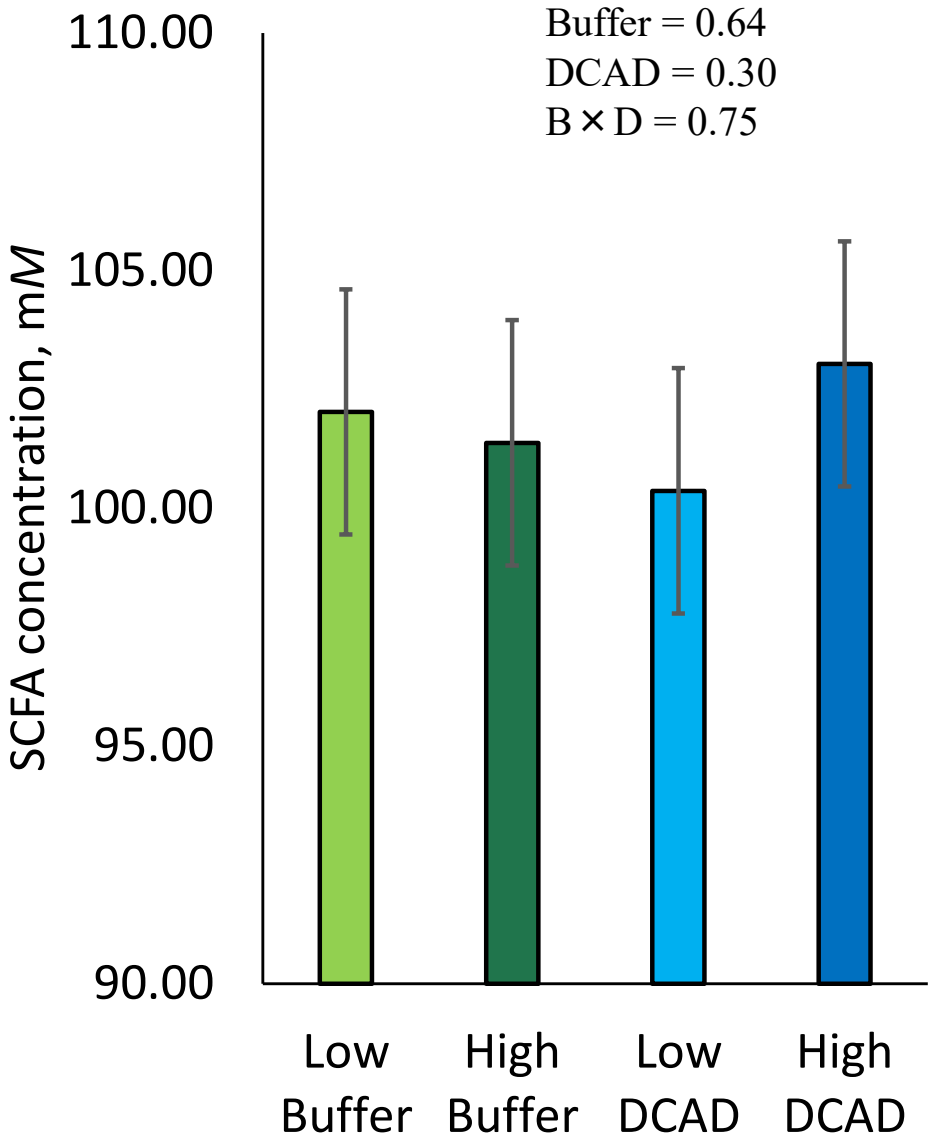




Diurnal ruminal pH

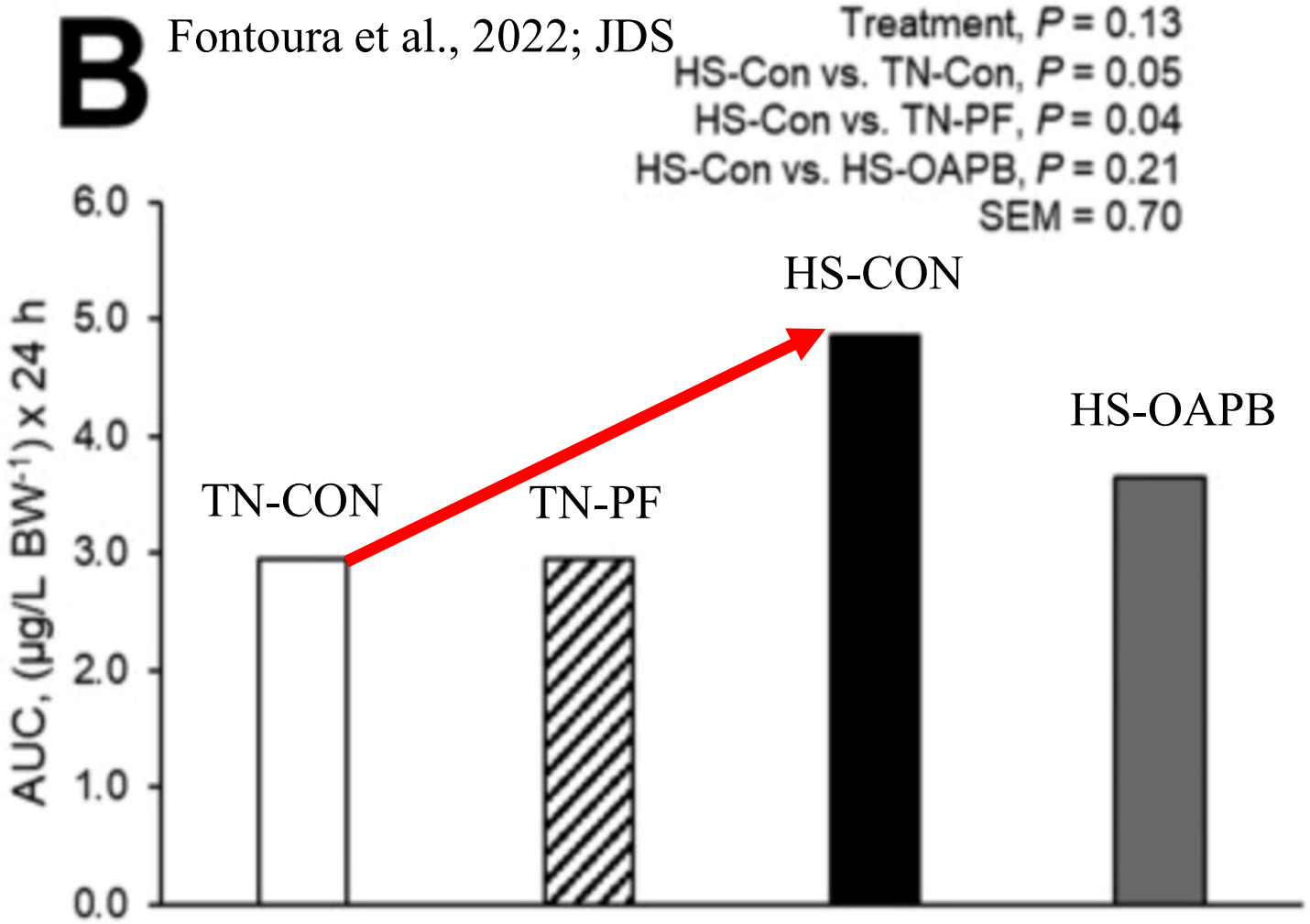


No effect of buffer or DCAD on ruminal SCFA



- No effect of buffer, DCAD, or their interaction on the molar proportions of individual SCFA, ammonia, or osmolality
- Rumen digesta weight was not affected
  - 85.8 kg as is
  - 11.3 kg DM

Heat-stress induced leaky gut

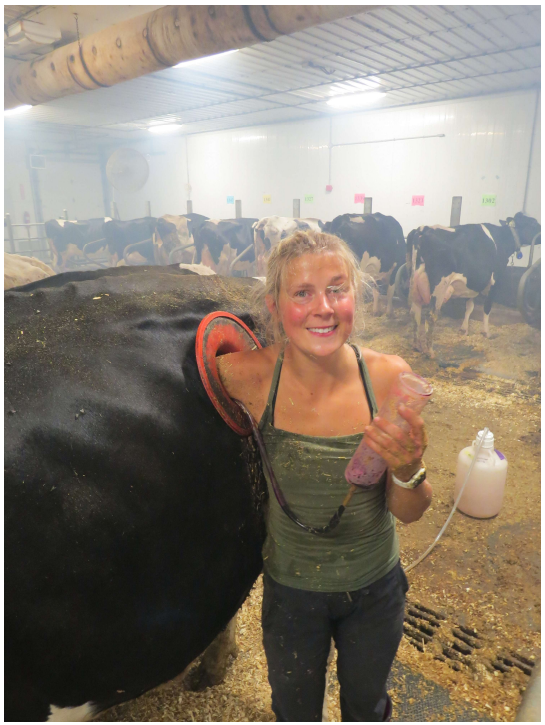


J. Dairy Sci. 107:11708–11727
https://doi.org/10.3168/jds.2024-25142
© 2024, The Authors. Published by Elsevier Inc. on behalf of the American Dairy Science Association®.
This is an open access article under the CC BY license (https://creativecommons.org/licenses/by/4.0/).

Validation of an in vivo dual permeability marker technique to characterize regional gastrointestinal tract permeability in mid-lactation Holstein cows during short-term feed restriction

C. A. Bertens,[1] D. J. Seymour,[2,3] and G. B. Penner[1]*
[1]Department of Animal and Poultry Science, University of Saskatchewan, Saskatoon, SK, Canada S7N 5A8
[2]Trouw Nutrition R&D, 5830 AE Boxmeer, the Netherlands
[3]Centre for Nutrition Modelling, Department of Animal Biosciences, University of Guelph, ON, Canada N1G 2W1

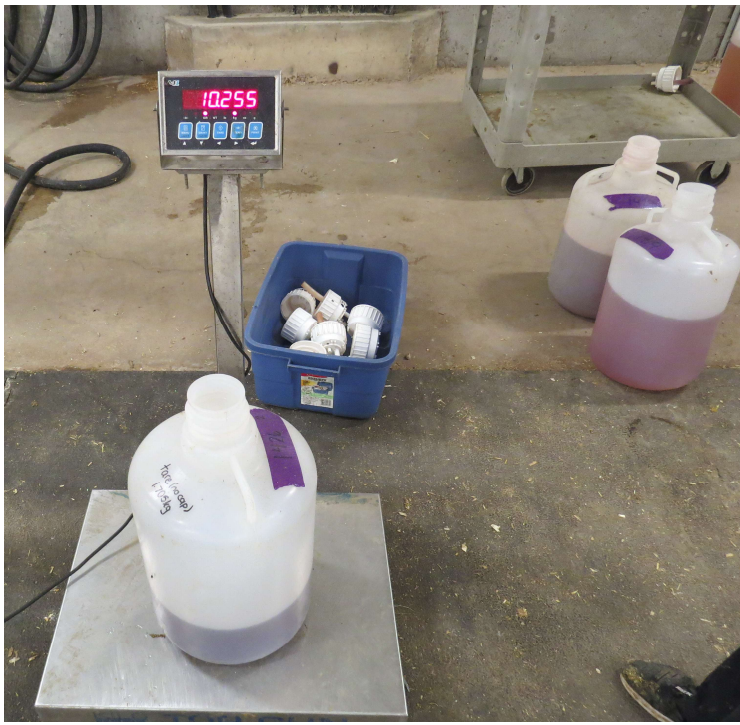
Total and post-ruminal gastrointestinal tract barrier function "leaky gut"



Cobalt-EDTA



Chromium-EDTA



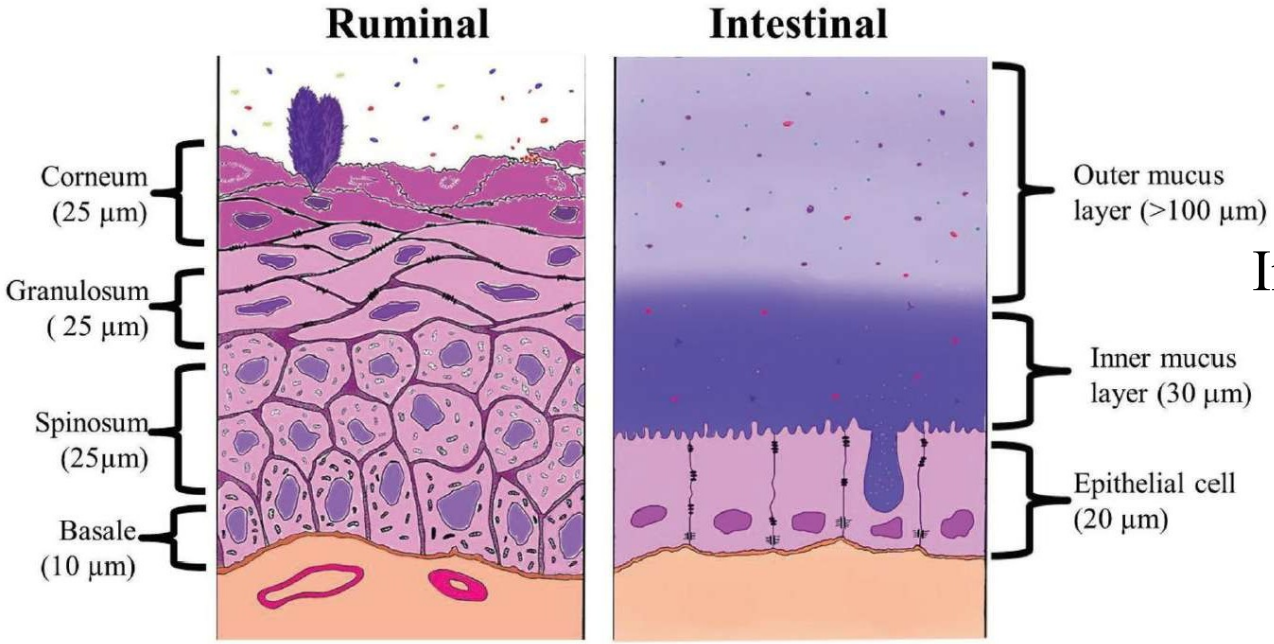
Urine collection

Total and post-ruminal gastrointestinal tract barrier function

- **Buffer reduced intestinal permeability by 27%**

	Treatment					P value		
Variable	HB-HD	HB-LD	LB-HD	LB-LD	SEM	Buffer	DCAD	Buffer*DCAD
Chromium excreted, mg	139.2	150.0	155.0	166.9	12.11	**0.098**	0.24	0.96
Cobalt excreted, mg	100.0	83.0	127.0	122.6	8.36	**<0.01**	0.21	0.46

55-82% of total marker excretion was post-ruminal

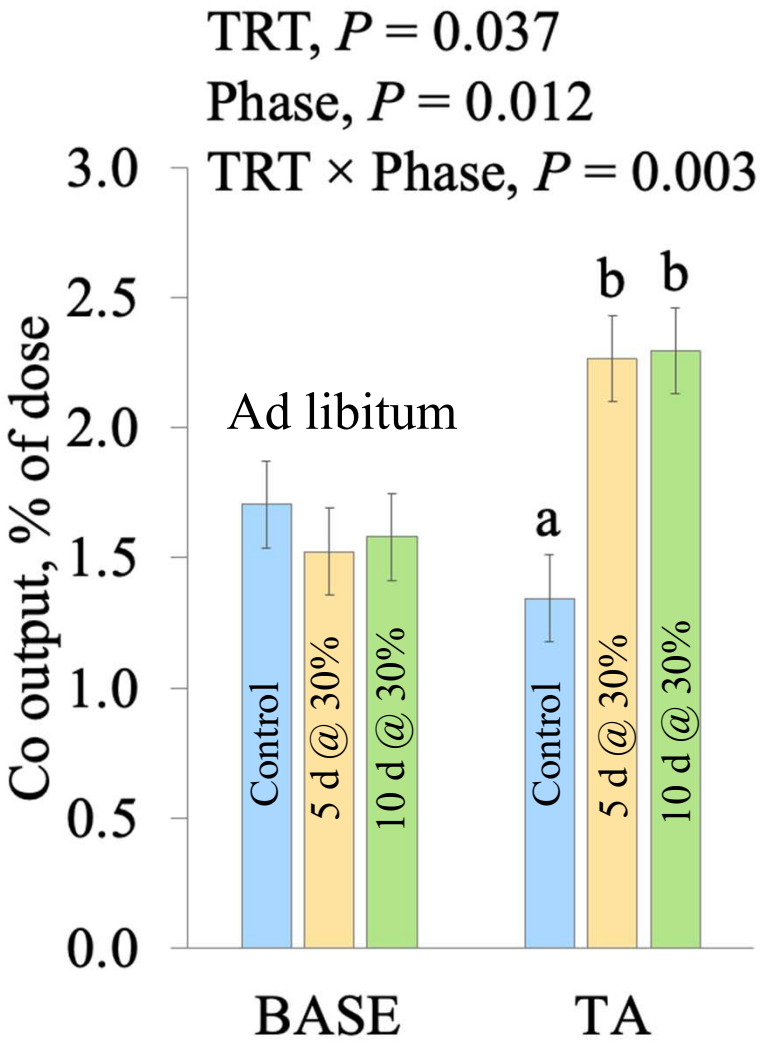


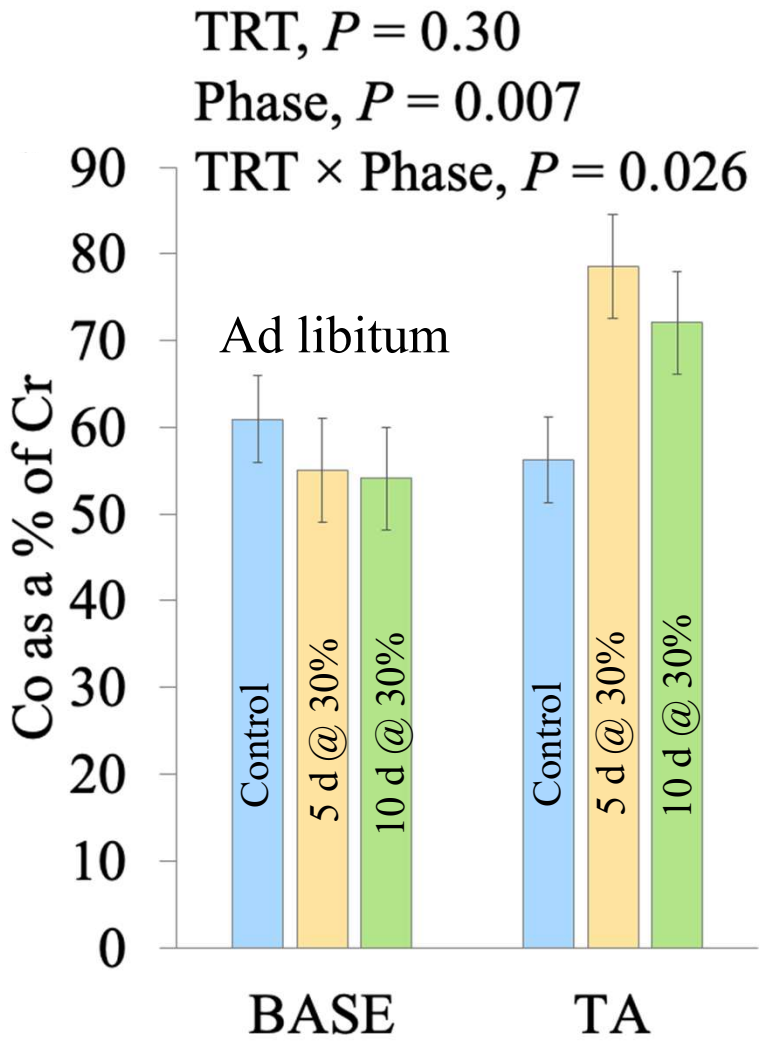
Steele et al., 2016; JDS

Increased risk of inflammation

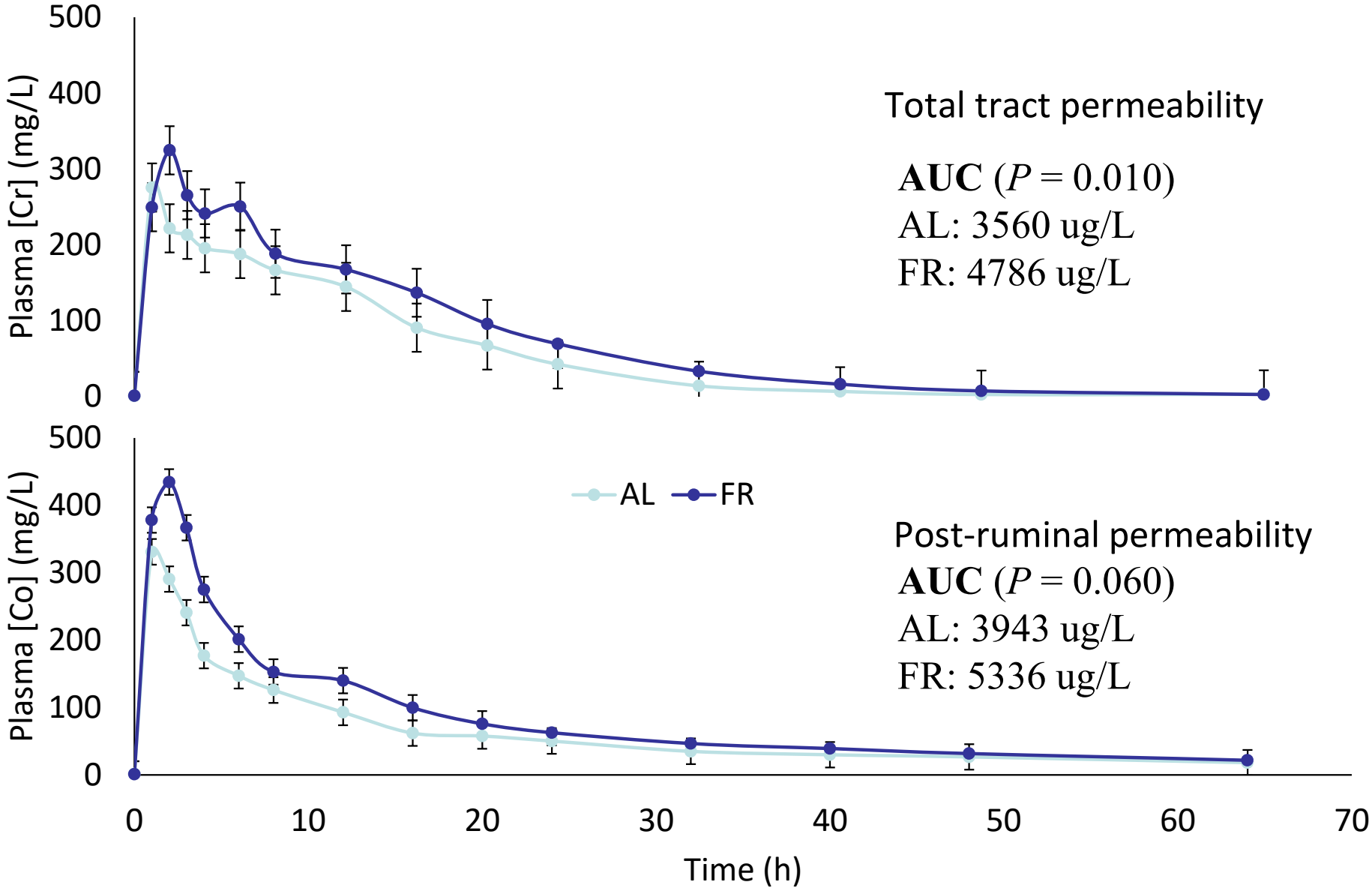
- Glucose utilization ~1 kg/12 h (Kvidera et al., 2017)
- Irreversible hepatic amino acid utilization

Low feed intake increases intestinal permeability not ruminal

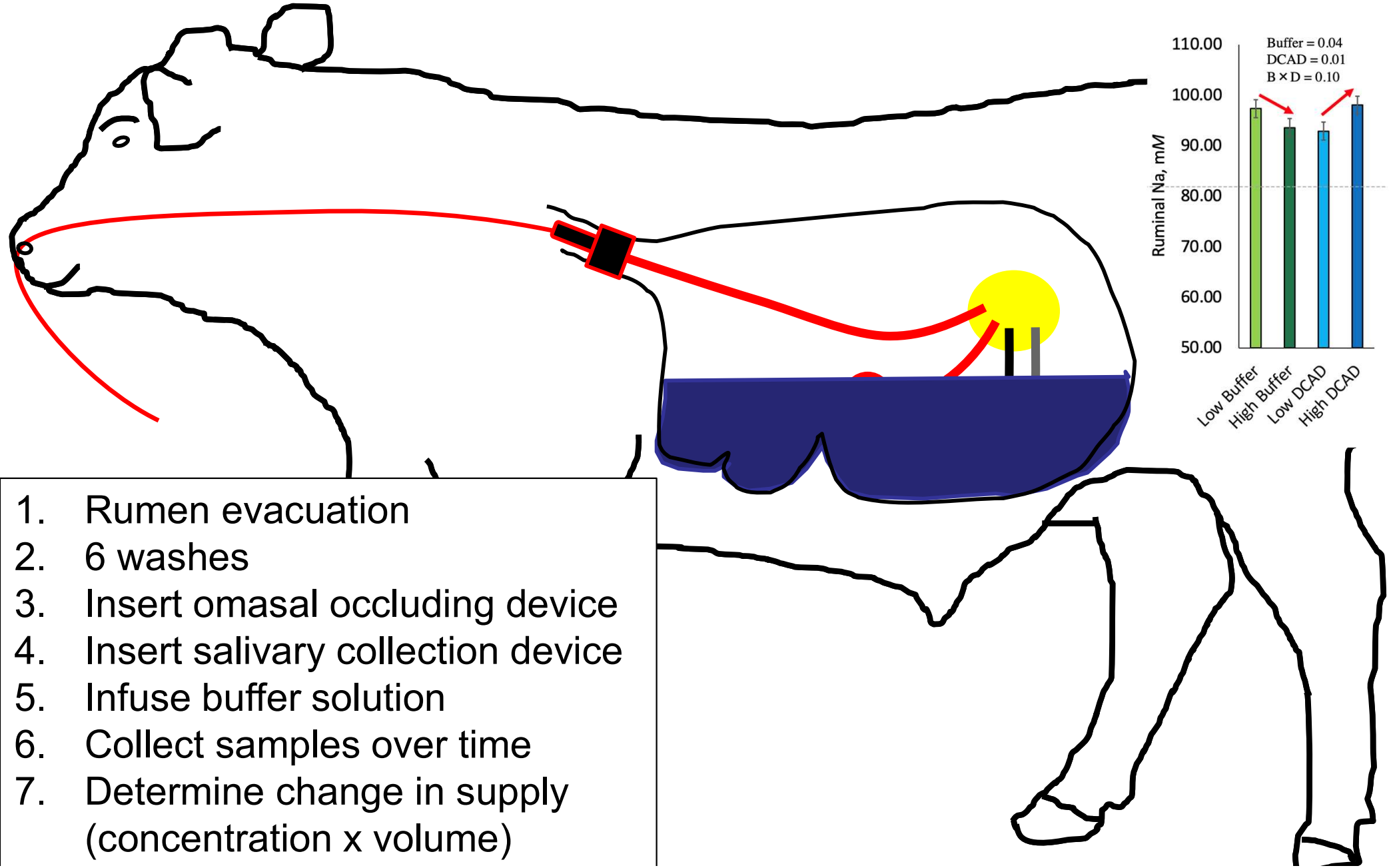




Increased permeability likely occurs in the intestinal regions



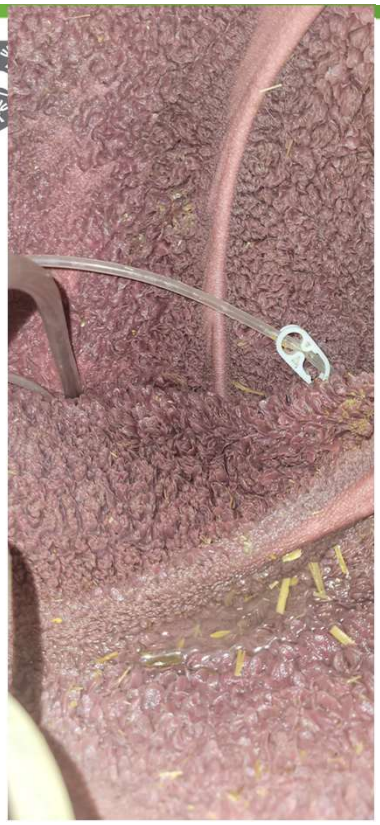
Does the altered ruminal Na matter?



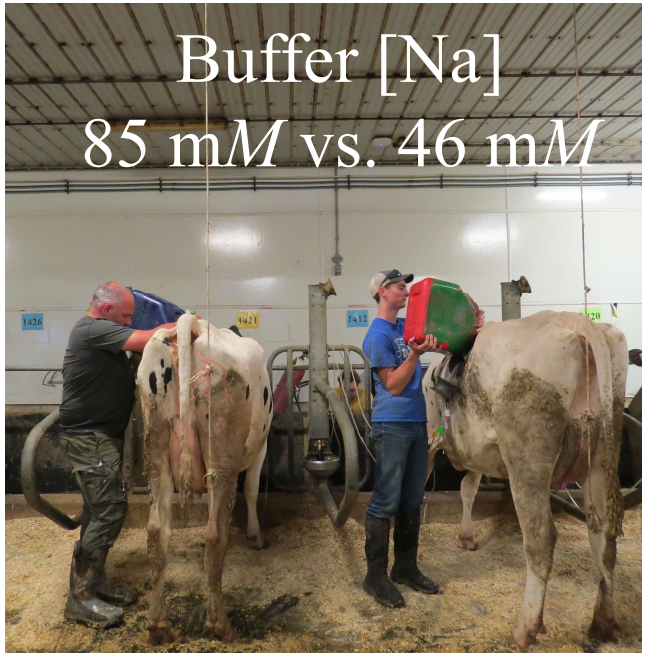
1. Rumen evacuation
2. 6 washes
3. Insert omasal occluding device
4. Insert salivary collection device
5. Infuse buffer solution
6. Collect samples over time
7. Determine change in supply (concentration x volume)

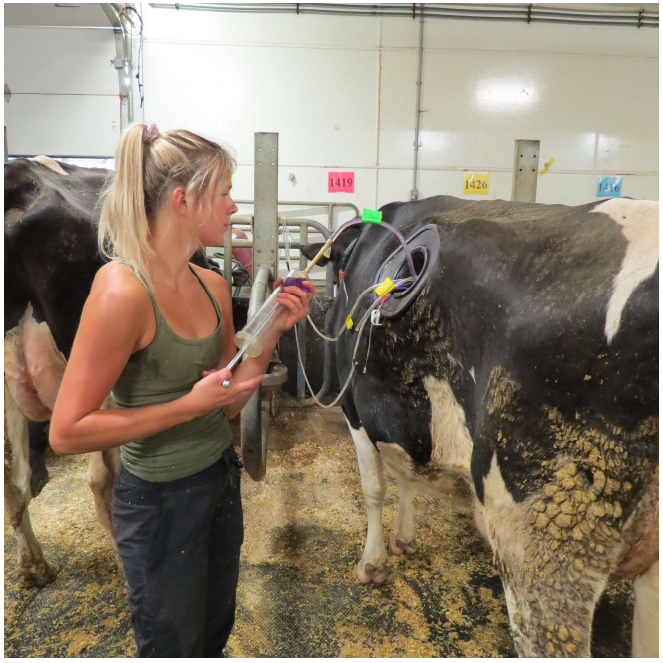






Buffer [Na]
85 m*M* vs. 46 m*M*







SCFA Disappearance

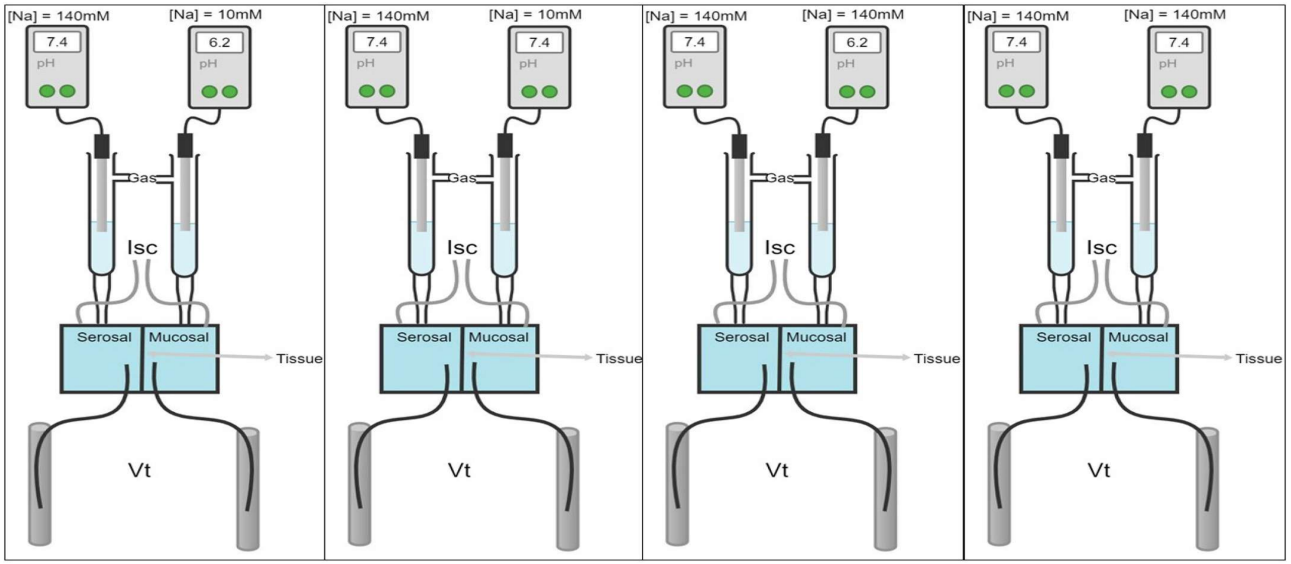
- No effect of buffer Na concentration on SCFA disappearance ($P \geq 0.60$)
- No effect of diet (DCAD or Buffer) on SCFA disappearance ($P \geq 0.66$)
- Total SCFA absorption = 45.8 %/h
  a) Acetate = 42.0 %/h
  b) Propionate = 49.2 %/h
  c) Butyrate = 55.3 %/h

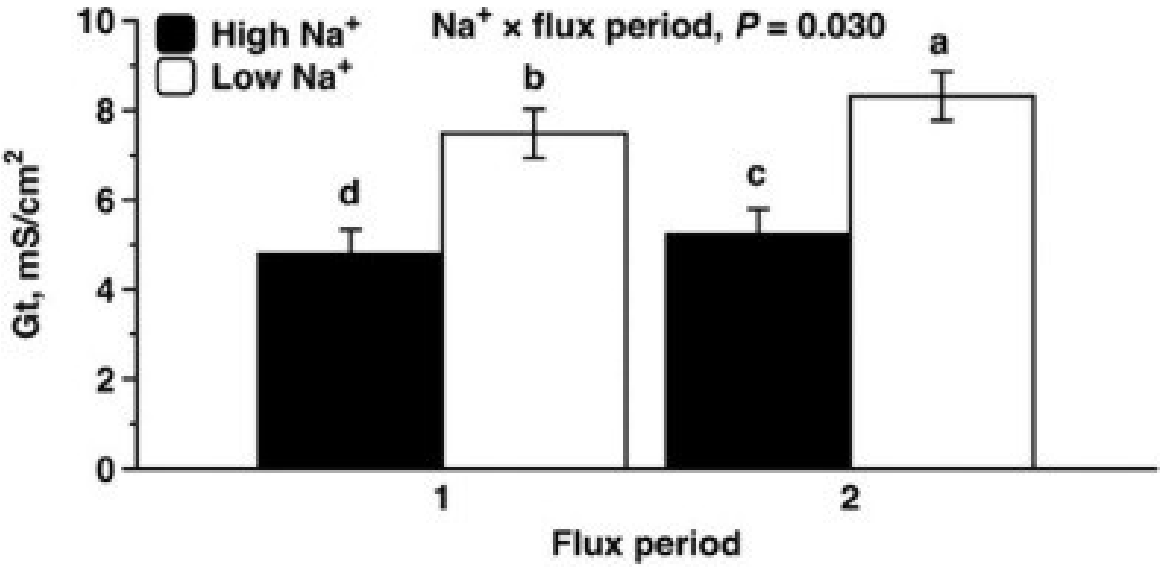
J. Dairy Sci. 106:7310–7319
https://doi.org/10.3168/jds.2022-23052
© 2023, The Authors. Published by Elsevier Inc. and Fass Inc. on behalf of the American Dairy Science Association®.
This is an open access article under the CC BY license (http://creativecommons.org/licenses/by/4.0/).

Effect of sodium concentration and mucosal pH on apical uptake of acetate and butyrate, and barrier function of the isolated bovine ruminal epithelium

C. A. Bertens, T. Mutsvangwa, A. G. Van Kessel, and G. B. Penner*
Department of Animal and Poultry Science, University of Saskatchewan, Saskatoon, SK, Canada S7N 5A8

Na may help stabilize barrier function but not absorption





Conclusions

- There was no effect of increasing DCAD or dietary buffer on DMI or milk yield for lactating dairy under mild heat stress
  - DCAD improved blood acid/base status (increased HCO3), increased urine output, and increased milk fat yield
  - No effect on ruminal pH – no evidence of ruminal acidosis
- Dietary buffer ($CaMg(CO_3)_2$) reduced intestinal permeability
  - Mechanism is currently not understood (CaSr)?
  - Additional studies are needed to verify responses
- Ruminal sodium is likely not limiting nutrient absorption and only a severe deficiency may alter permeability

This research would not have been possible without support from

INTER-ROCK MINERALS INC

Papillon Feed Efficiently

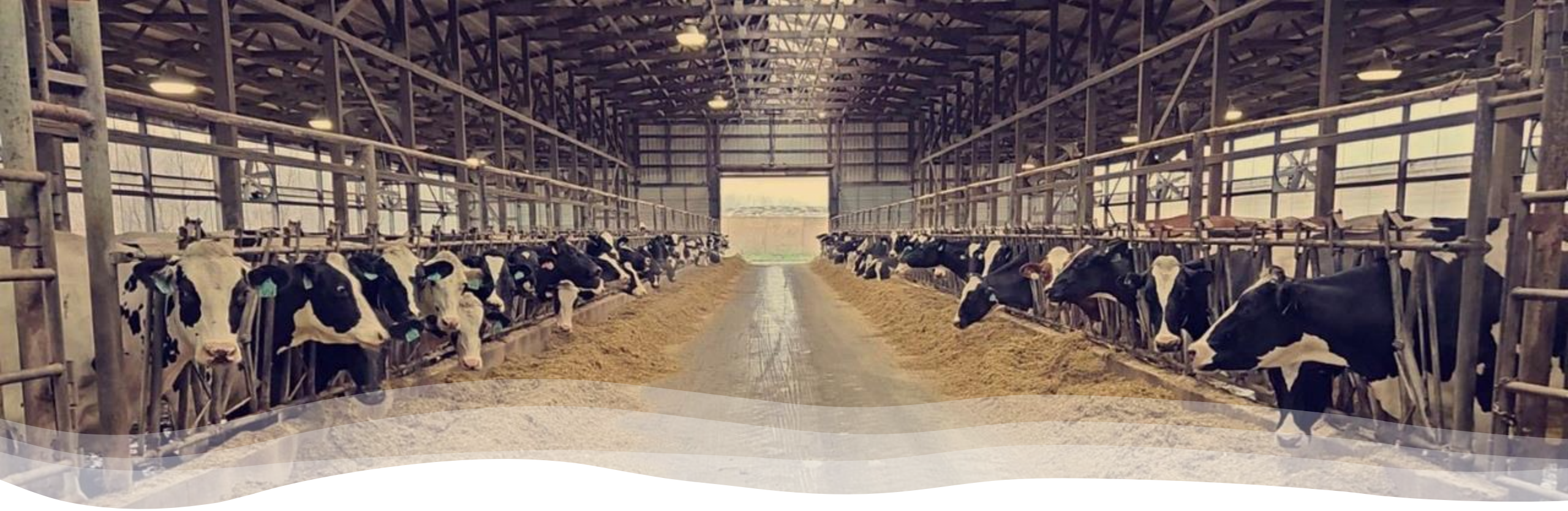
Saskmilk



Natural Sciences and Engineering Research Council of Canada | Conseil de recherches en sciences naturelles et en génie du Canada

Natural Sciences and Engineering Research Council of Canada

www.nserc-crsng.gc.ca



Prevention & Treatment of Subclinical Hypocalcemia to Optimize Health & Production in Dairy Cattle

Dr. Claira Seely

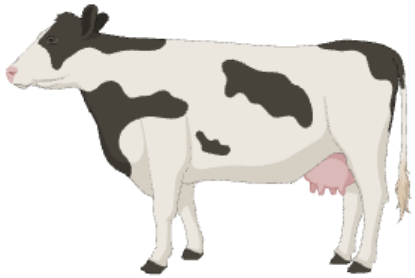
University of New Hampshire

Overview

- Ca challenge and homeostasis
- Importance of blood Ca dynamics in early lactation
- Subclinical hypocalcemia prevention/mitigation strategies
- Next steps



Calcium Challenge of Early Lactation



Cow
21 g Ca/d



Colostrum
23 g Ca

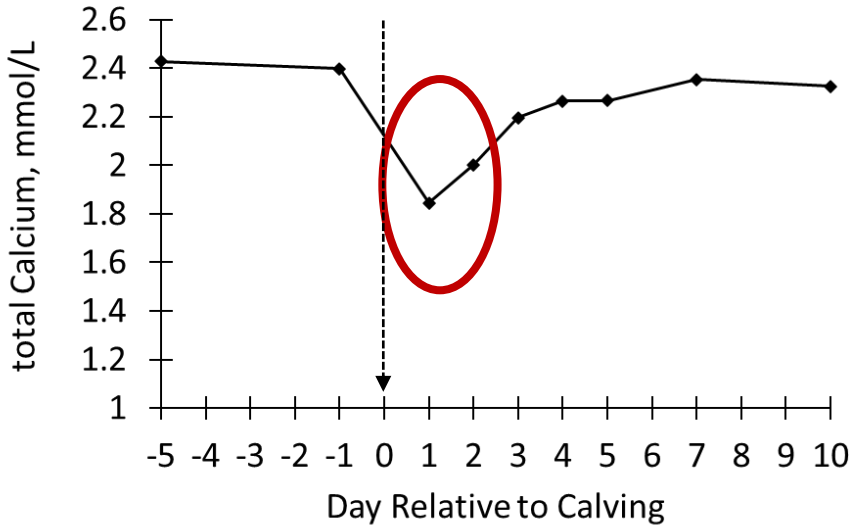


45 lb/d milk
33 g Ca/d

More than doubles Ca requirement!

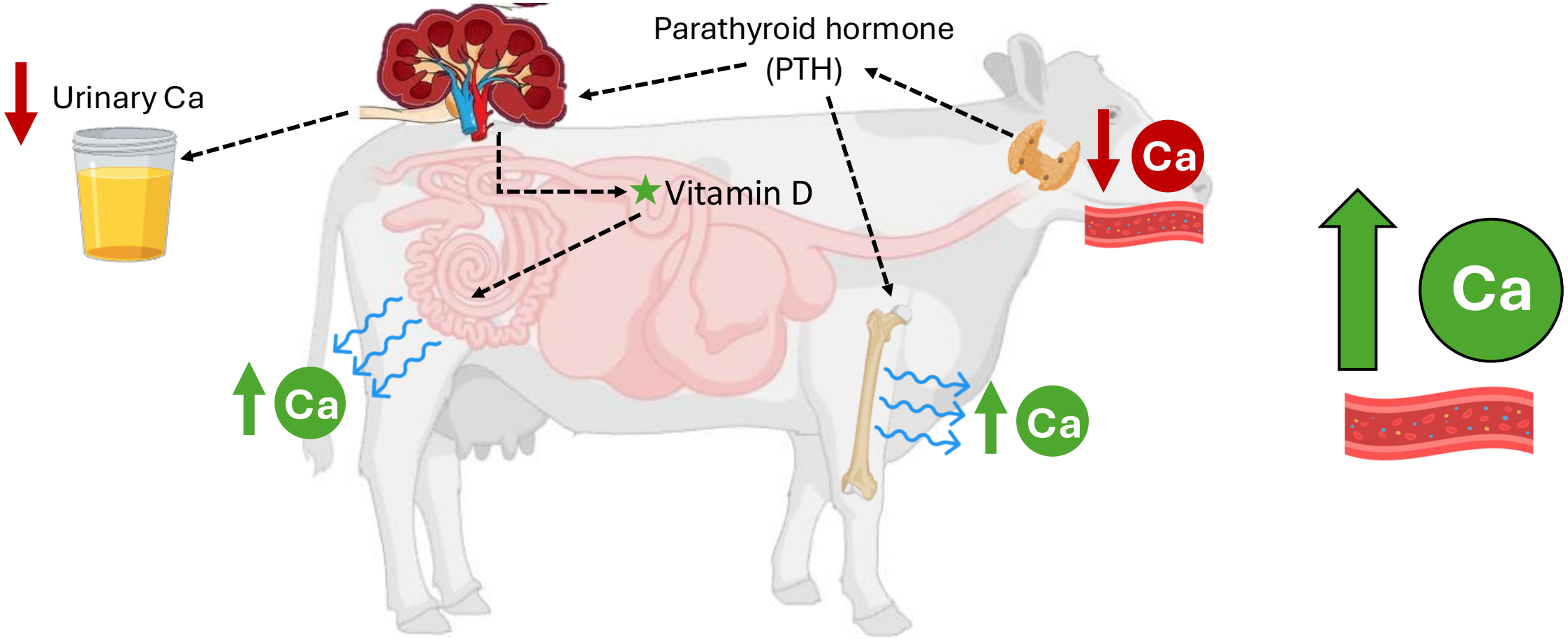


Intake ↓ 30%



Adopted from Seely and McArt , 2023

How does the cow restore blood Ca?



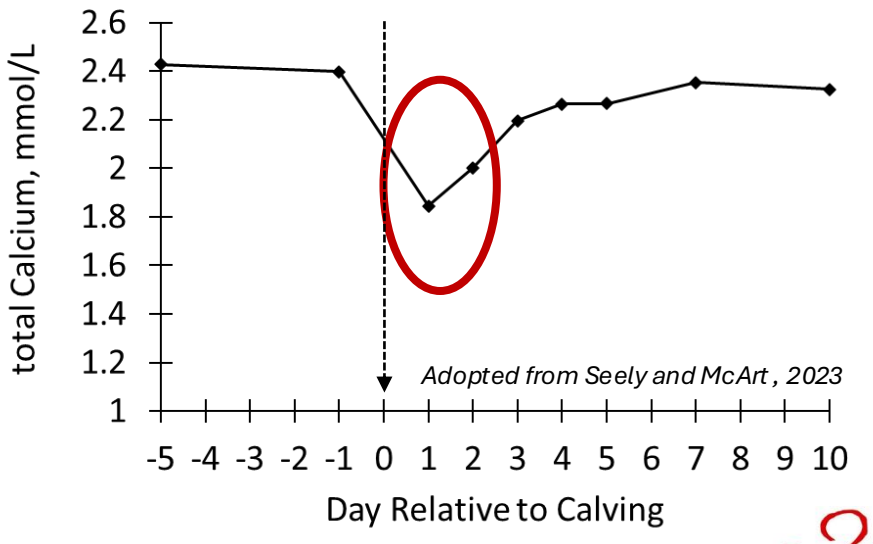
What happens when things don’t go to plan?

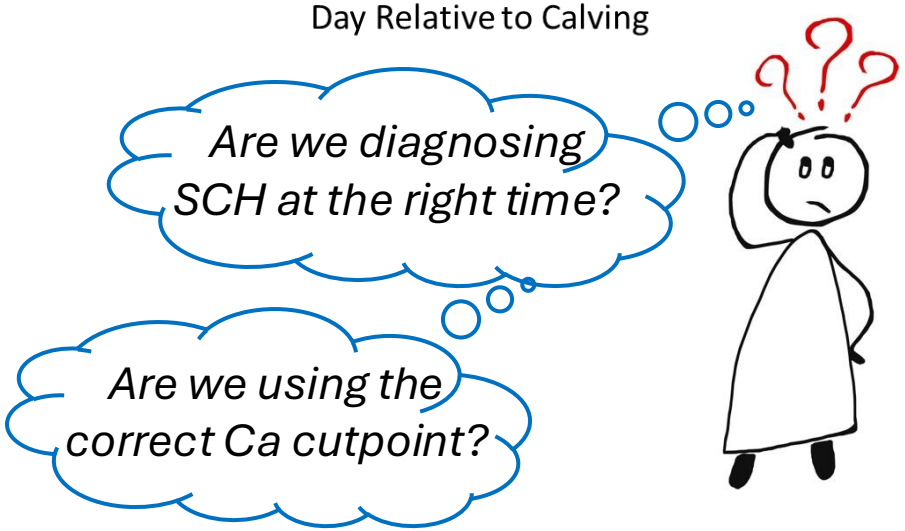




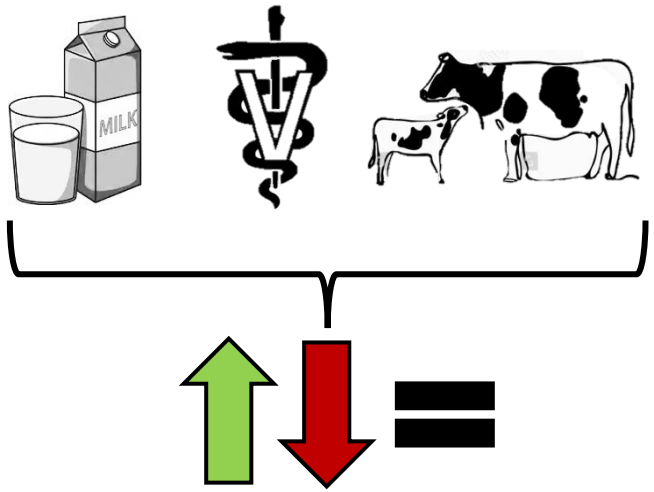
- Clinical hypocalcemia- Milk Fever
  - Obvious clinical symptoms
    - Down cow
  - Usually at blood Ca < 5.5 mg/dL (1.37 mmol/L)
  - Requires treatment to avoid death
    - 500 mL Ca gluconate IV
    - Oral Ca bolus when she stands and again 12 h later
- Subclinical hypocalcemia (SCH)
  - No physical signs of disease
  - Blood sample required for true diagnosis

Defining Subclinical Hypocalcemia

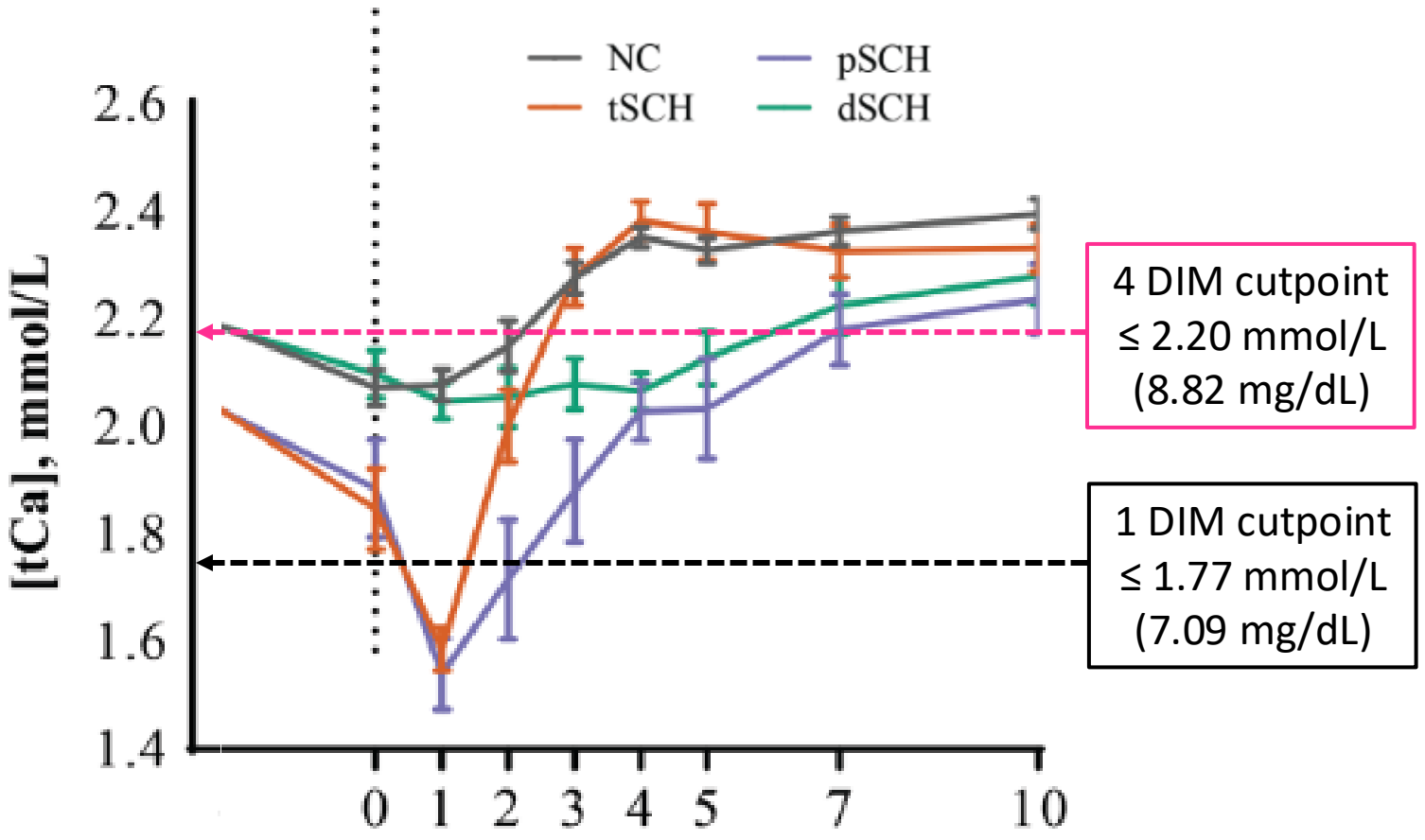




- Historically we have focused on blood Ca at 0-24 h post calving
  - Varying blood Ca cutpoints from 7.2 – 8.8 mg/dL
    - Aka 1.8 – 2.2 mmol/L
- Associated outcomes varied



RE-defining Subclinical Hypocalcemia



4 DIM cutpoint
≤ 2.20 mmol/L
(8.82 mg/dL)

1 DIM cutpoint
≤ 1.77 mmol/L
(7.09 mg/dL)

263 multiparous Holstein cows
2 farms in New York state

Normocalcemic; n = 109
NC: 1 DIM [Ca] ↑
4 DIM [Ca] ↑

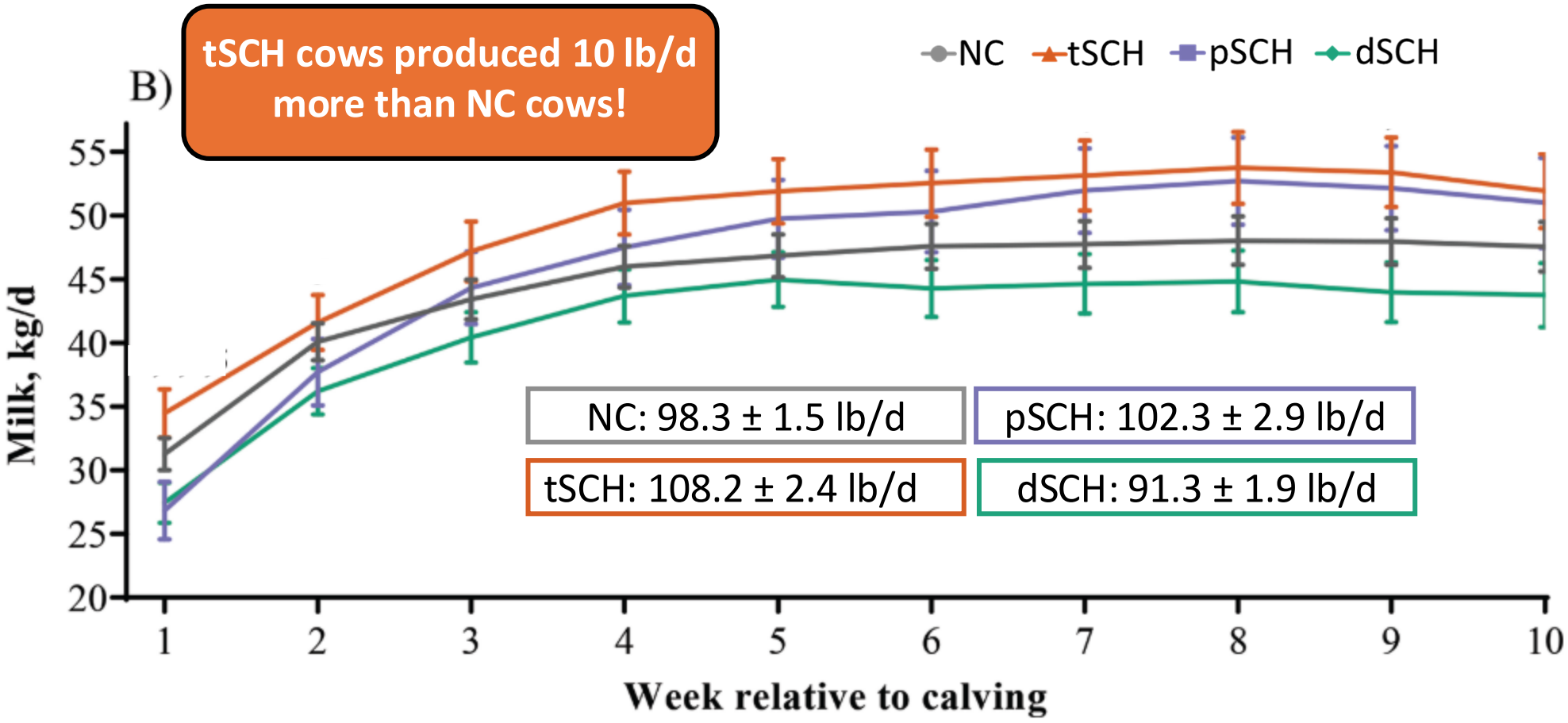
Transient SCH; n = 50
tSCH: 1 DIM [Ca] ↓
4 DIM [Ca] ↑

Persistent SCH; n = 34
pSCH: 1 DIM [Ca] ↓
4 DIM [Ca] ↓

Delayed SCH; n = 70
dSCH: 1 DIM [Ca] ↑
4 DIM [Ca] ↓

McArt and Neves, 2020, http://dx.doi.org/10.3168/jds.2019-17191

Dynamics of SCH; Milk Production



Error bars represent 95% confidence intervals

McArt and Neves, 2020, http://dx.doi.org/10.3168/jds.2019-17191

Dynamics of SCH; Health

	Incidence, %			
	NC (n=109)	tSCH (n=50)	pSCH (n=34)	dSCH (n=70)
Hyperketonemia	30.3	48.0	50.0	50.0
Metritis	5.5	4.0	17.6	12.9
Displaced abomasum	1.8	2.0	11.8	8.6
Herd removal	0.9	2.0	2.9	12.9
Adverse event*	33.0	50.0	61.8	60.0

*Adverse event = one or more of hyperketonemia, metritis, DA, or herd removal diagnosis

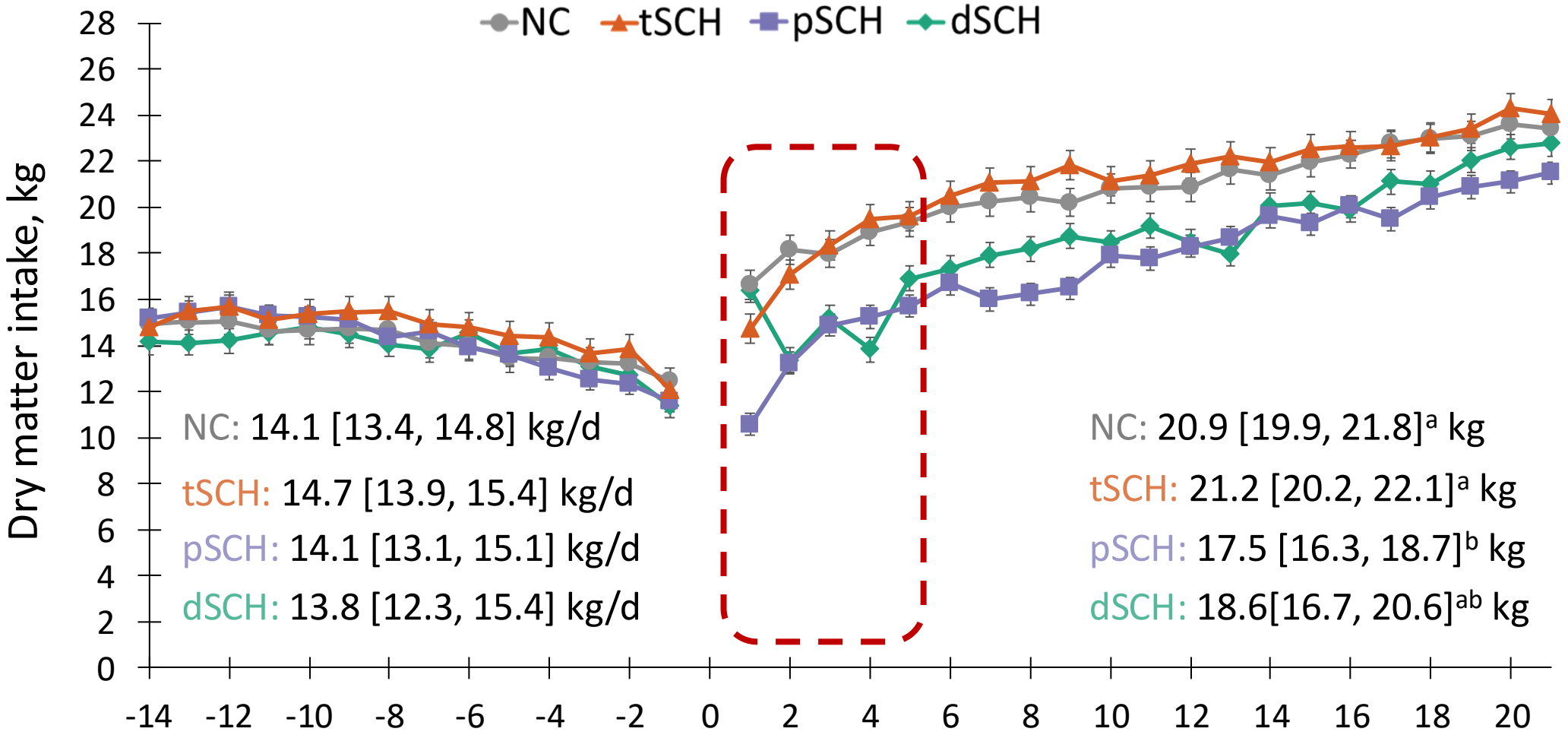
pSCH and dSCH = twice as likely to experience Adverse Event compared to NC cows

McArt and Neves, 2020, http://dx.doi.org/10.3168/jds.2019-17191

Where does dry matter intake fit in?



Dynamics of SCH; Dry Matter Intake



78 multiparous Holstein cows
Cornell research herd- tie stalls

Error bars represent standard error

Seely et al., 2021, 10.3168/jds.2020-19344



What about Reproduction?

Dynamics of SCH; Reproduction

Normocalcemic (NC; n = 515): tCa > 2.2 mmol/L (8.82 mg/dL) at **4 DIM**
Subclinical hypocalcemia (SCH; n = 182): tCa ≤ 2.2 mmol/L (8.82 mg/dL) at **4 DIM**

Variable	Incidence (%)[1]	OR[2]/HR[3]	95% CI	*P*-value
Time of first AI, DIM				
NC	64.1 days		62.3-65.4	0.28
SCH	65.1 days		63.4-66.8	
Pregnant to 1st service				
NC	27.4%	Ref	-	-
SCH	18.1%	0.75	0.61-0.93	0.01
Pregnant by 150 DIM				
NC	70.7%	Ref	-	-
SCH	65.4%	0.82	0.67-1.01	0.06

[1]Mean DIM of first AI and incidence (%) for pregnancy to 1st service and pregnant by 150 DIM
[2] Odds ratio of pregnant to 1st service
[3] Hazard ratio of pregnancy by 150 DIM

Seely and McArt, 2023, http://dx.doi.org/10.3168/jdsc.2022-0279

Dynamics of SCH; Reproduction

Normocalcemic (NC; n = 515): tCa > 2.2 mmol/L at **4 DIM**
Subclinical hypocalcemia (SCH; n = 182): tCa ≤ 2.2 mmol/L at **4 DIM**

Median time to pregnancy

NC = 103 ± 11 d

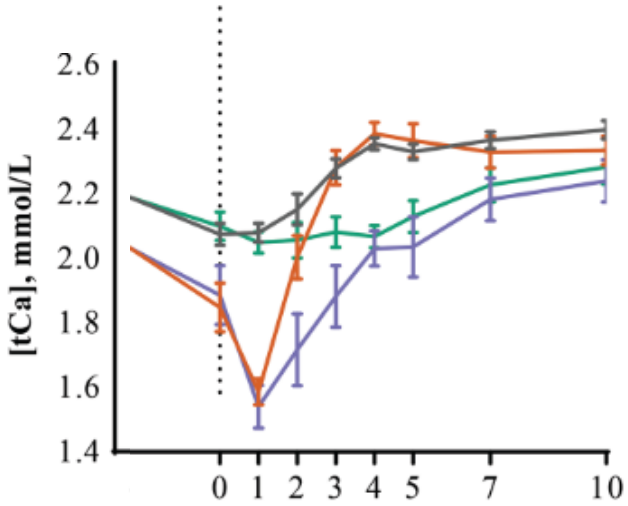
SCH = 119 ± 16 d

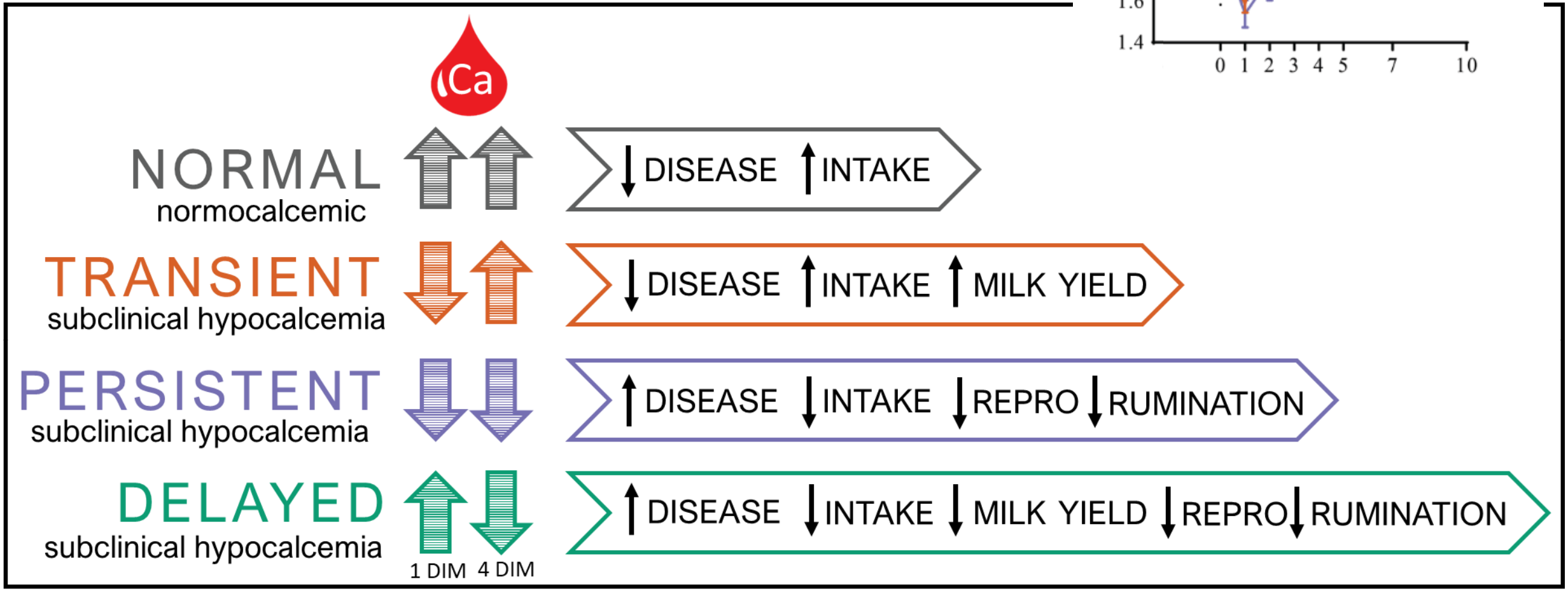


16 days!

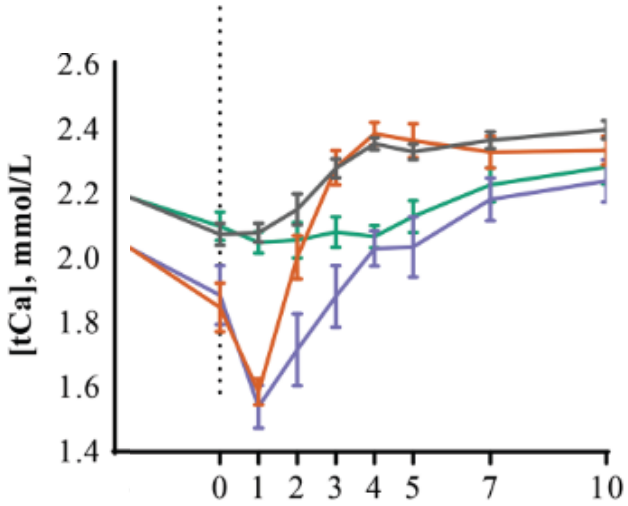
Seely and McArt, 2023, http://dx.doi.org/10.3168/jdsc.2022-0279

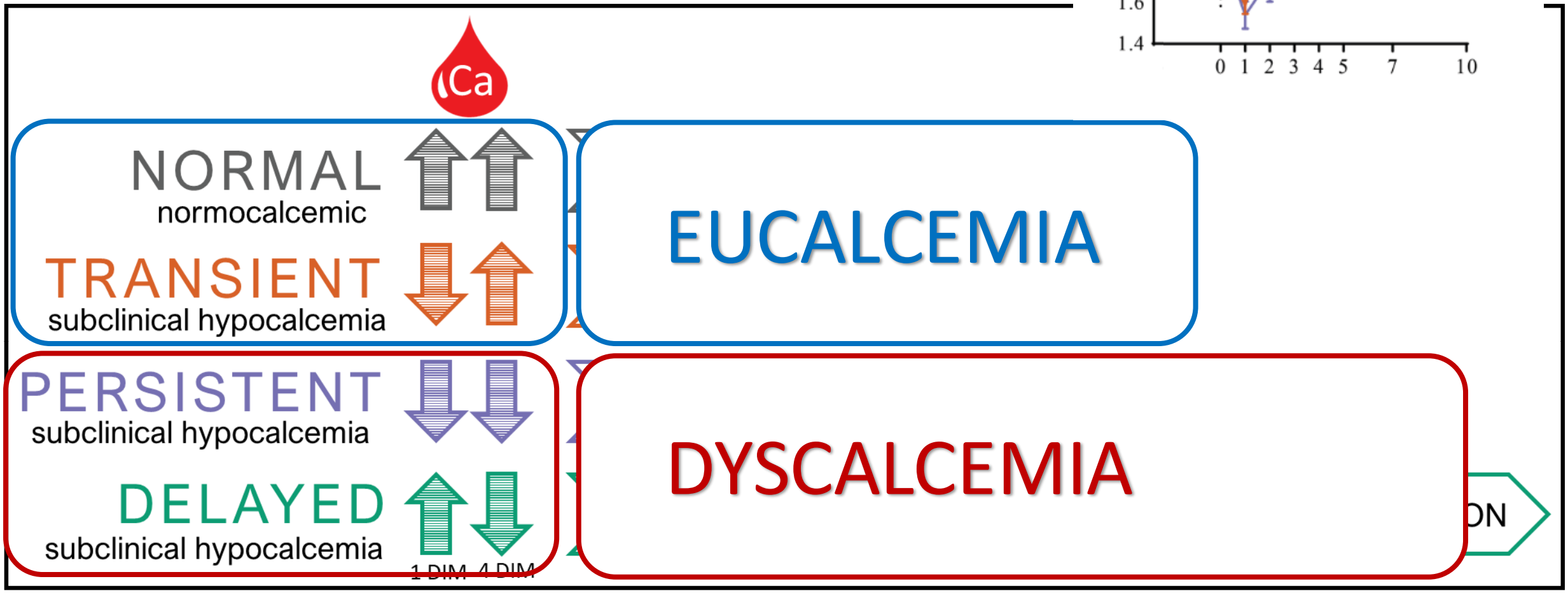
Is low Ca at 1 DIM really that bad?





Is low Ca at 1 DIM really that bad?





Can we improve blood Ca status in early lactation?



Ration formulation for prepartum cows



Ca supplementation at or after calving as treatment/prophylaxis

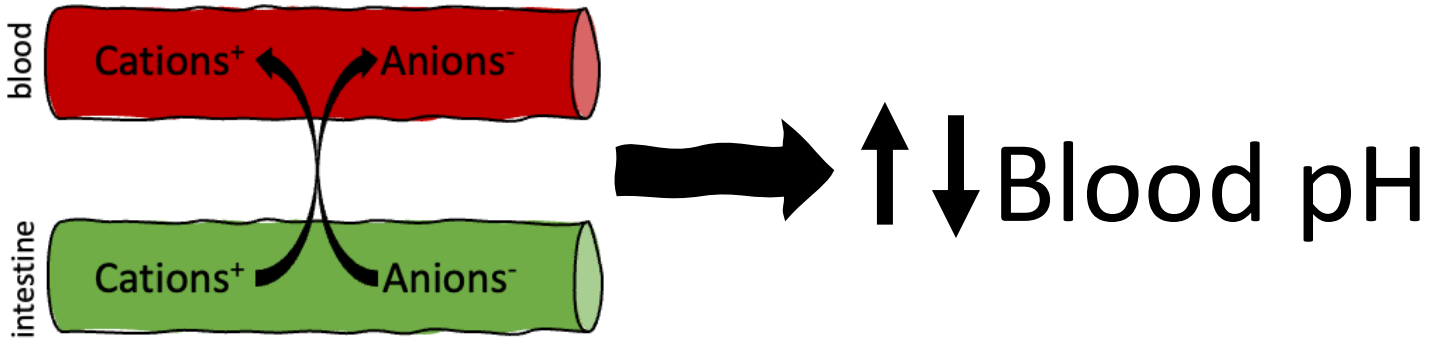


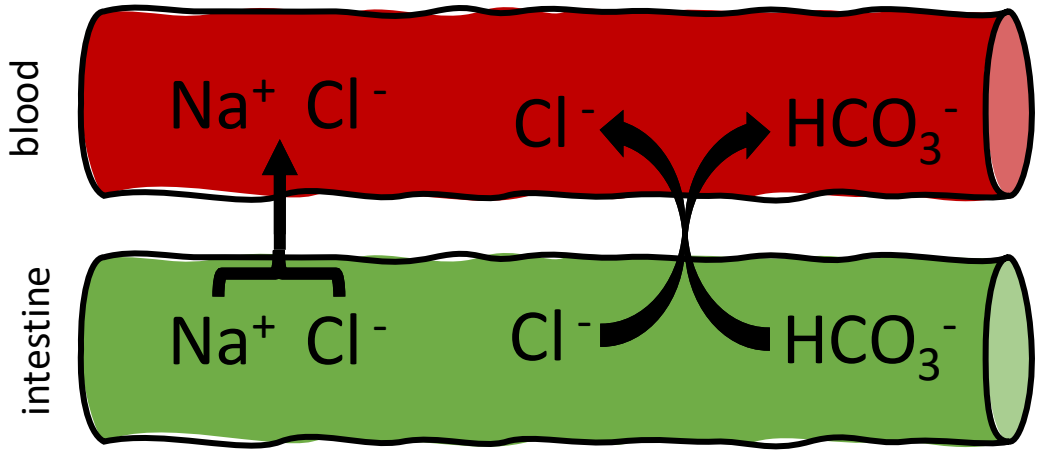
Evaluating the success of Ca supplementation

- Blood Ca concentrations?
- Milk production
- Health events/culling
- Reproductive success



Dietary Cation Anion Difference



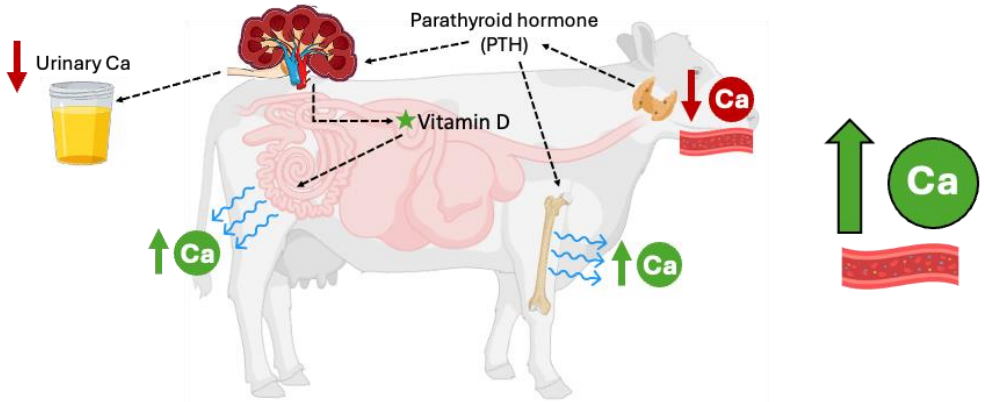


Negative DCAD

strong anions > strong cations

blood pH ↓

Improving Ca status via nDCAD

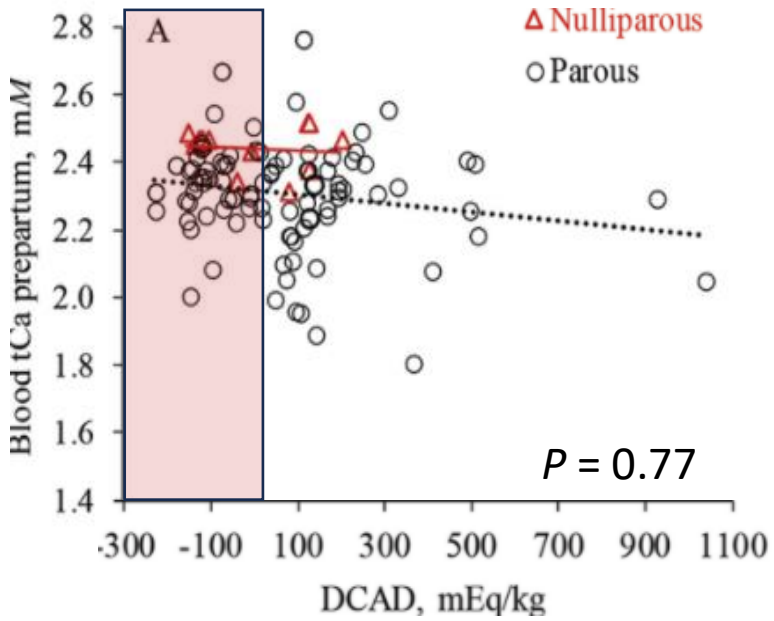


Priming cow for low blood Ca post calving

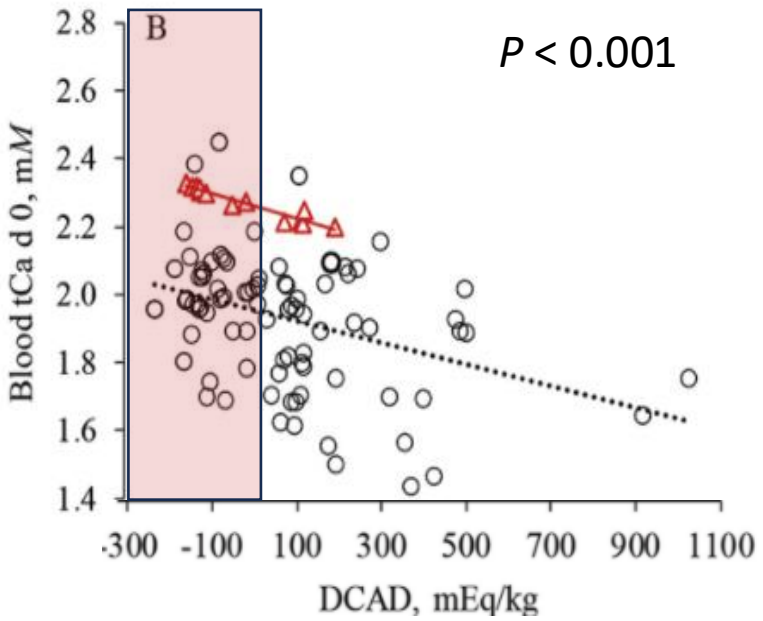
- Acidification improves sensitivity of PTH receptor
- Decrease in urine pH → increase in Ca excretion in urine → increase Ca flux
- Systemic pH reduction → stimulation of Ca release from bone

Effect of DCAD on blood tCa

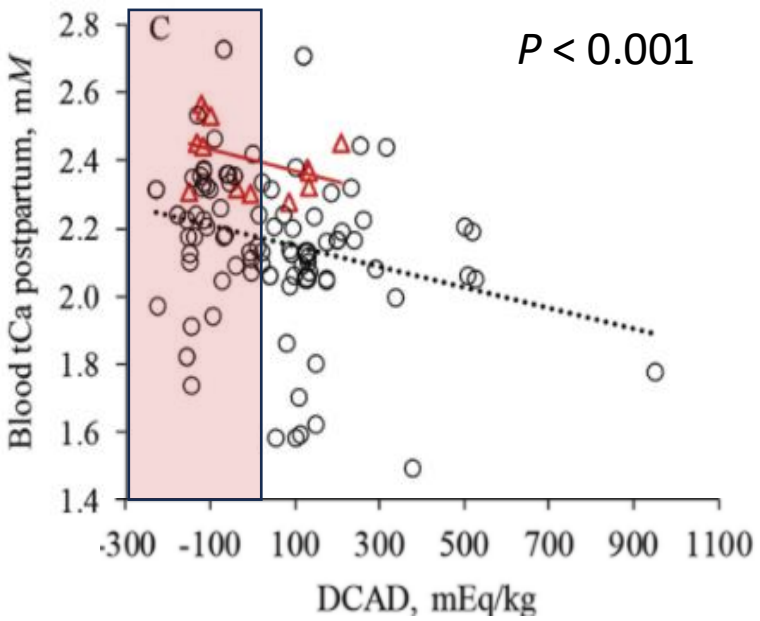
Prepartum Blood tCa



Day 0 blood tCa



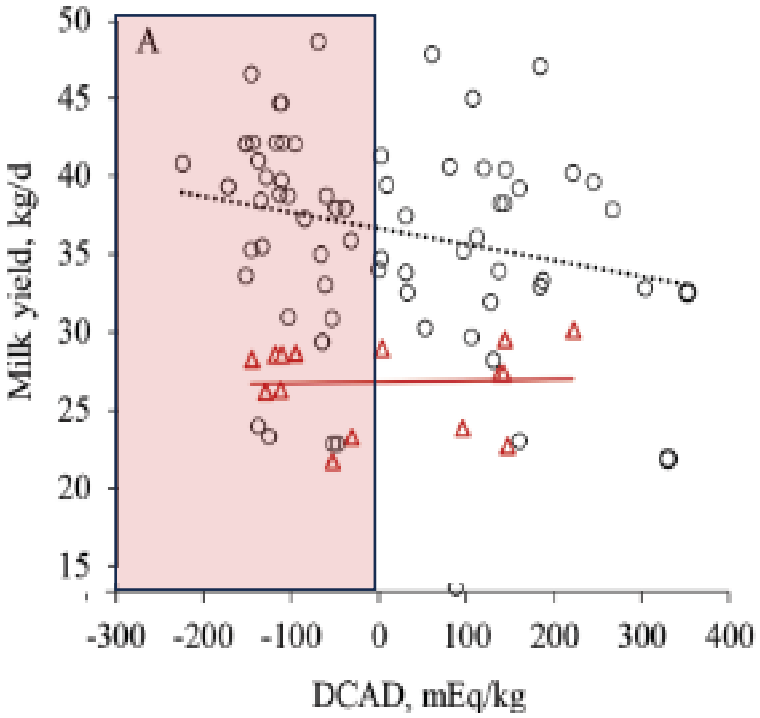
Postpartum blood tCa



Santos et al., 2019; https://doi.org/10.3168/jds.2018-14628

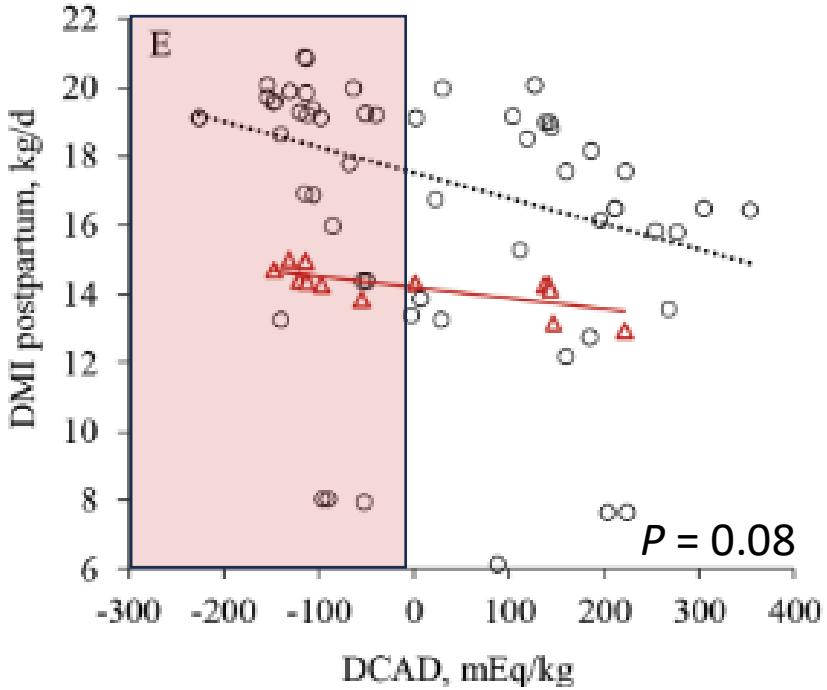
Effect of DCAD on Milk and Intake

Milk Production



Multiparous
$P < 0.001$

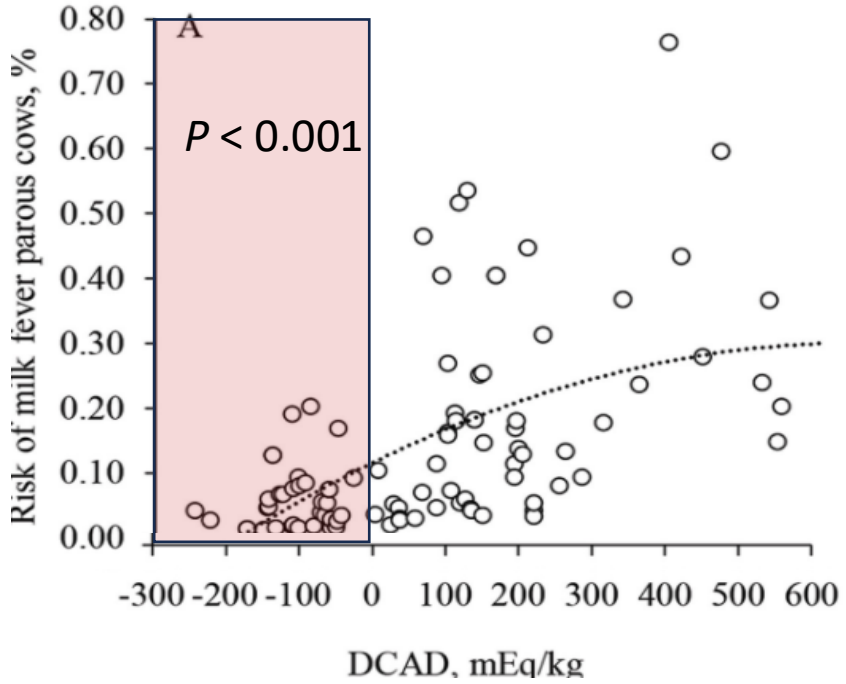
Postpartum DMI



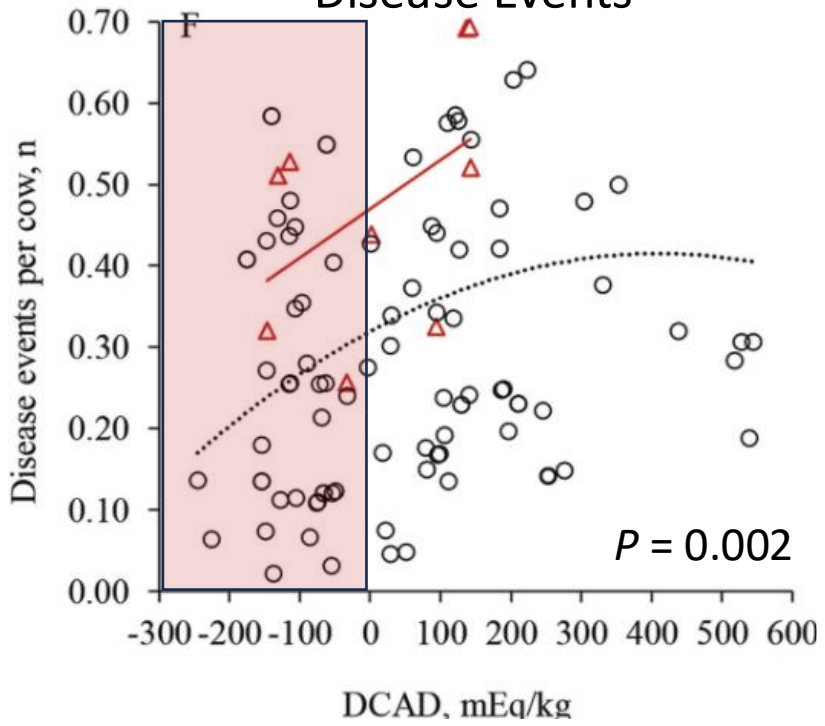
Santos et al., 2019; https://doi.org/10.3168/jds.2018-14628

Effect of DCAD on health outcomes

Risk of Milk Fever



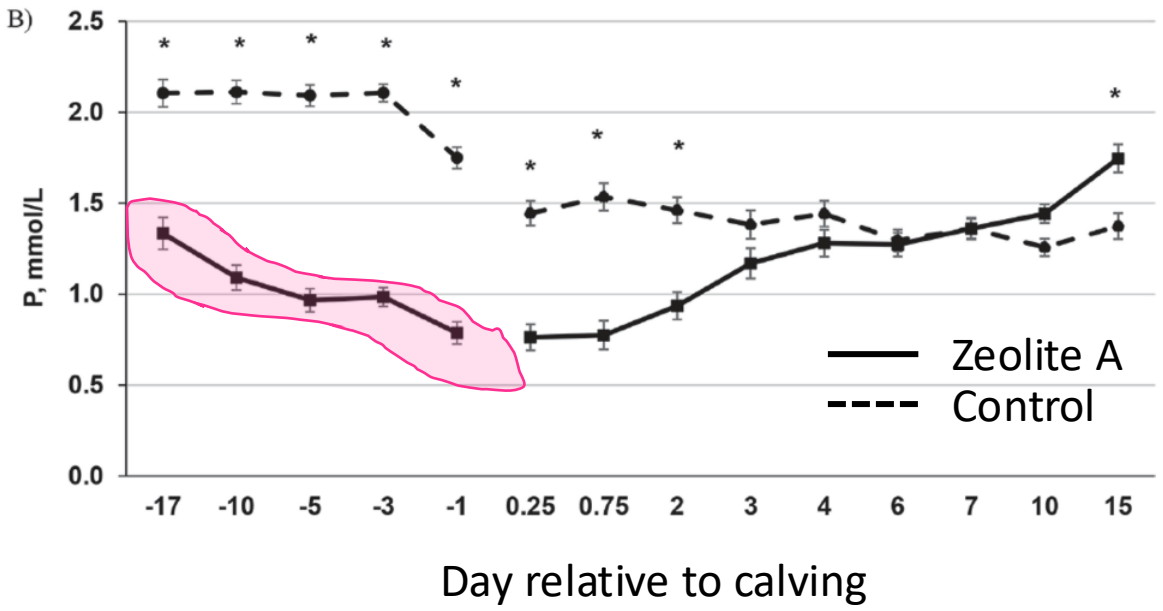
Disease Events

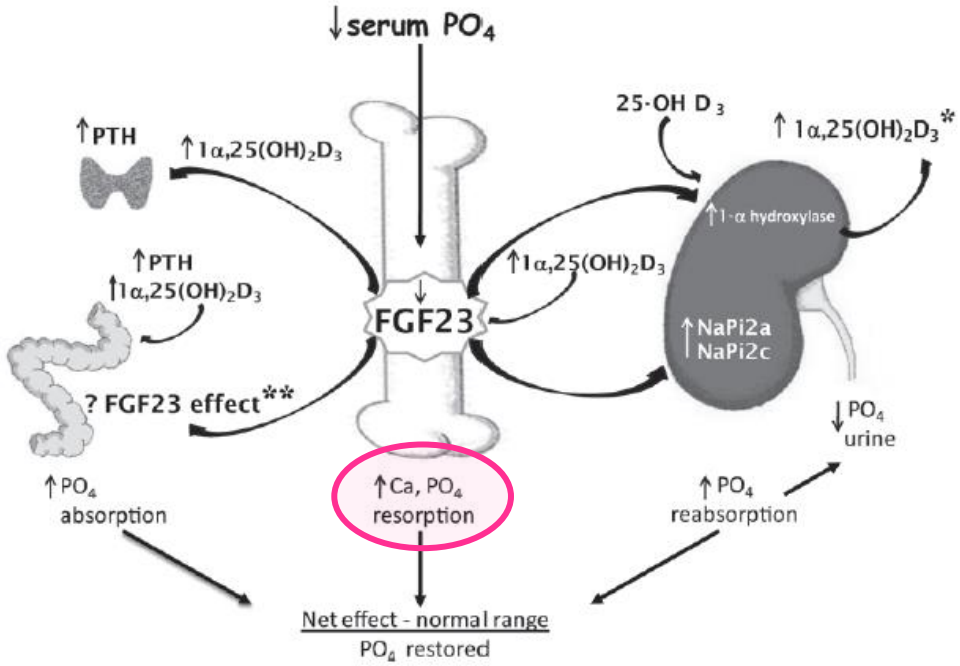


Santos et al., 2019; https://doi.org/10.3168/jds.2018-14628

Improving Ca Status via Zeolite A

- Binds P (and Ca and Mg) in the rumen
- Elicits a hypophosphatemic state



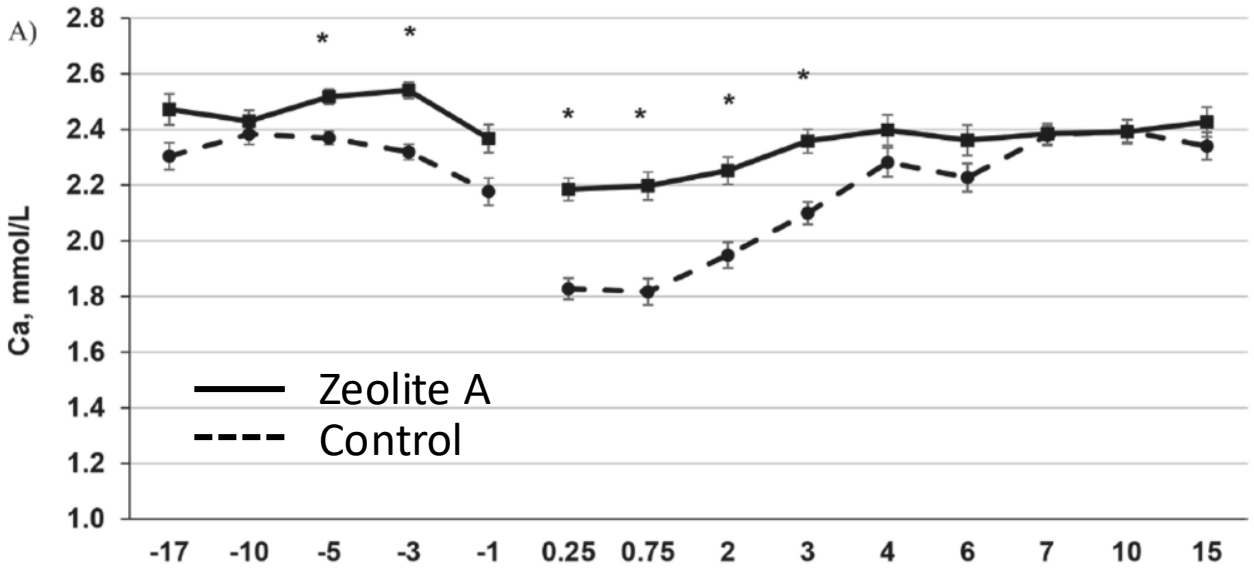


Kerwin et al., 2019; https://doi.org/10.3168/jds.2019-16272

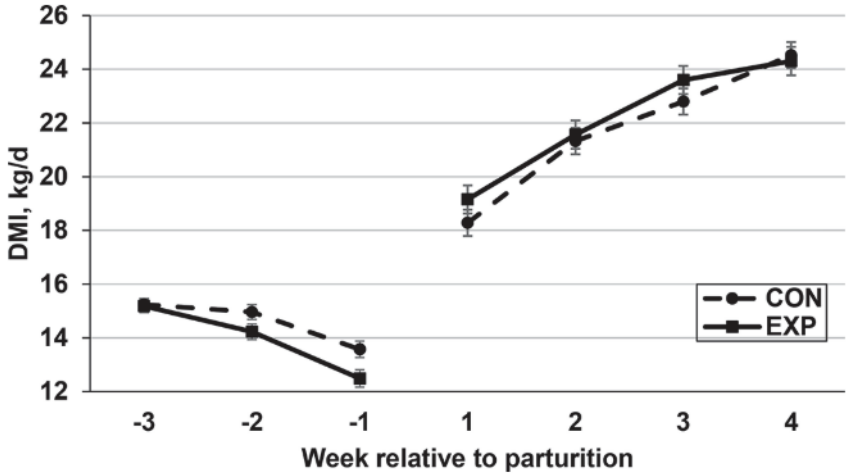
Effect of Zeolite A on blood Ca & Production

Tie-stall research herd
Zeolite A: n = 26
Control: n = 29

Blood Ca



Dry Matter Intake





Milk Production

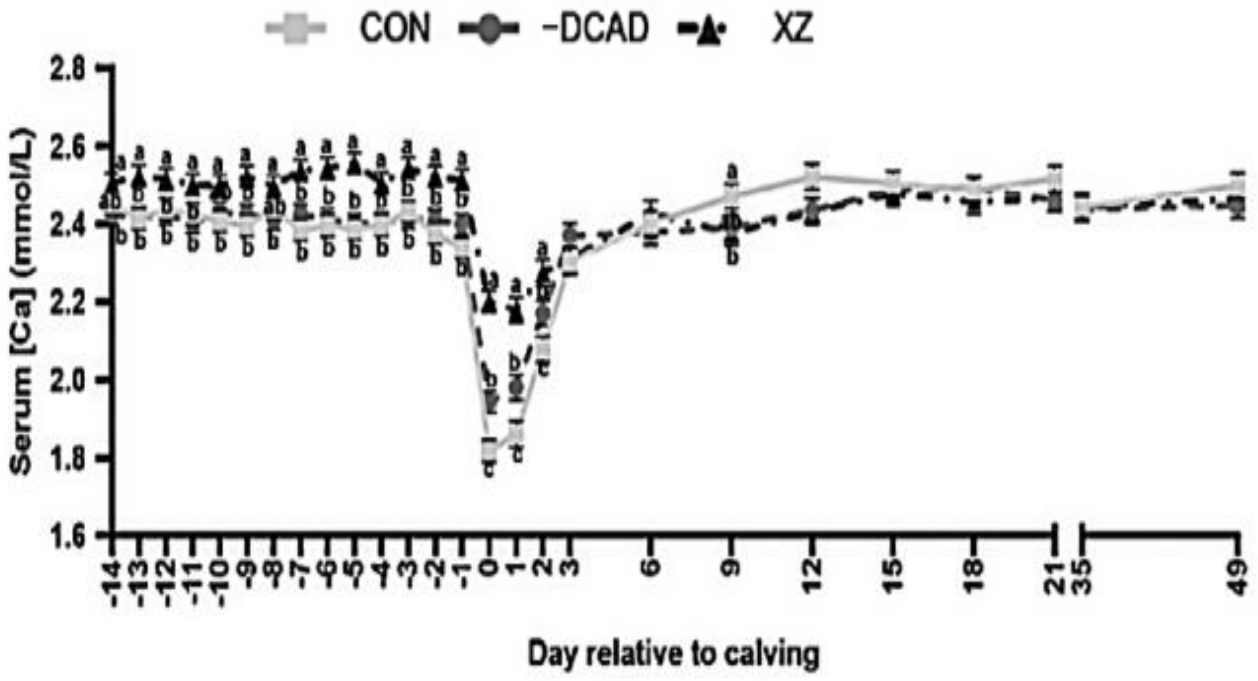
1-9 weeks of lactation
Zeolite A = 50.7 kg/d
Control: 51.7 kg/d

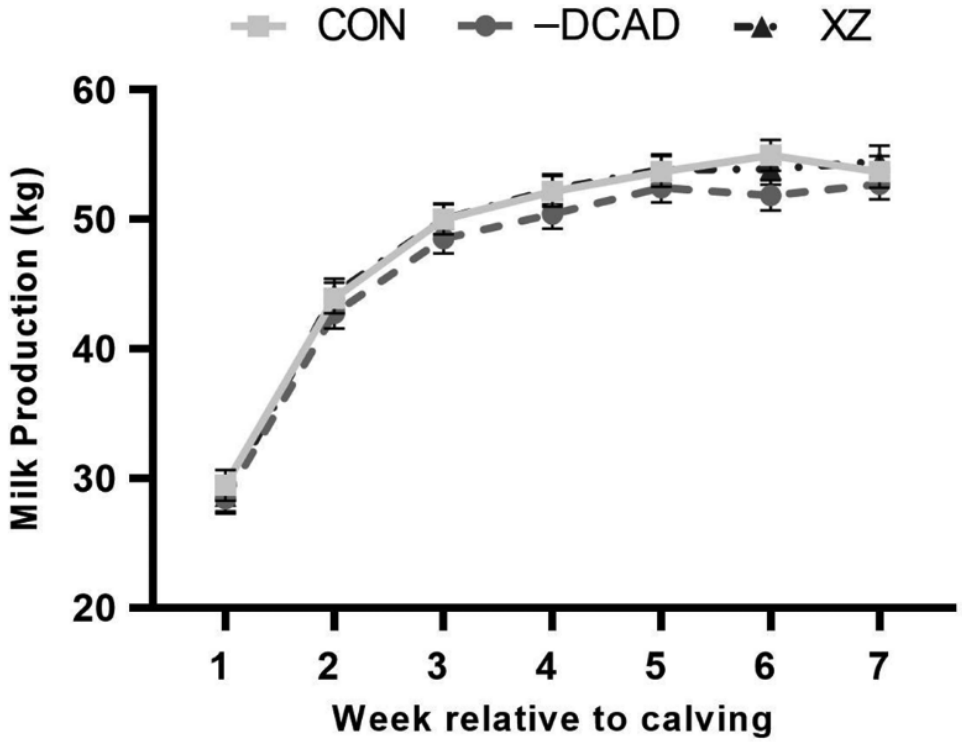
Kerwin et al., 2019; https://doi.org/10.3168/jds.2019-16272

Comparison of Zeolite A and nDCAD

CON; n = 40
-DCAD = urine pH 6; n = 41
XZ = Zeolite A; n = 40

Prepartum Intake
* similar between nDCAD and CON
* Zeolite A cows consumed less than nDCAD& CON





Frizzarini et al., 2024a & b; https://doi.org/10.3168/jds.2024-24056, https://doi.org/10.3168/jds.2024-24057

nDCAD vs Zeolite- Dyscalcemia Outcomes

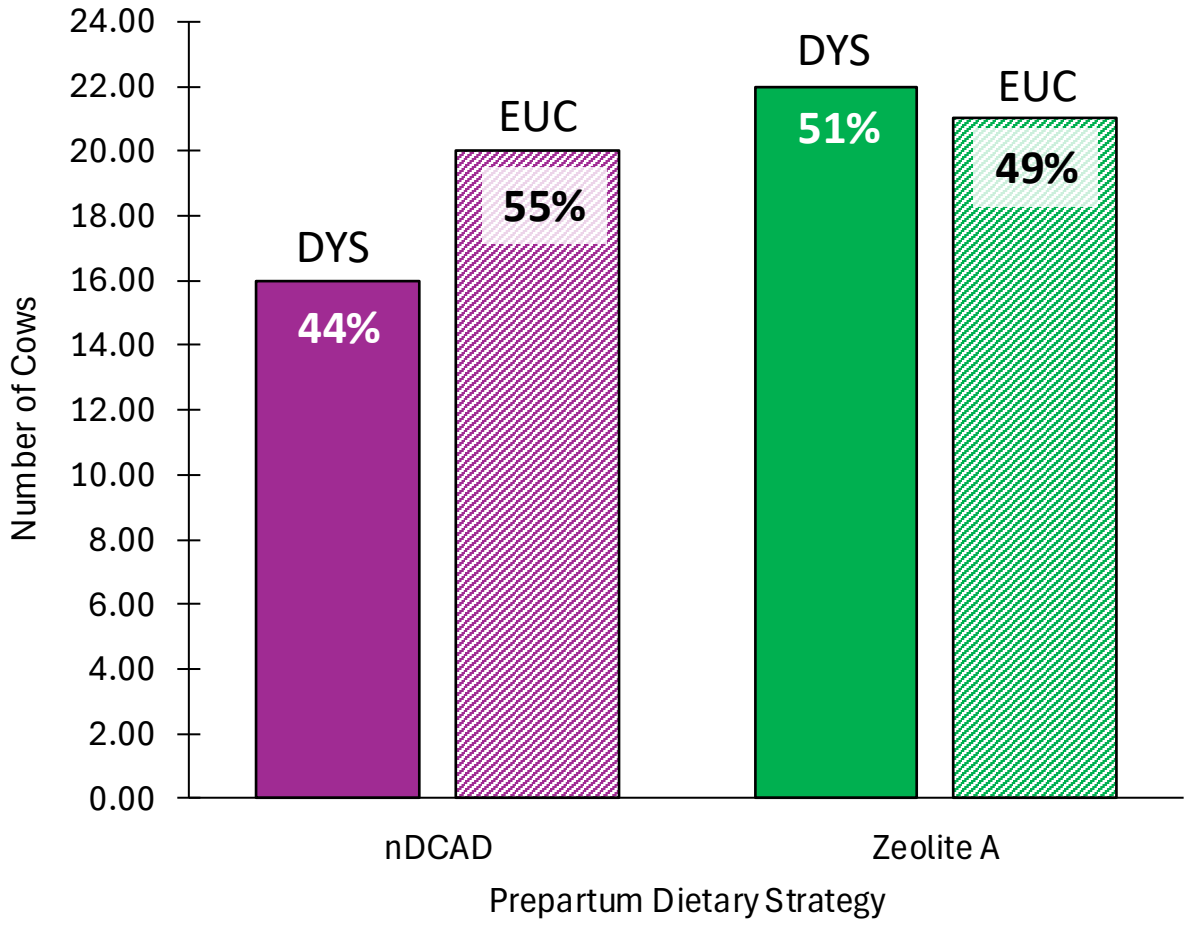
4 herds feeding nDCAD
n = 36 multiparous Holstiens

5 herds feeding Zeolite A
n = 43 multiparous Holstiens

tCa analysis at 4 DIM

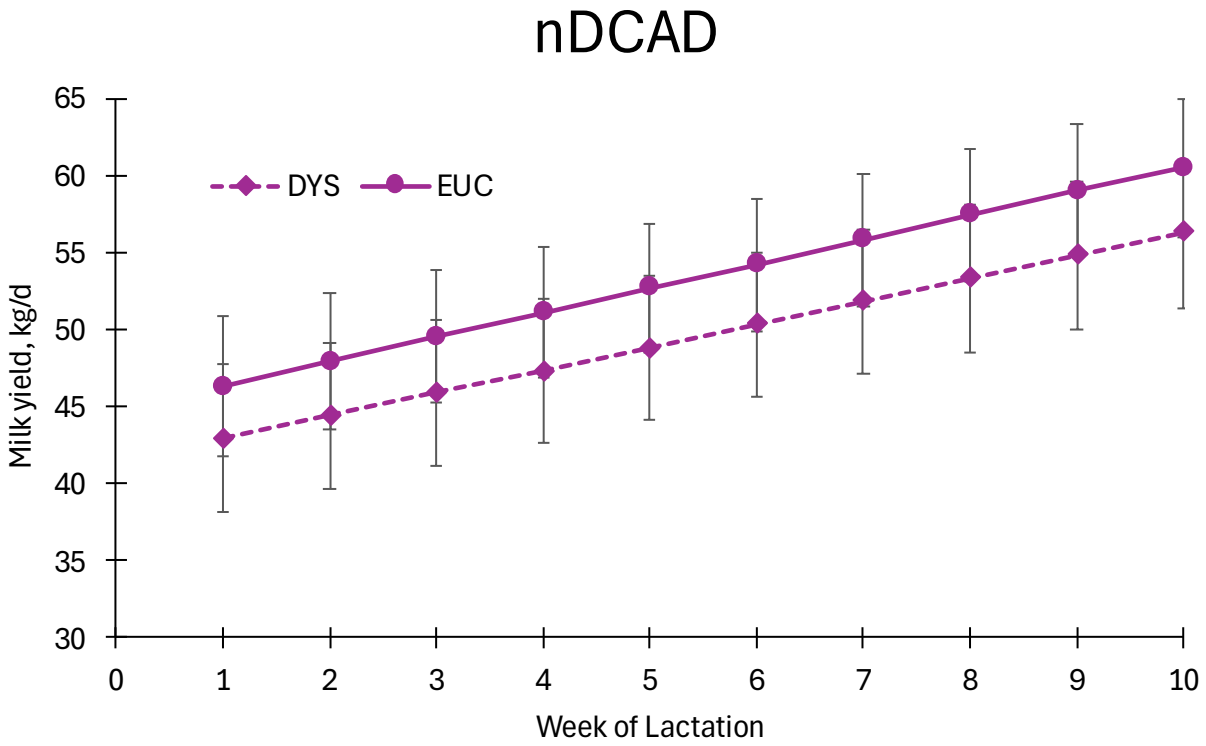
Eucalcemic; 4 DIM serum Ca ≥ 2.15 mmol/L (8.62 mg/dl)

Dyscalcemic; 4 DIM serum Ca < 2.15 mmol/L

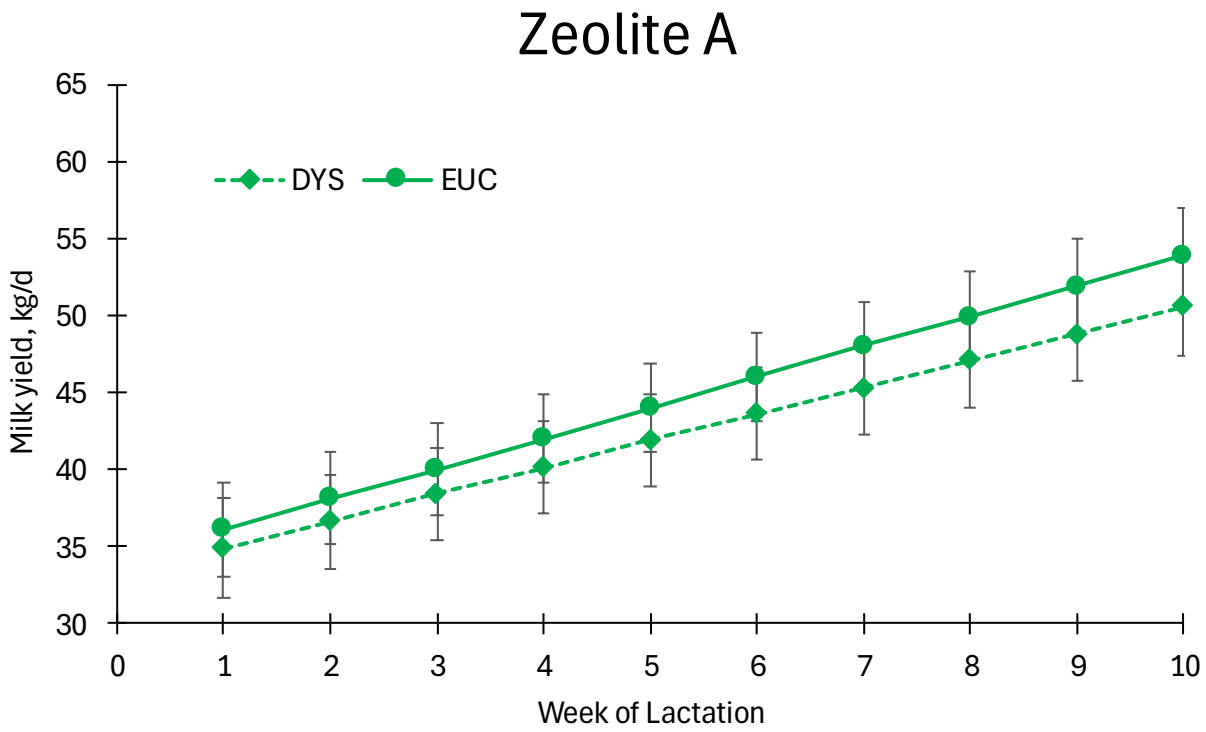


Phibro, *unpublished data*

nDCAD vs Zeolite- Dyscalcemia Outcomes



P = 0.006
EUC = 53.4 ± 4.3 kg/d
DYS = 49.6 ± 4.8 kg/d



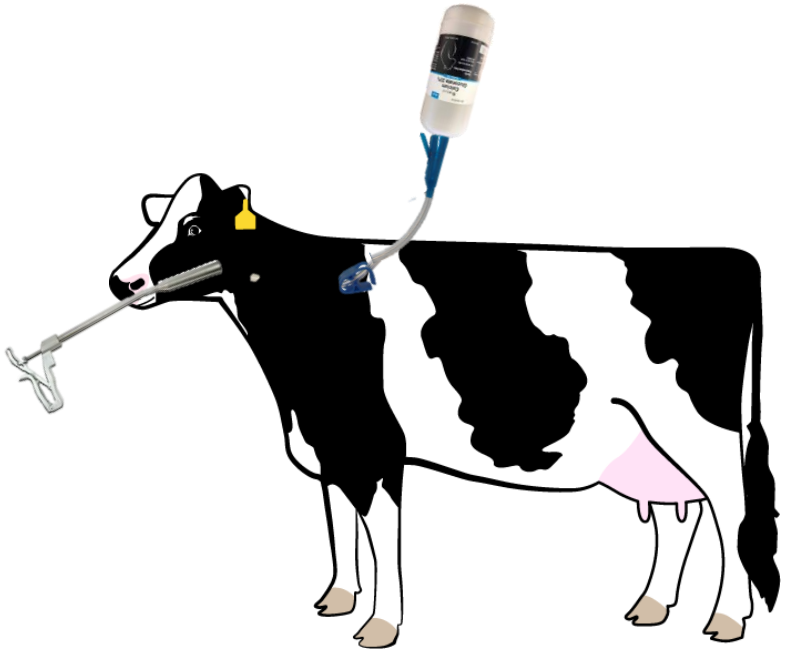
P = 0.4
EUC = 44.9 ± 2.9 kg/d
DYS = 42.7 ± 3.1 kg/d

Phibro, *unpublished data*

Can we improve blood Ca status in early lactation?



Ca supplementation at or after calving as treatment/prophylaxis



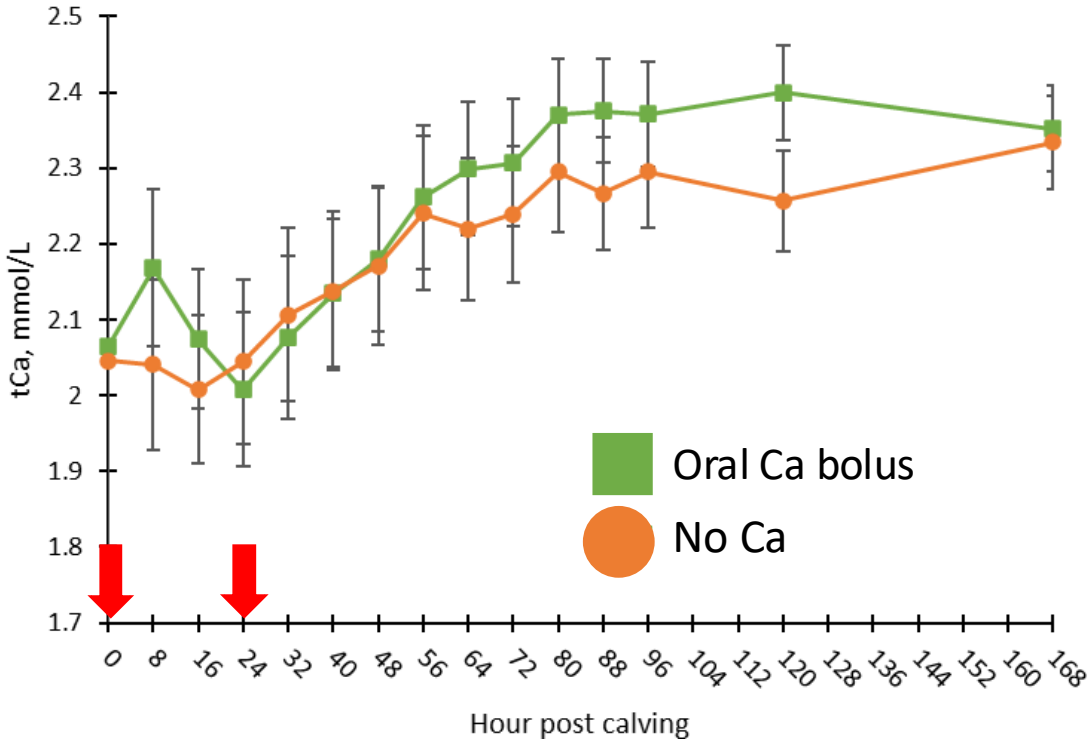
IV/Subcutaneous Ca

- Very steep increase in blood Ca ⇨ very fast decrease in blood Ca
- Reserve for Milk Fever!

Oral Ca bolus

- Slow release of Ca salts
- Sustained increase in blood Ca

Oral Ca Supplementation

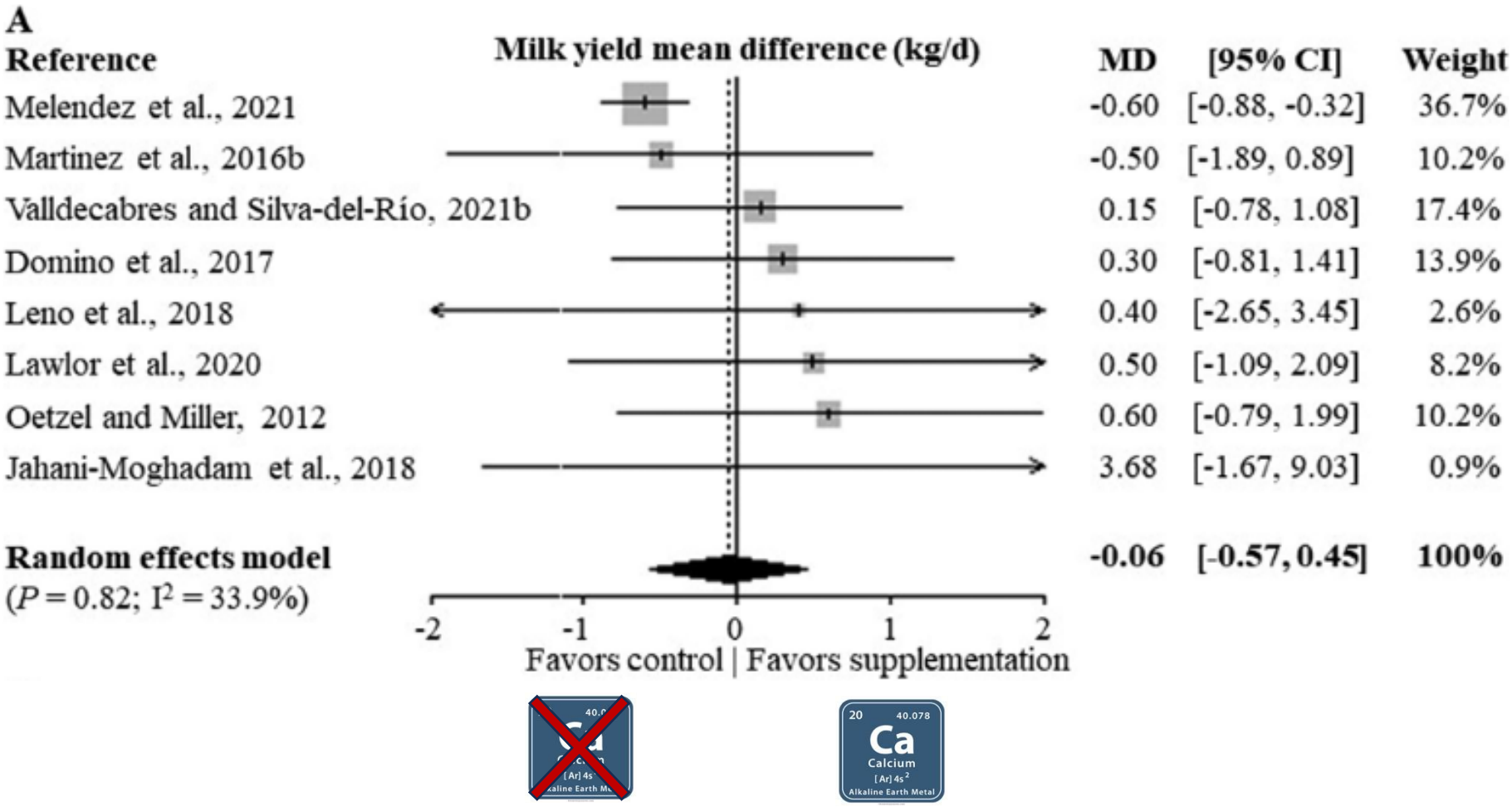


- Sustained increase in blood Ca via absorption in rumen and intestines
- What about production responses?



Adapted from Frost et al., 2023, https://doi.org/10.3168/jdsc.2023-0455

Production Response to Ca Bolus



Valldecabres et al., 2023, 10.3168/jdsc.2022-0235

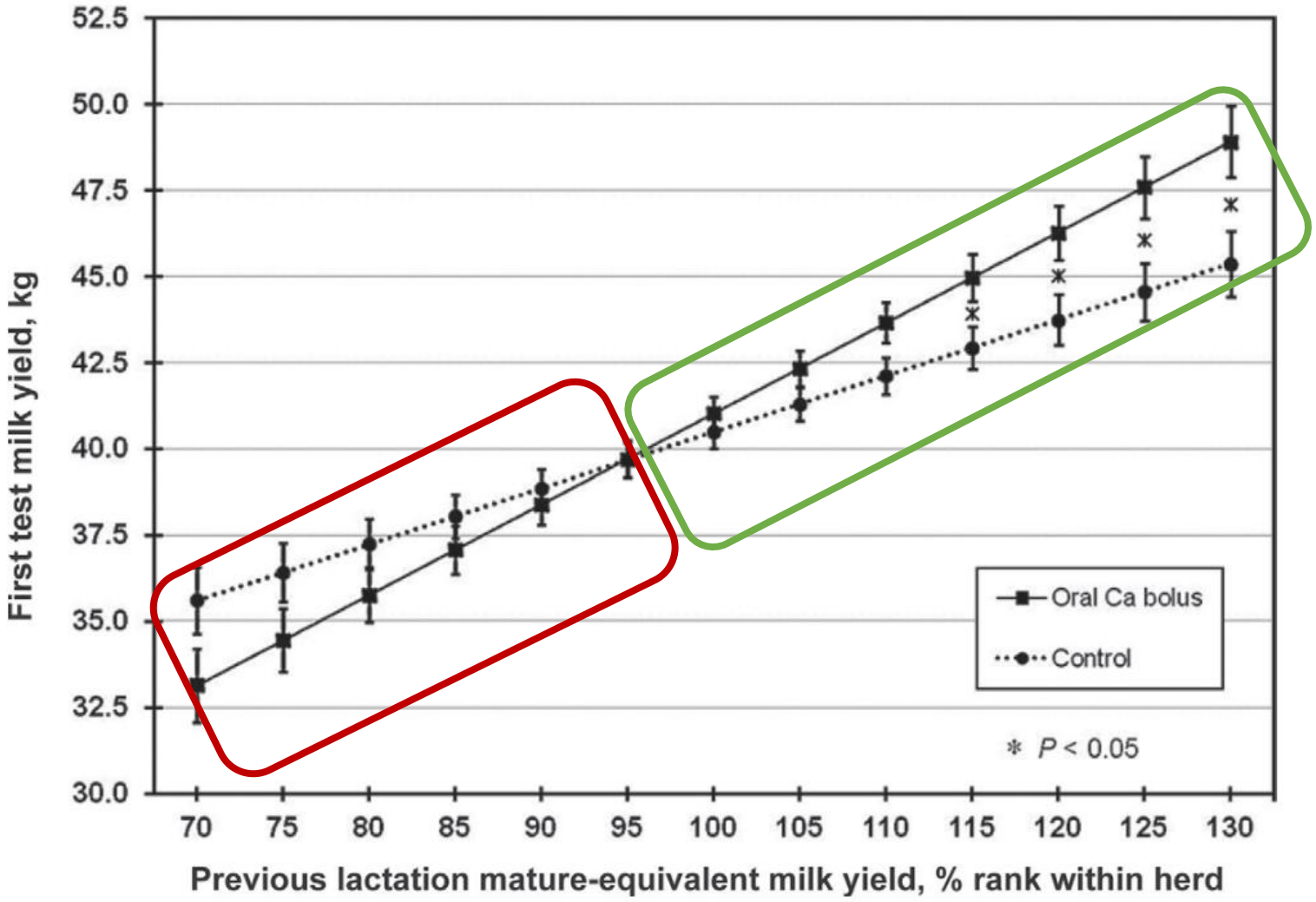
Production Response to Ca Bolus

J. Dairy Sci. 95:7051–7065
http://dx.doi.org/10.3168/jds.2012-5510
© American Dairy Science Association®, 2012. Open access under CC BY-NC-ND license.

Effect of oral calcium bolus supplementation on early-lactation health and milk yield in commercial dairy herds

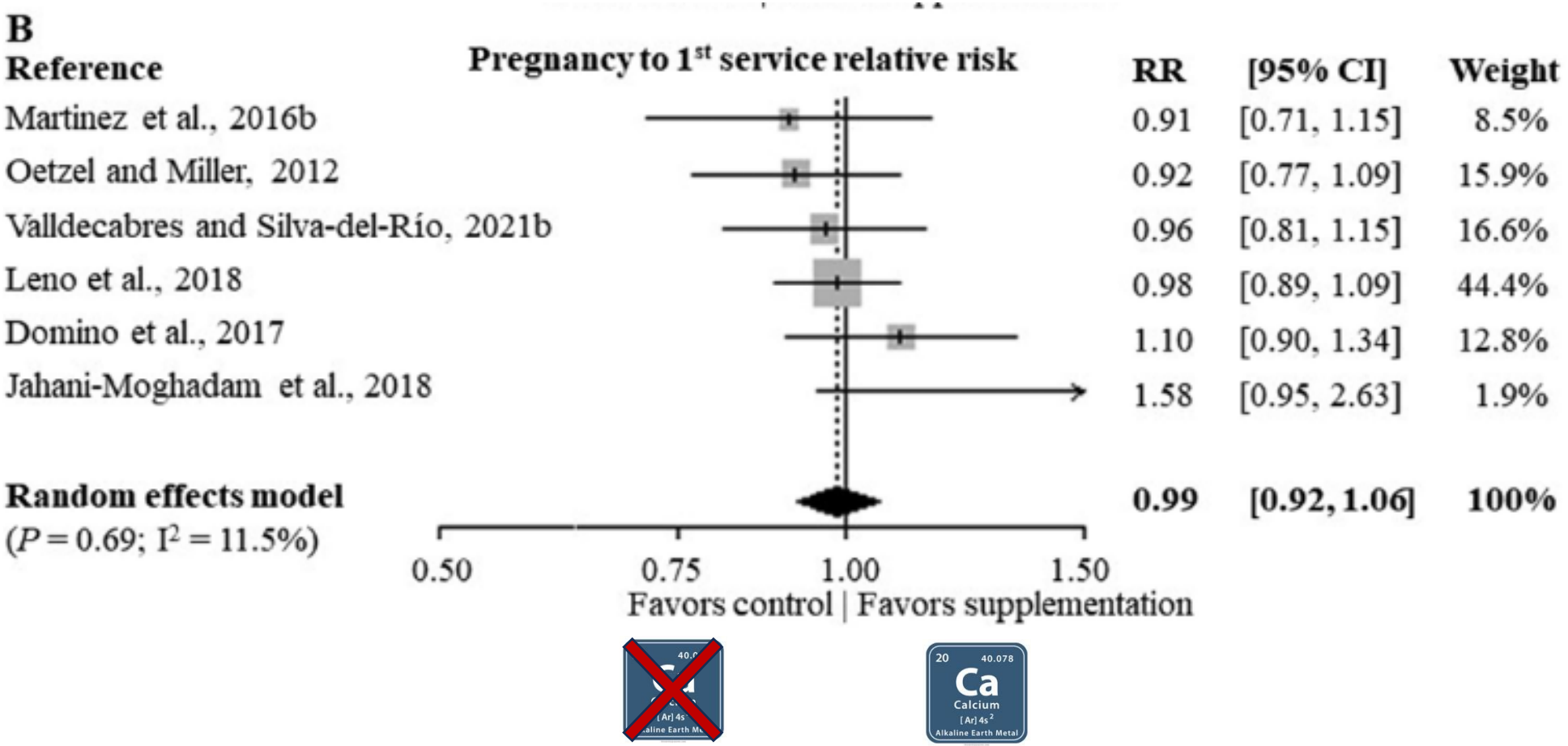
G. R. Oetzel*[1] and B. E. Miller†
*School of Veterinary Medicine, University of Wisconsin, Madison 53706
†Boehringer Ingelheim Vetmedica Inc., St. Joseph, MO 64506

- 927 multiparous Holstein cows
  - 431 oral Ca bolus (0 h and 24 h post calving)
  - 496 control
- No effect of Ca supplementation on milk yield at study population level



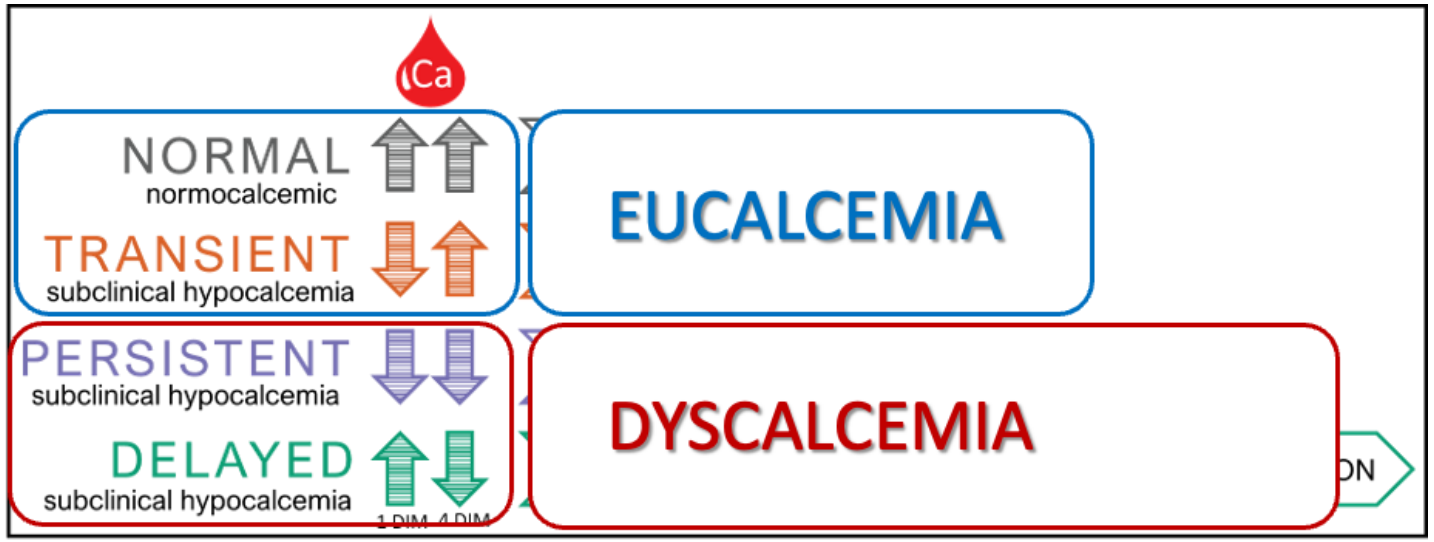
Oetzel and Miller, 2012, 10.3168/jds.2012-5510

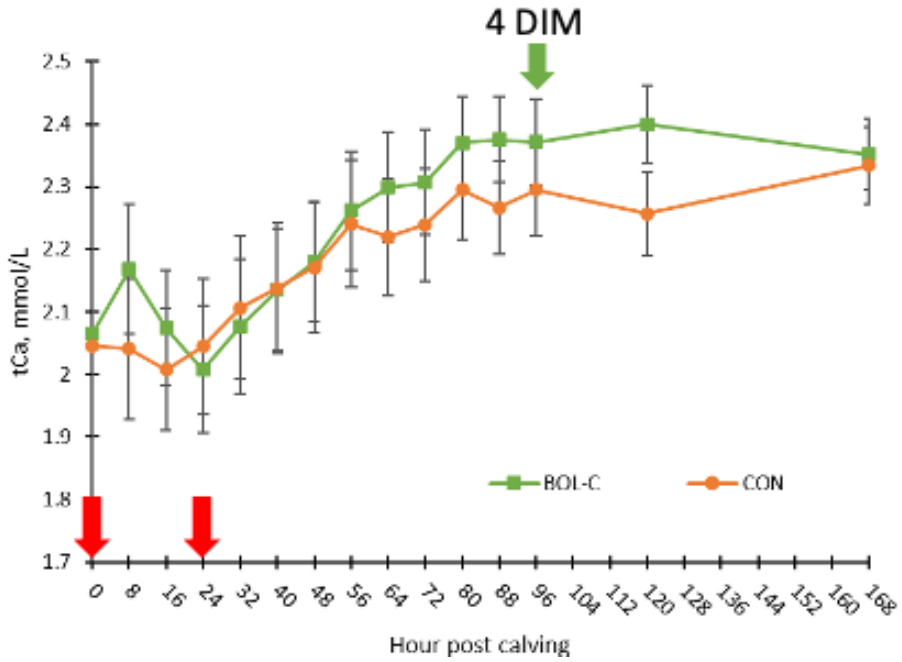
Reproductive Response to Ca Bolus



Valldecabres et al., 2023, 10.3168/jdsc.2022-0235

Are we giving oral Ca at the right time?





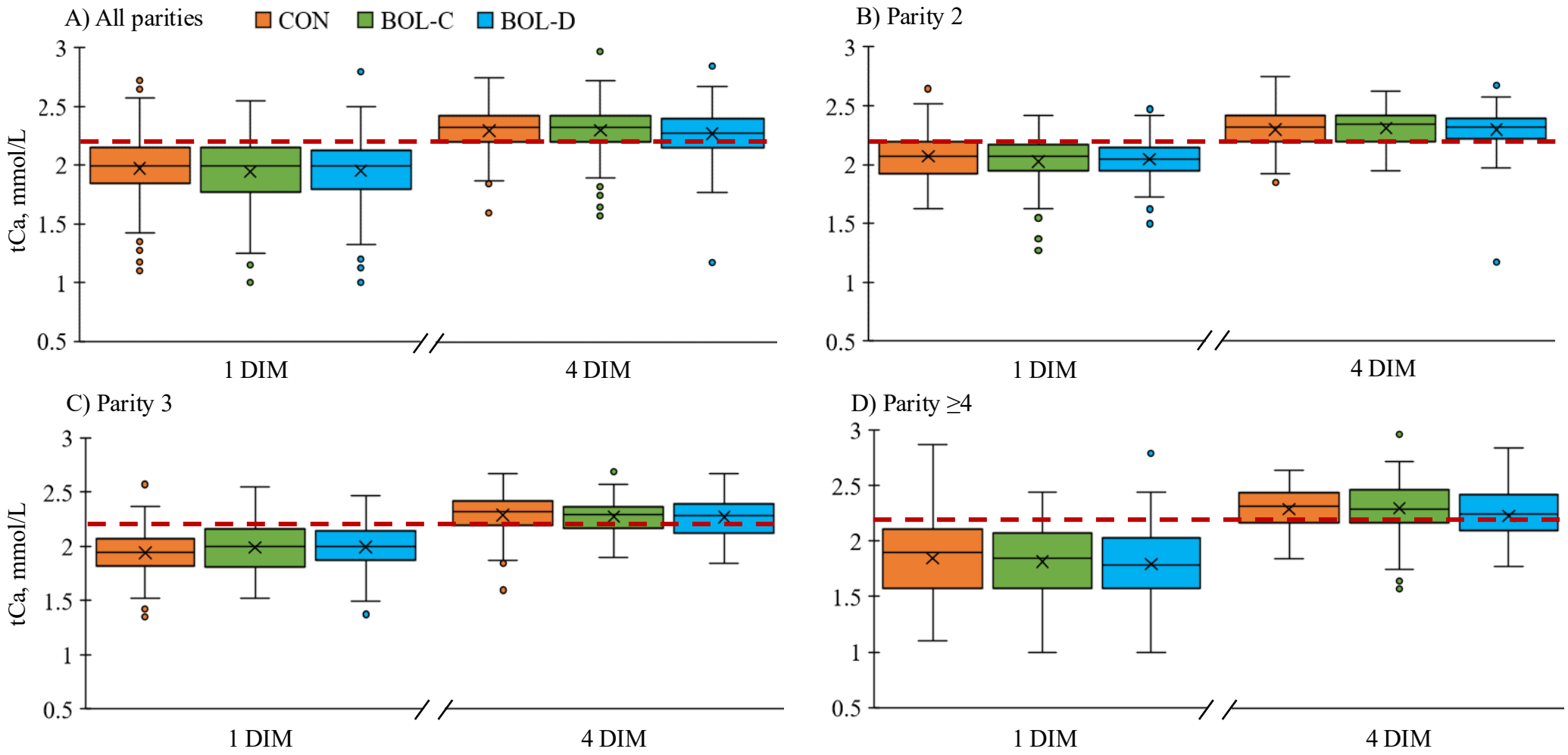
What if we delay Ca bolus administration?

- Enrolled 998 multiparous Holstein cows from 4 herds in NY at calving

CON	Control; no Ca supplementation, n = 343
BOL-C	Conventional bolus; oral Ca bolus (43 g Ca) at 0 & 1 DIM, n = 330
BOL-D	Delayed bolus; oral Ca bolus (43 g Ca) at 2 & 3 DIM, n = 325

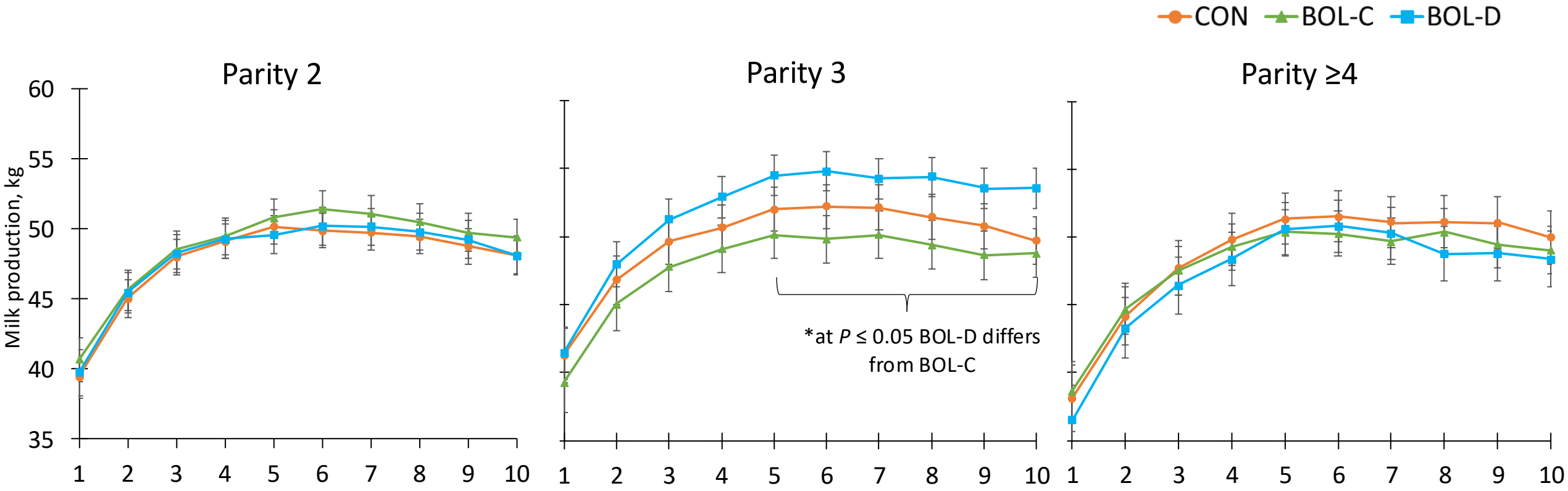
- Blood was collected from the coccygeal vessels at 1 & 4 DIM
  - Analyzed for serum total Ca (tCa)
- Milk production was recorded for the first 10 wk of lactation
- Health events and herd removal were recorded for the first 30 DIM

Minimal impact of Ca bolus on 4 DIM tCa



Seely et al., 2023; http://dx.doi.org/10.3168/jds.2023-23541

Milk production differences between parities

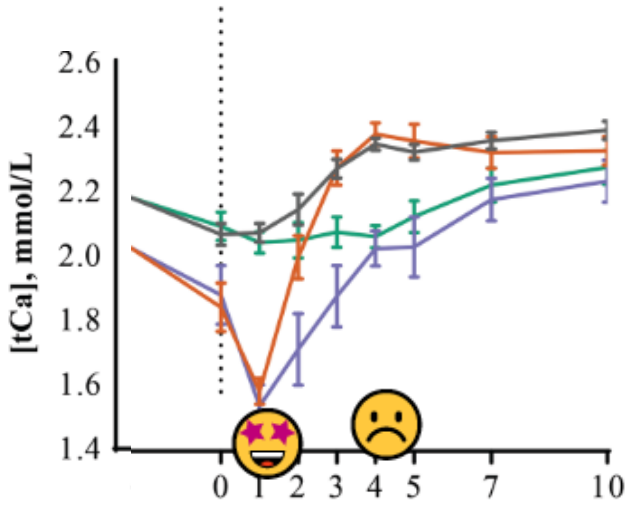


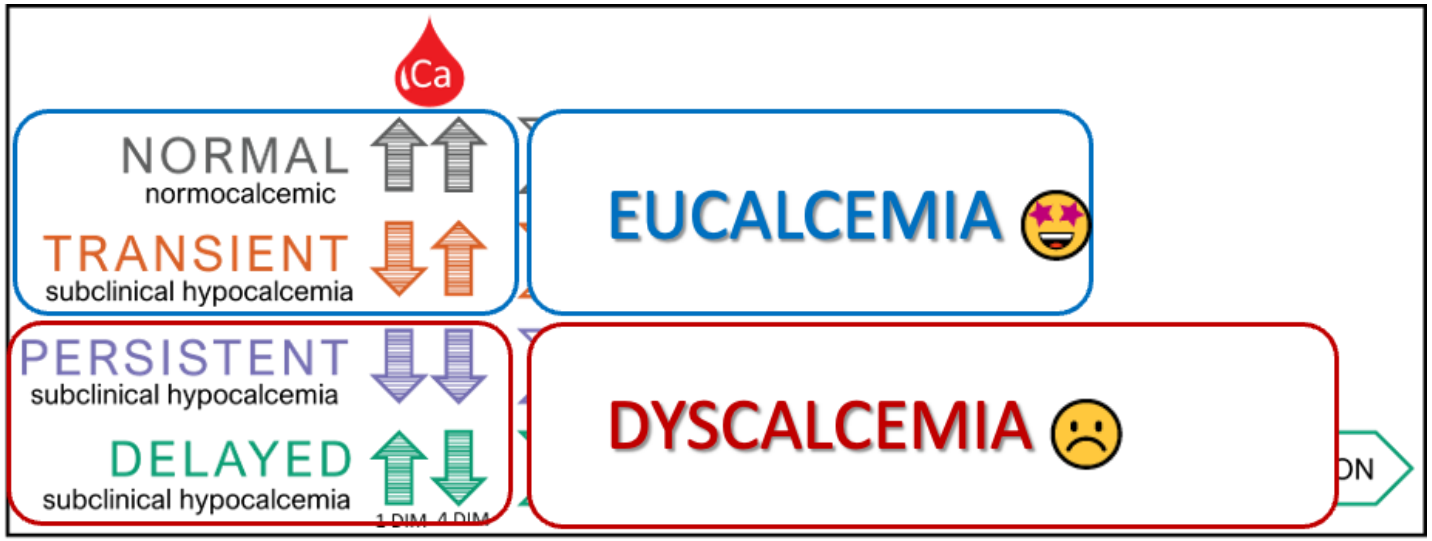
Parity 2		Parity 3		Parity ≥4	
CON	47.9 [46.8, 49.0] kg/d	CON	49.8^{ab} [48.2, 51.3] kg/d	CON	48.8 [47.0, 50.5] kg/d
BOL-C	48.8 [47.7, 50.0] kg/d	BOL-C	47.9^{b} [46.3, 49.5] kg/d	BOL-C	48.1 [46.5, 49.6] kg/d
BOL-D	48.1 [46.9, 49.3] kg/d	BOL-D	52.0^{a} [50.6, 53.4] kg/d	BOL-D	47.4 [45.5, 49.2] kg/d

Error bars represent 95% confidence intervals

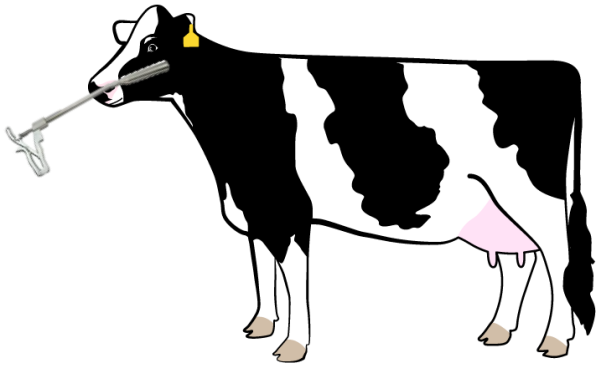
Seely et al., 2023; http://dx.doi.org/10.3168/jds.2023-23541

What we've learned so far…







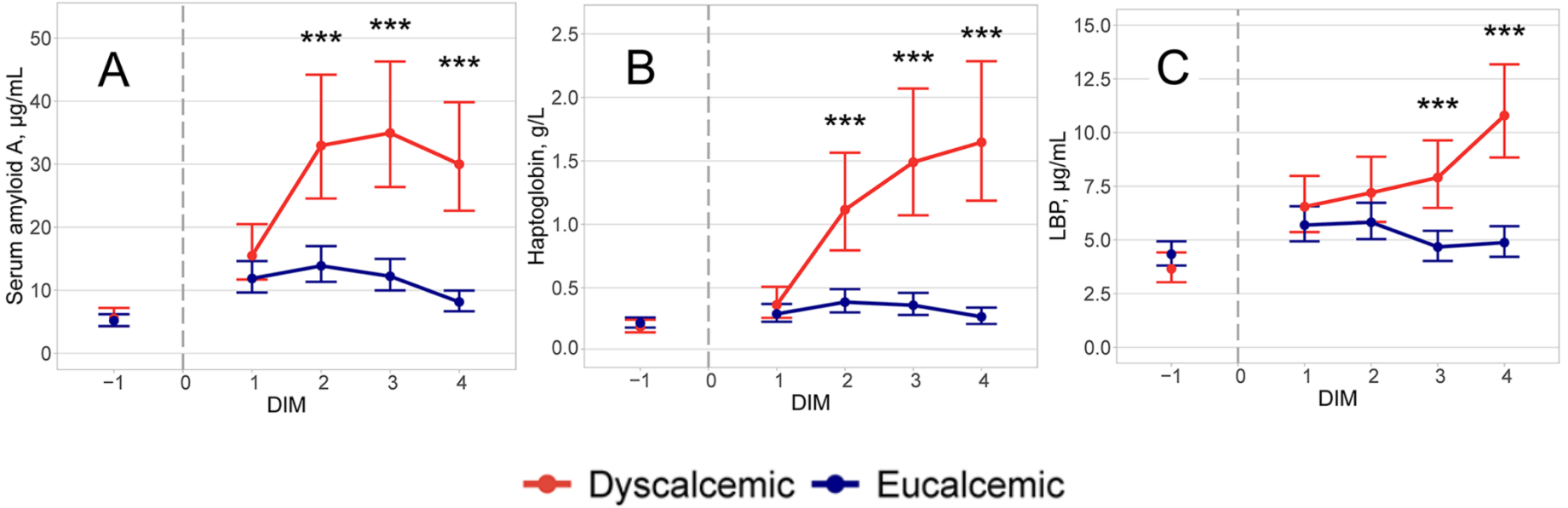


Prophylactics help sometimes…

What are the next steps?

- What is behind Dyscalcemia?
- Is inflammation involved?



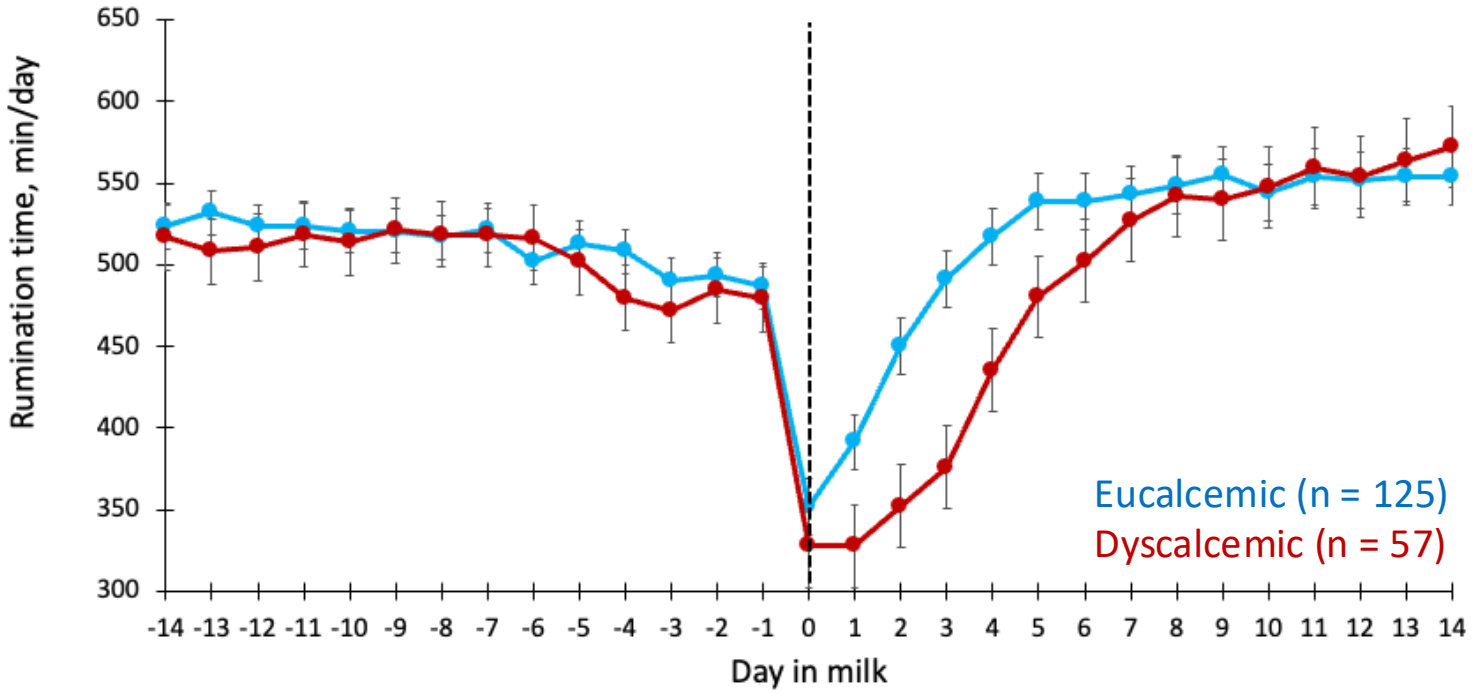


Seminara et al., 2025; https://doi.org/10.3168/jds.2024-25300

What are the next steps?

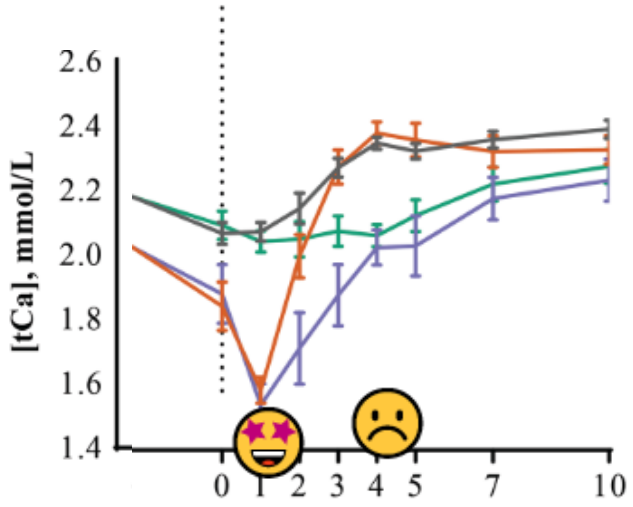
- Can we use non-invasive methods to identify cows with Dyscalcemia?

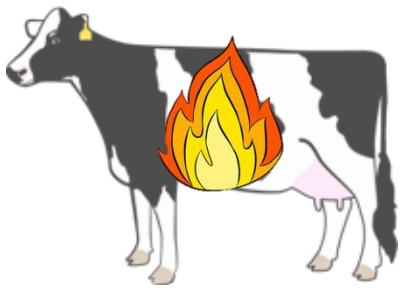




Seely and McArt, 2023; https://doi.org/10.3168/jds.2023-24139

The future of Dyscalcemia







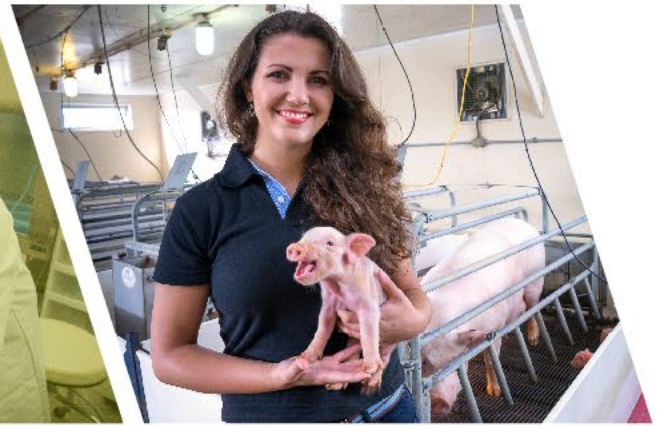
Make more informed management decisions to support Ca homeostasis



Questions?

Claira.Seely@unh.edu






Protein and Muscle in the Dairy Cow

Dr. Jackie Boerman

JBoerma@purdue.edu

Associate Professor – Purdue University

High Plains Dairy Conference

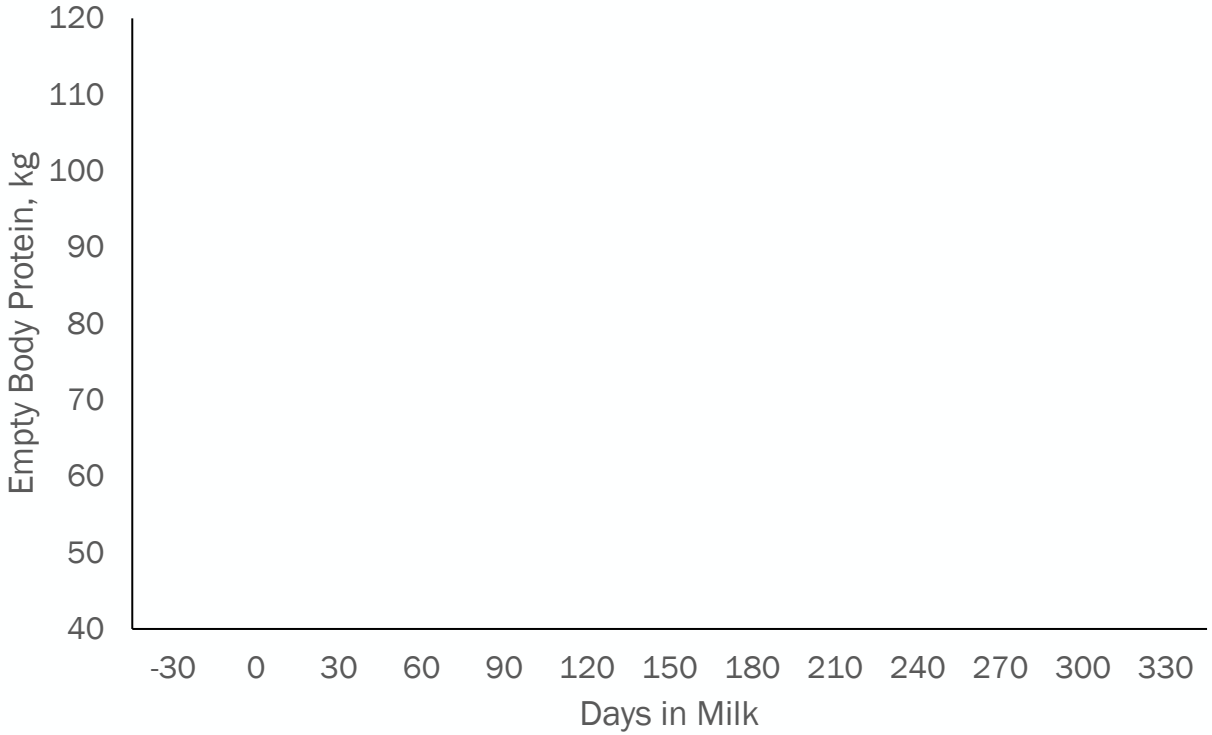
March 3, 2026

Metabolic Changes Associated with Onset of Lactation – Partial List

Biological Function	Metabolic Change	Tissues Involved
Milk synthesis	Increased use of nutrients	Mammary
Lipid metabolism	Increased lipolysis Decreased lipogenesis	Adipose tissue
Glucose metabolism	Increased gluconeogenesis Increased glycogenolysis Decreased use of glucose and increased use of lipid as energy source	Liver Body tissues in general
Protein metabolism	Mobilization of protein reserves	Muscle and other body tissues
Mineral metabolism	Increased absorption Increased reserve mobilization	Gut, bone, kidney and liver
Intake and digestion	Increased food consumption Hypertrophy of digestive tract Increased nutrient absorption capacity	Central nervous system All segments of the digestive tract
Immune function	Increased positive acute phase proteins Decreased negative acute phase proteins	Liver and other tissues

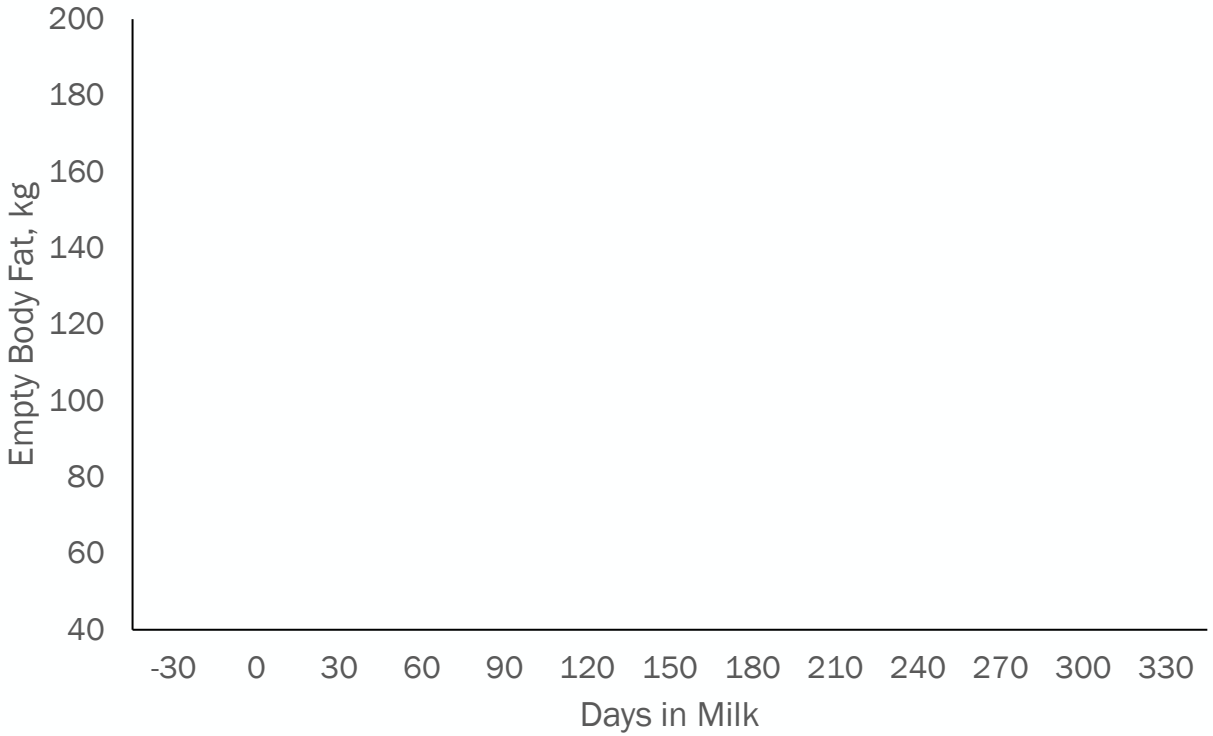
Slide adapted from Dr. Dale Bauman

Body Composition Across Lactation



Range 62 – 112 kg

Range 47 – 185 kg



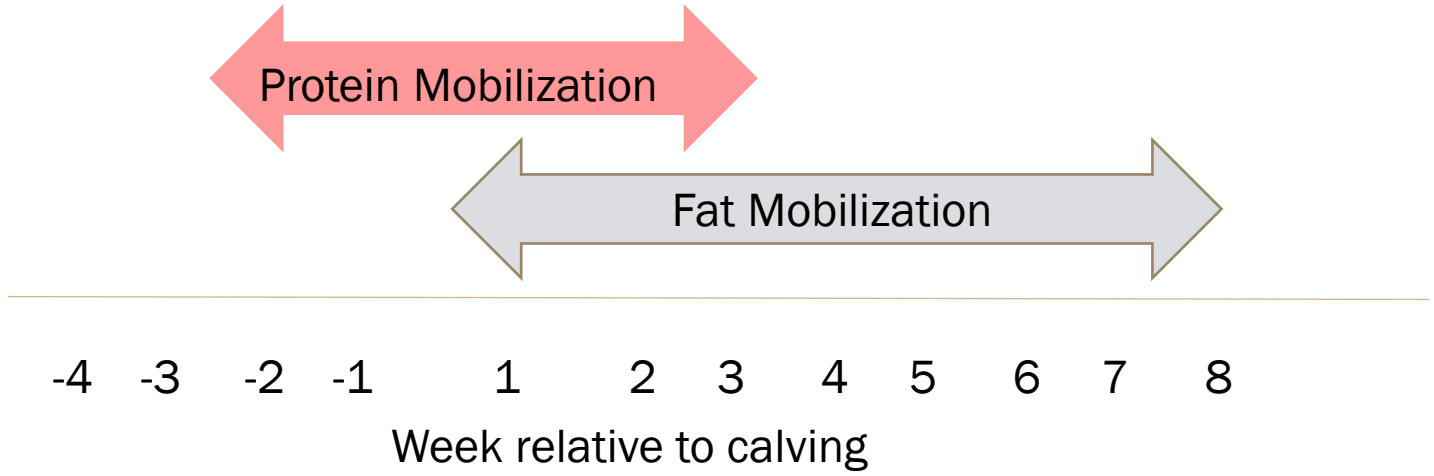
Coombe et al., unpublished

PURDUE UNIVERSITY

Mobilization of Tissue Stores

- 3 main stores of tissue to mobilize during the transition period
  - Glycogen – mobilized quickly, not a large reserve
  - Adipose – usually largest pool of tissue unless under-conditioned
  - Protein – mostly skeletal muscle and likely starts prior to calving

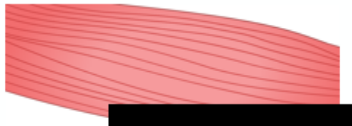
    *when it starts is likely dependent on a couple of factors



PURDUE UNIVERSITY

van der Drift et al., 2012

Uses for Skeletal Muscle



Skeletal Muscle

catabolism

anabolism

Digestive Tract Requirements



Fetal Requirements

Metabolizable Protein

Amino Acids

Milk Protein

Immune system modulators

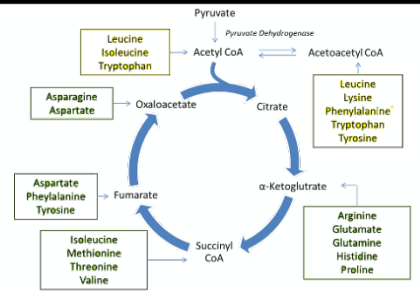
Hormone signaling

Ammonia and Urea

TCA Cycle Intermediates

Ketones

Glucose



PURDUE UNIVERSITY®

Protein Balance Post Calving

- MP balance reaching nadir around 7 DIM
- By about 30 DIM positive protein balance
- Dependent on intake, milk production, and milk protein yield

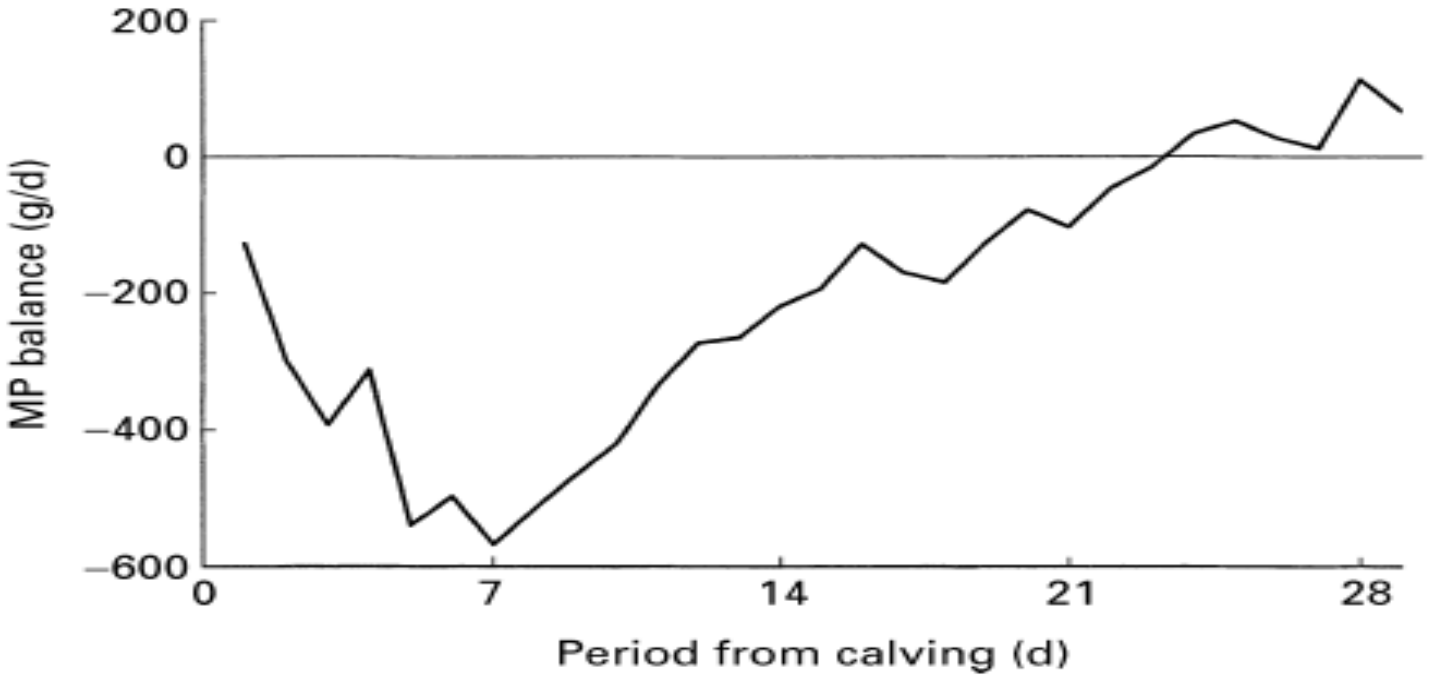


Fig. 1. Calculated metabolizable protein (MP) balance in post-parturient cows (*n* 80) fed on a ration containing (/kg DM) 178 g crude protein (nitrogen × 6·25) and 7·0 MJ net energy for lactation. Individual values were calculated from daily individual measurements of crude protein intake and milk yield, and weekly measurements of milk composition.

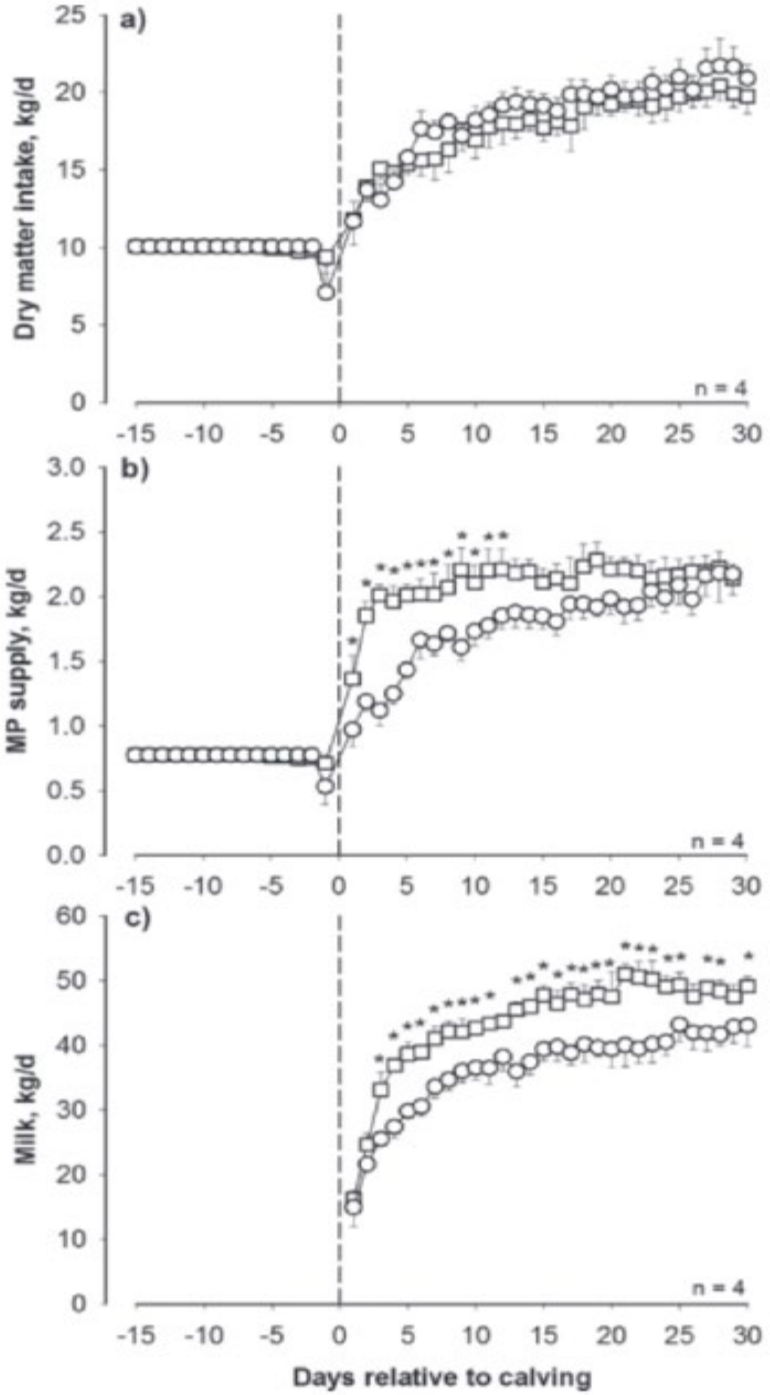
Bell et al., 2000

PURDUE UNIVERSITY

Infusions of Casein Studies

- Due to the negative MP balance observed in early lactation → abomasal infusions of AA of casein (Larsen et al., 2014) or similar in profile to casein (Larsen et al., 2015)
  - Supply of ~700g/d, ~500 or ~200 g/d at 4, 15, 29 DIM
  - No difference in intake
  - Milk yield was 7.2 kg/d (15.8 lbs/d) greater from through 30 DIM
  - Milk protein yield greater earlier in lactation
- In early lactation → mammary gland is selfish

- **What about if AA were mobilized from muscle, would they go to the mammary gland? What if they were mobilized pre-calving?**

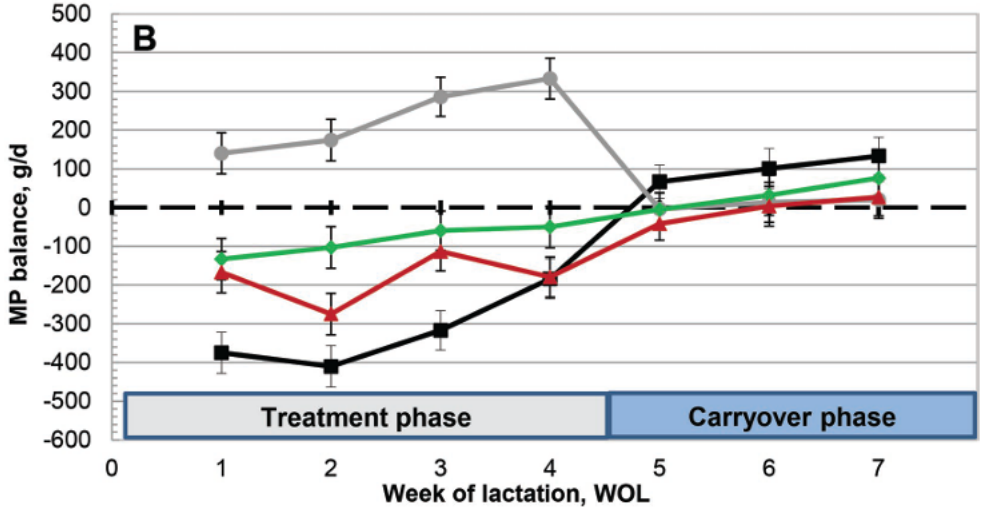


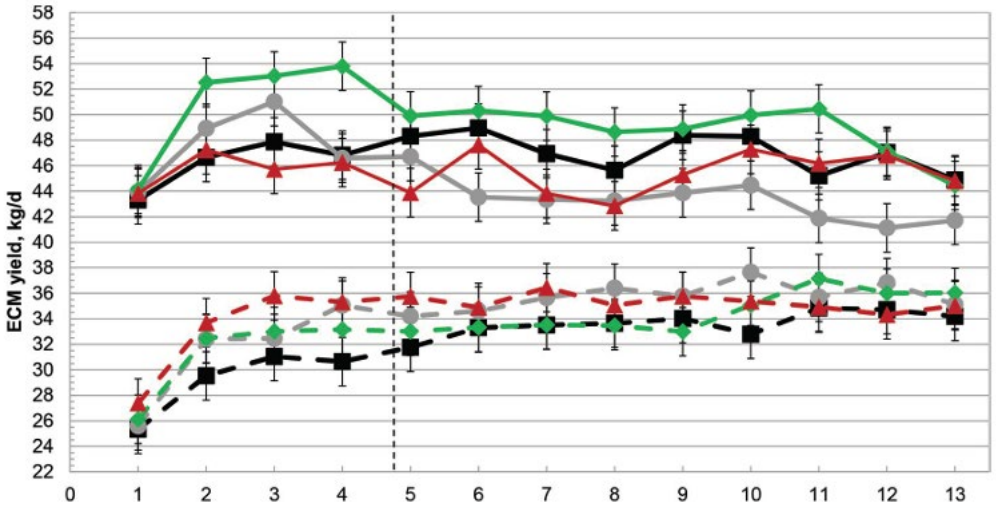
PURDUE UNIVERSITY

MP Supplementation Postpartum – Tebbe and Weiss (2021)

- Increasing MP and AA supply may be of greater importance for fresh cows than dietary energy supply because postpartum cows have a greater capacity to mobilize body lipid versus protein (Schei et al., 2005).
- 40 primigravid and 40 multi gravid Holsteins fed common diet prepartum and in the carryover phase.
- After calving to 25 DIM
  - Deficient in MP (DMP; 17% CP; 1,856 g/d MP) **BLACK**
  - Adequate MP primarily soy (AMP; 20% CP; 2,329 g MP) GRAY
  - Adequate MP primarily R-P AA (Blend; 20% CP; 2,471 g/d MP) RED
  - Blend but less fNDF (Blend-fNDF; 2,482 g/d MP) GREEN

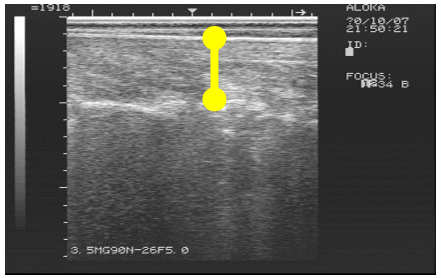
- Different responses in mature vs primiparous cows to MP supplementation in the fresh period.



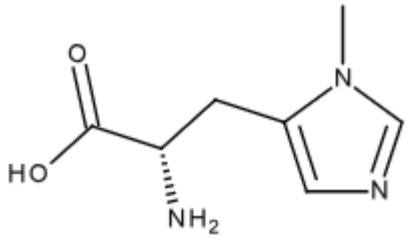


PURDUE UNIVERSITY

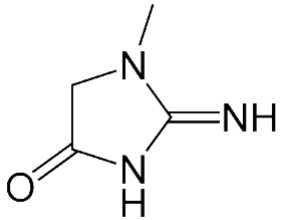
Measuring Muscle Mobilization



- Serial ultrasound images to measure change in muscle depth



- 3-methylhistidine is released when muscle fiber (actin and myosin) is degraded and is not used for protein synthesis

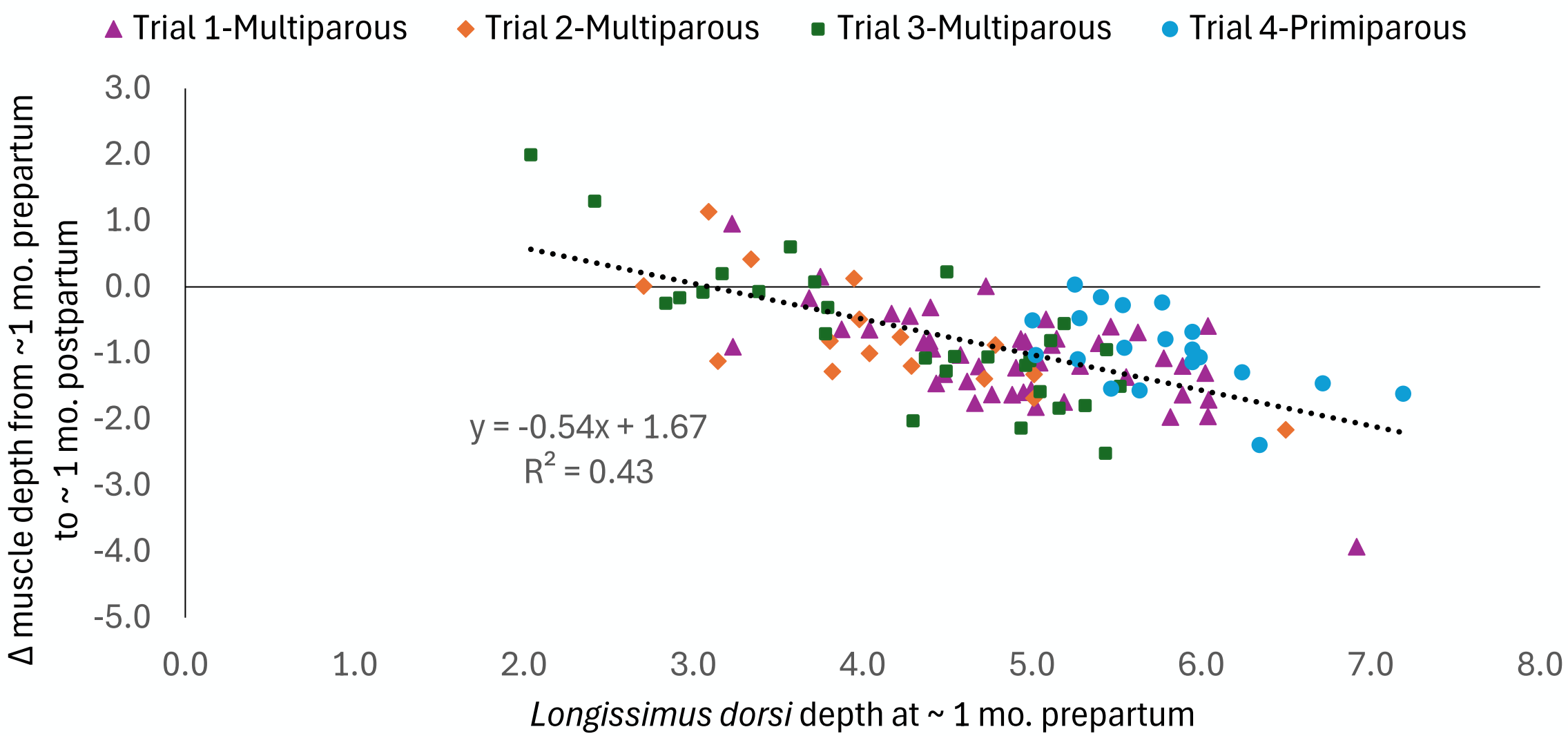


- Creatinine is an indicator of muscle mass

- Ratio of 3-methylhistidine to creatinine would indicate muscle mobilization per unit of muscle mass
  - Higher → more muscle mobilization

PURDUE UNIVERSITY®

If Cows Have More Muscle They Mobilize More Muscle In The Transition Period

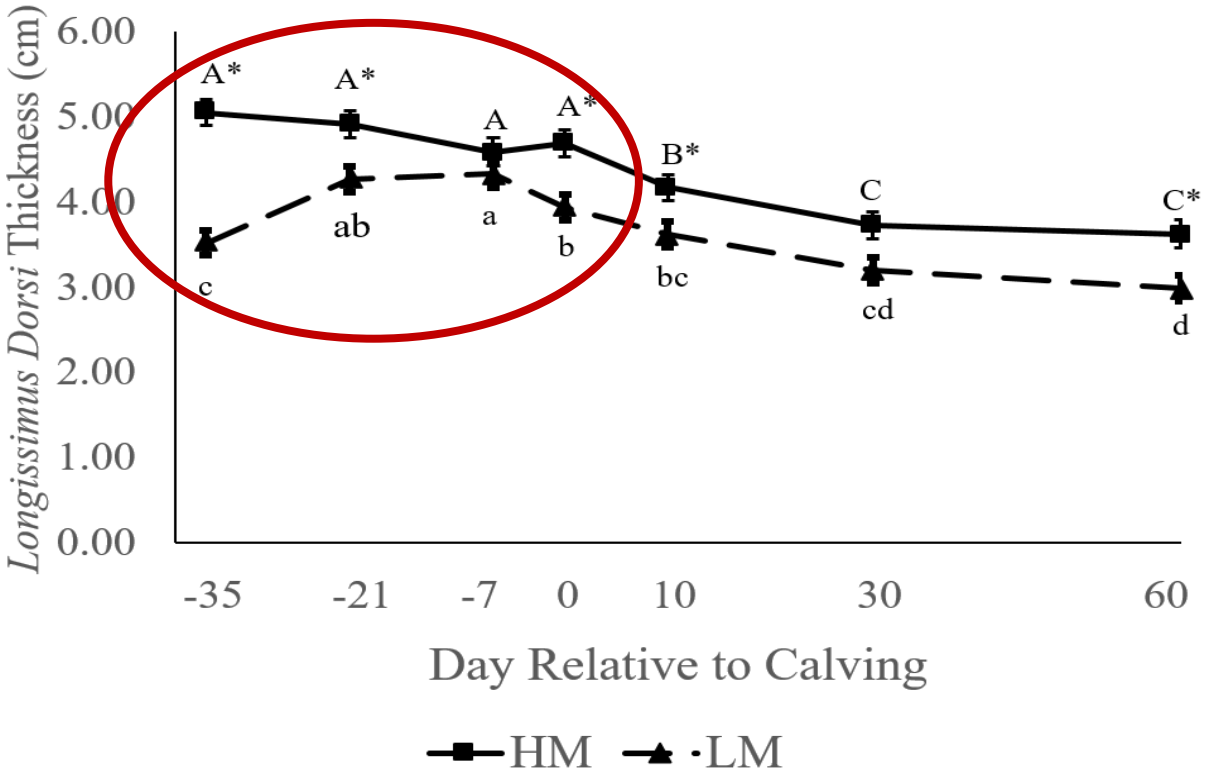


PURDUE UNIVERSITY

How Dynamic is Muscle Amount in the Transition Period?

- Separated animals into low muscle and high muscle from 35 d before calving to 60 DIM based on *longissmus dorsi* thickness

- High muscle (HM) "mobilized" average of 1.54 cm (n=20)
- Low muscle (LM) "mobilized" average of 0.52 cm (n=21)
  - Because gained muscle during prepartum period



Differences in uppercase letters indicate a difference between time points within HM, lowercase letters indicate a difference between days within LM, and an asterisk indicates a difference between groups within a day at $P<0.05$.

McCabe et al., 2021

PURDUE UNIVERSITY

High Muscle Cows Have Higher 3-MH and 3-MH:CRE → More Muscle Mobilization

	2 DIM		7 DIM		14 DIM		21 DIM			*P*- Value
Item	HM	LM	HM	LM	HM	LM	HM	LM	SEM	Group
Insulin (ng/mL)	0.21	0.37	0.18	0.41	0.15	0.31	0.31	0.24	0.10	0.26
Glucose (mg/dL)	68.1	69.8	70.8	64.6	66.3	64.8	69.6	68.8	2.2	0.32
BHB (mmol/L)	0.97	1.04	1.15	1.11	1.08	0.99	0.95	0.87	0.17	0.80
NEFA (mmol/L)	0.64	0.54	0.72	0.62	0.63	0.63	0.75	0.51	0.09	0.15
CRE (ng/mL)	3,588	3,477	3,398	3,407	3,173	3,178	3,196	2,994	125	0.57
3-MH (ng/mL)	493^{abc}	437^{cd}	538^{a}	414^{d}	581^{a}	471^{c}	520^{ab}	428^{cd}	34	0.02
3-MH:CRE	0.137^{c}	0.122^{c}	0.163^{b}	0.118^{c}	0.188^{a}	0.143^{bc}	0.167^{b}	0.141^{bc}	0.010	<0.01

PURDUE UNIVERSITY

McCabe et al., 2021

High Muscle Multiparous Cows Produce Heavier Calves

7.5 lbs. larger calves
No significant difference in ECM

Item	HM	LM	SEM	Group *P*-value
Calf Birthweight (kg)	45.2	41.8	0.7	<0.01
Milk Yield (kg/d)	38.8	41.6	0.8	0.02
Fat %	4.33	4.05	0.12	0.09
Protein %	2.83	2.88	0.03	0.28
Lactose %	4.75	4.71	0.04	0.42
Fat Yield (g)	1703	1612	66	0.32
Protein Yield (g)	1102	1160	34	0.21
Lactose Yield (g)	1843	1918	57	0.35
Milk Urea Nitrogen (mg/dL)	7.44	8.08	0.30	0.12

McCabe et al., 2021

Prepartum Muscle Depth Results

48 multiparous cows
High Muscle (HM) > 4.6 cm
Low Muscle (LM) ≤ 4.6 cm

	High Muscle	Low Muscle	SEM	*P*-values
DMI, kg/d	13.7	13.3	0.47	0.52
BW, kg	789	762	22.3	0.38
BCS, 1-5 scale	3.61	3.29	0.06	<0.01
Glucose, mg/dL	78.6	76.8	0.89	0.16
BHB, mmol/L	0.61	0.60	0.02	0.76
Insulin, ng/mL	0.54	0.66	0.11	0.26

PURDUE UNIVERSITY

Gouveia et al., 2024

Prepartum Dam Muscle Depth - Calf Results

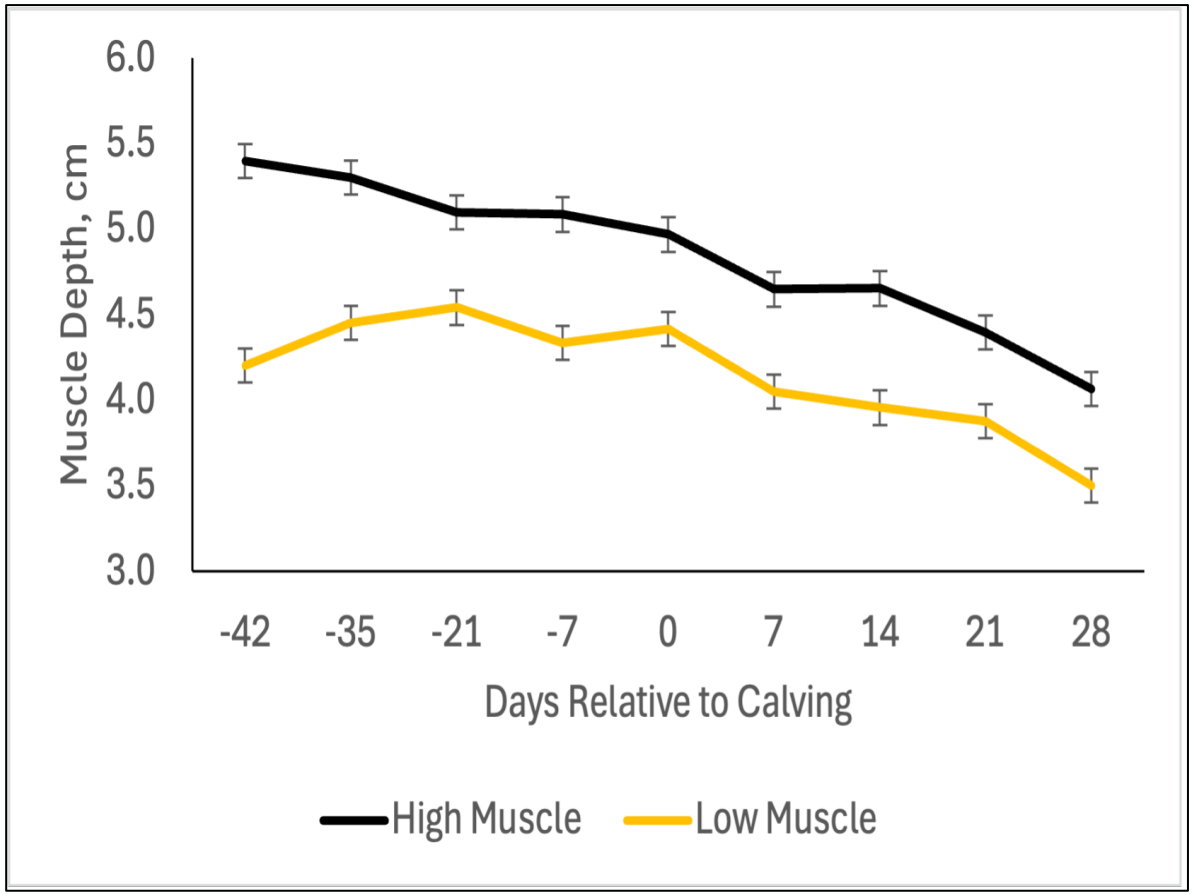
~8 lbs. larger calves from HM dams

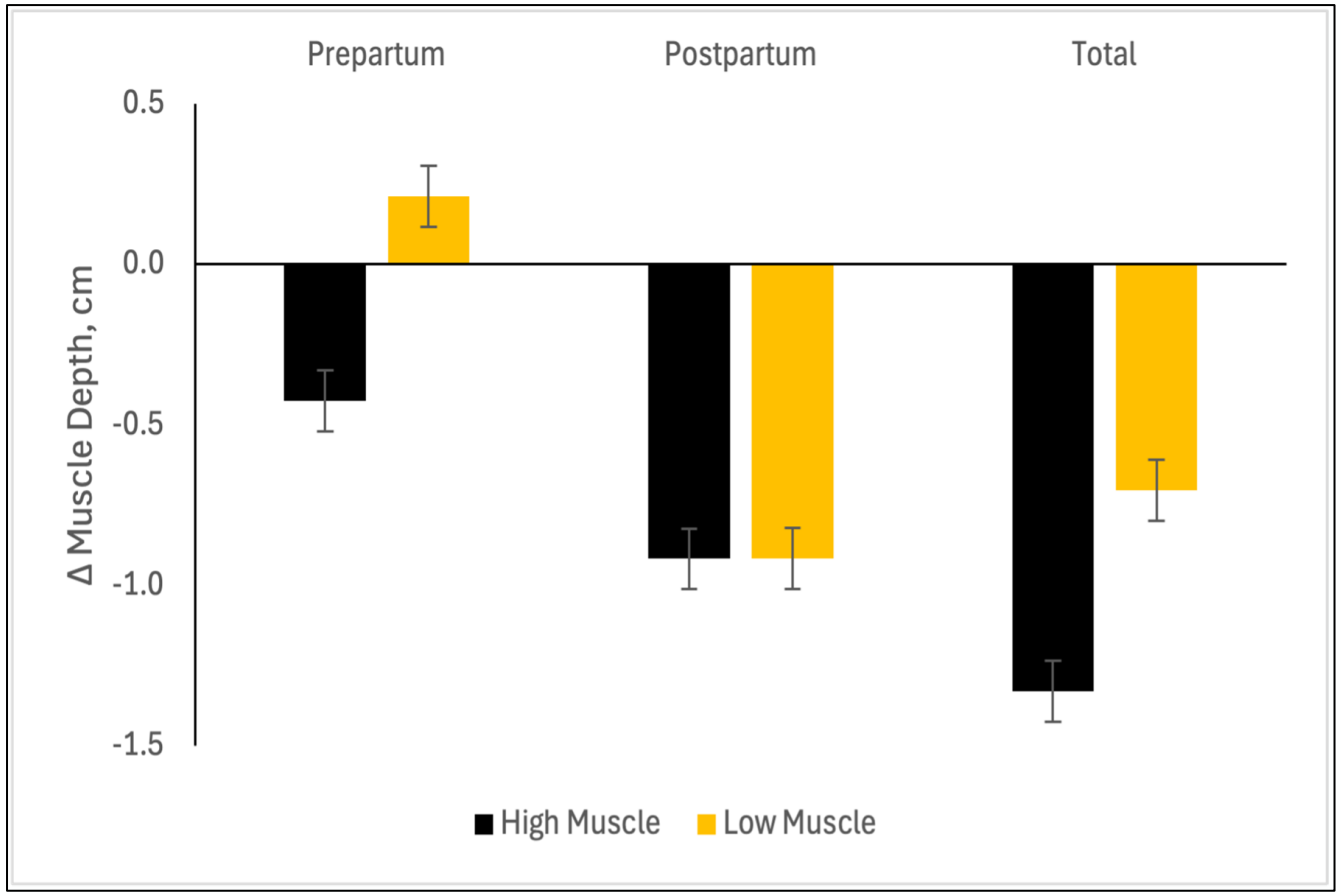
	High Muscle	Low Muscle	SEM	*P*-values
Birthweight, kg	48.8	45.2	1.04	0.01
Muscle metabolic activity, fluor g-1 h-1/1000	2,846	2,253	187	0.02
Creatinine, ng/µL	10.2	8.81	0.59	0.10
3-methylhistinine, ng/µL	3.78	3.13	0.38	0.21

PURDUE UNIVERSITY

Beckett et al., 2025

High Muscle Cows Mobilize Muscle ~5 Weeks Before Calving





PURDUE UNIVERSITY

Gouveia et al., 2024

High Muscle Cows Make More Milk

14 lbs. of ECM based on muscle reserves

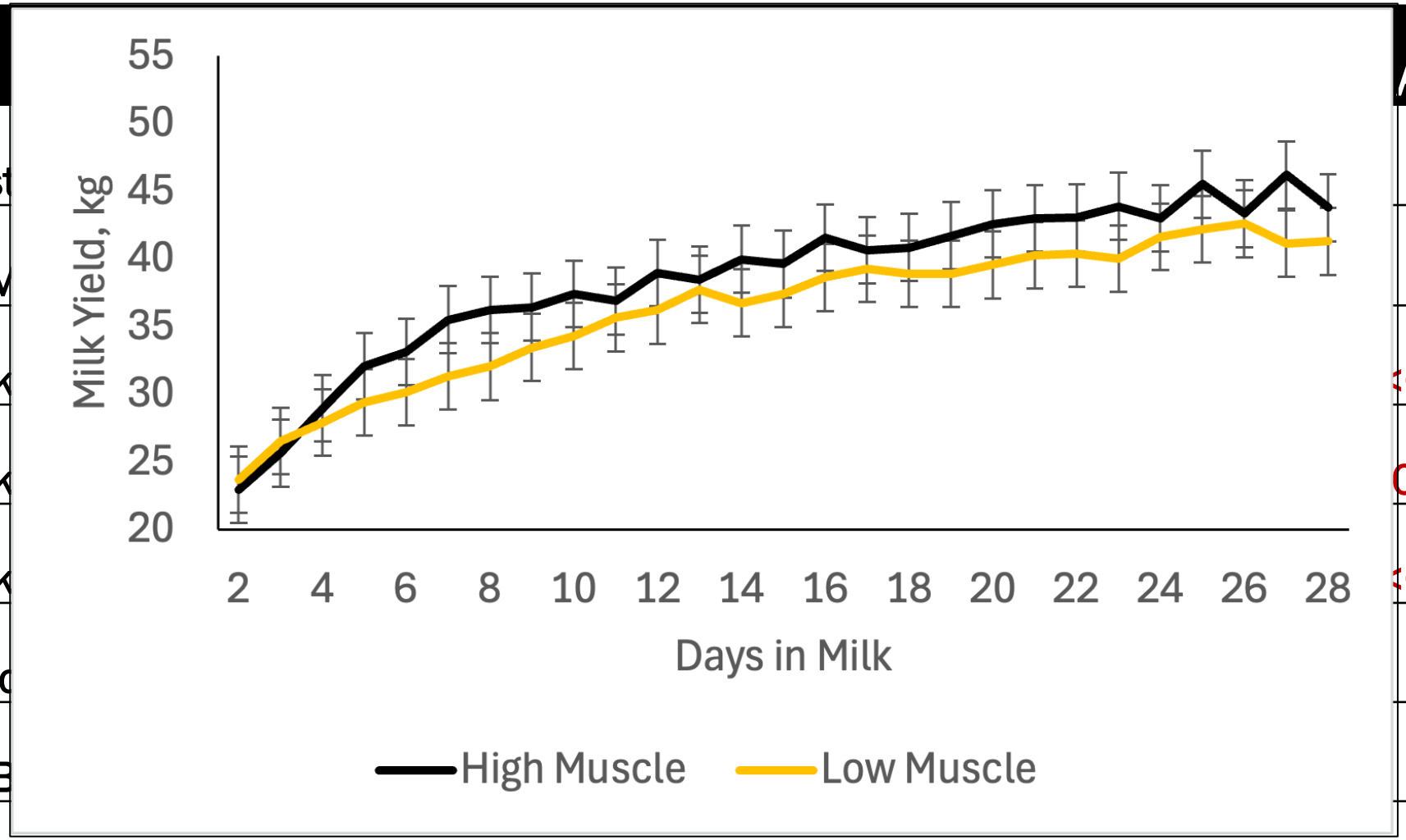
	High Muscle	Low Muscle	SEM	*P*-value
Postpartum DMI, kg/d	20.1	19.4	0.21	0.02
ECM, kg/d	47.8	41.4	1.06	<0.01
Milk fat, kg/d	1.90	1.63	0.05	<0.0001
Milk protein, kg/d	1.32	1.18	0.03	0.0001
Milk lactose, kg/d	2.04	1.76	0.05	<0.0001
Glucose, mg/dL	78.4	76.4	0.96	0.10
BHB, mmol/L	0.90	0.90	0.04	0.96

PURDUE UNIVERSITY

Adapted from Gouveia et al., 2024

High Muscle Cows Make More Milk

14 lbs. of ECM based on muscle reserves



	P-value
Post	0.02
ECM	<0.01
Milk	<0.0001
Milk	0.0001
Milk	<0.0001
Gluc	0.10
BHB	0.96

PURDUE UNIVERSITY

Adapted from Gouveia et al., 2024

Springing Heifers with Greater Muscle Reserves Are A Bit Different

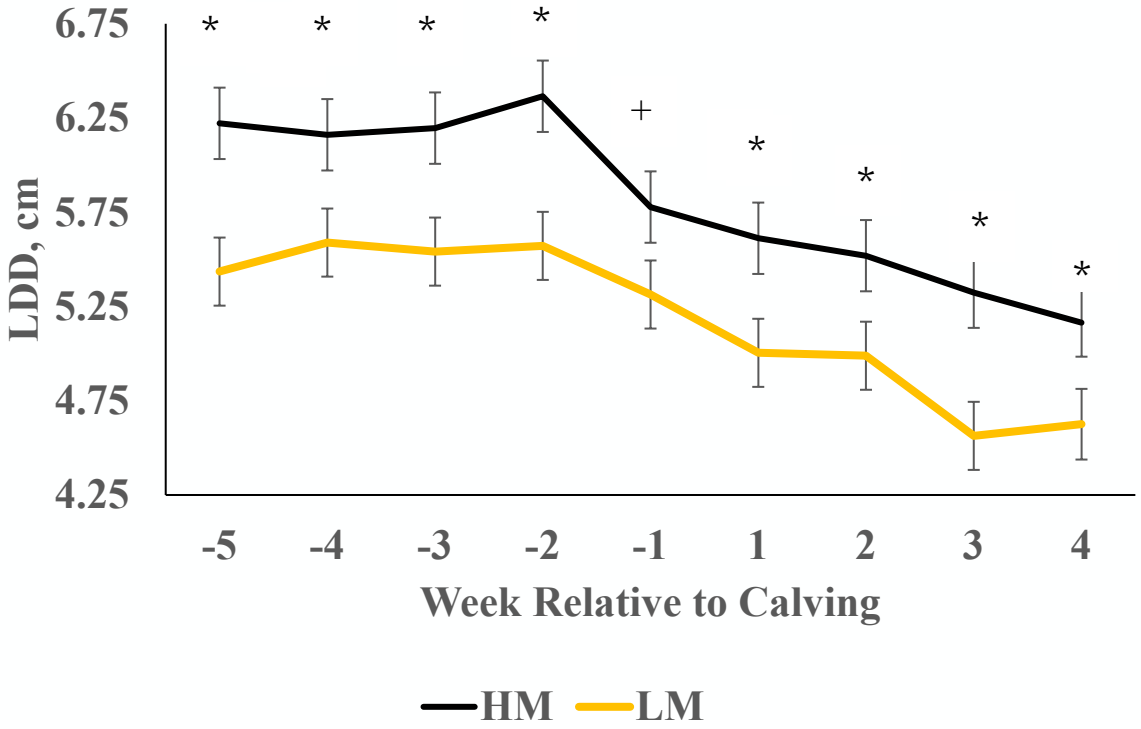
- They don't appear to give birth to larger calves and they don't lose muscle reserves until right before calving

- They start with more muscle → no difference in ECM between muscle groups

- Heifers have competing processes → they are still growing, myofibers increase in size as they age while they go through the transition period they should be reducing in size
  - Heifers have higher insulin concentrations → which may limit some mobilization

- Measured muscle at 280 DIM, similar to muscle depth at 4 wk of lactation

	Muscle Group	
Variable	HM	LM
Calf wt., kg	41.6 ± 3.73	41.9 ± 4.14
Colostrum wt., kg	6.80 ± 3.02	8.25 ± 4.05
Brix, %	31.0 ± 2.64	28.4 ± 4.70

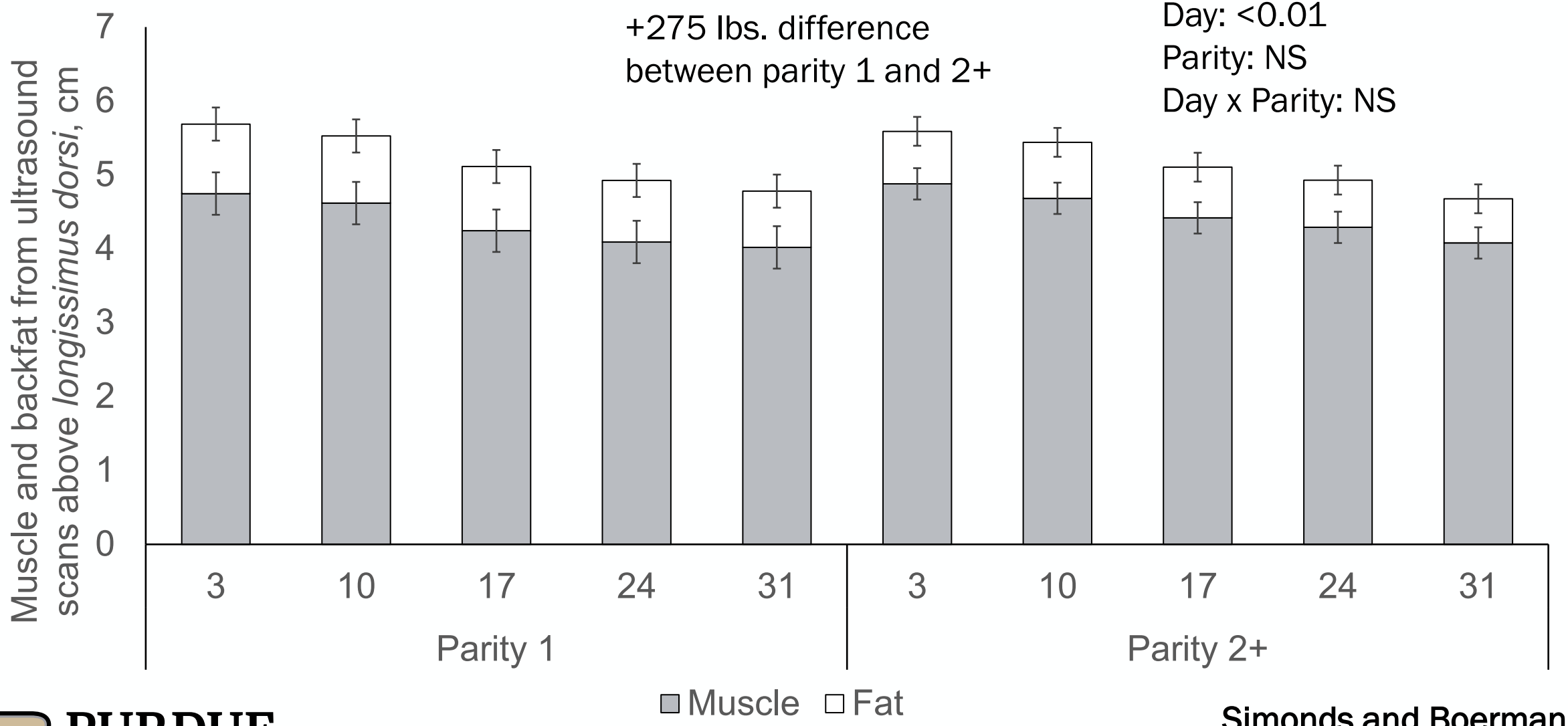


Coombe et al., 2026

PURDUE UNIVERSITY

Parity Effects of Tissue Reserves After Calving

Muscle and Backfat Depth
P-values
Day: <0.01
Parity: NS
Day x Parity: NS



PURDUE UNIVERSITY

Simonds and Boerman, unpublished

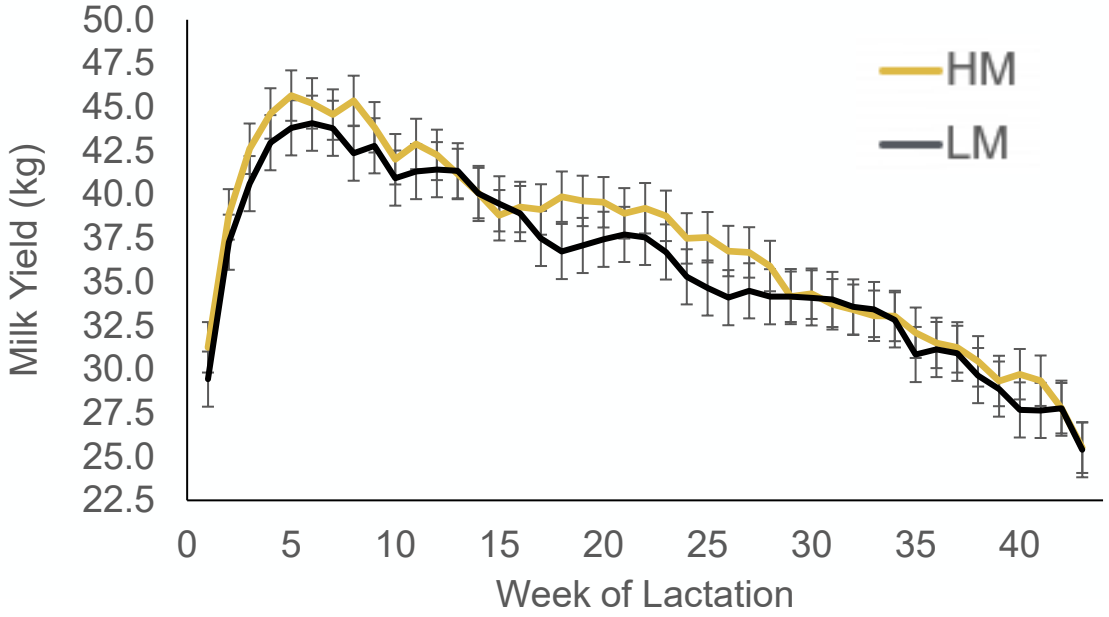
Production and Body Composition Changes Across Lactation

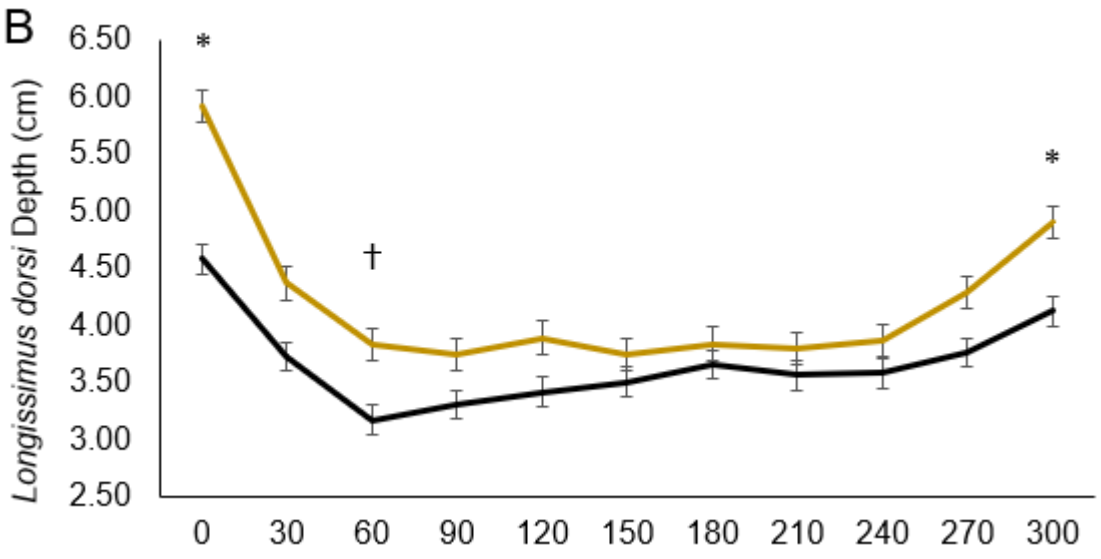
	0-60 DIM		60-240 DIM		240-300 DIM			*P*-values		
Variable	HM	LM	HM	LM	HM	LM	SEM	Muscle Group	Time	Muscle Group×Time
Milk Production										
Milk Yield (kg/d)	43.5	41.0	39.1	37.7	28.8	30.6	1.75	<0.01	<0.01	<0.01
Milk Fat (%)	4.15	3.84	4.21	4.00	4.04	4.11	0.11	0.05	0.50	0.12
Milk Protein (%)	3.03	3.09	3.29	3.31	3.48	3.52	0.05	0.23	<0.01	0.89
Absolute Change										
Δ Body Weight (kg)	-71.4	-45.8	65.1	61.5	26.3	29.5	8.70	0.20	<0.01	0.18
Δ Muscle Depth (cm)	-2.12	-1.42	0.01	0.41	1.04	0.54	0.16	0.09	<0.01	<0.01
Δ Backfat Depth (cm)	-0.15	-0.10	0.15	0.12	0.05	0.04	0.03	0.97	<0.01	0.17
Percent Change										
Δ Body Weight (%)	-9.0	-6.5	9.5	9.8	3.4	4.2	1.21	0.20	<0.01	0.60
Δ Muscle Depth (%)	-35.1	-30.8	2.8	13.9	26.7	15.2	3.85	0.65	<0.01	0.01
Δ Backfat Depth (%)	-28.4	-21.3	45.3	35.6	12.8	9.0	5.58	0.61	<0.01	0.27

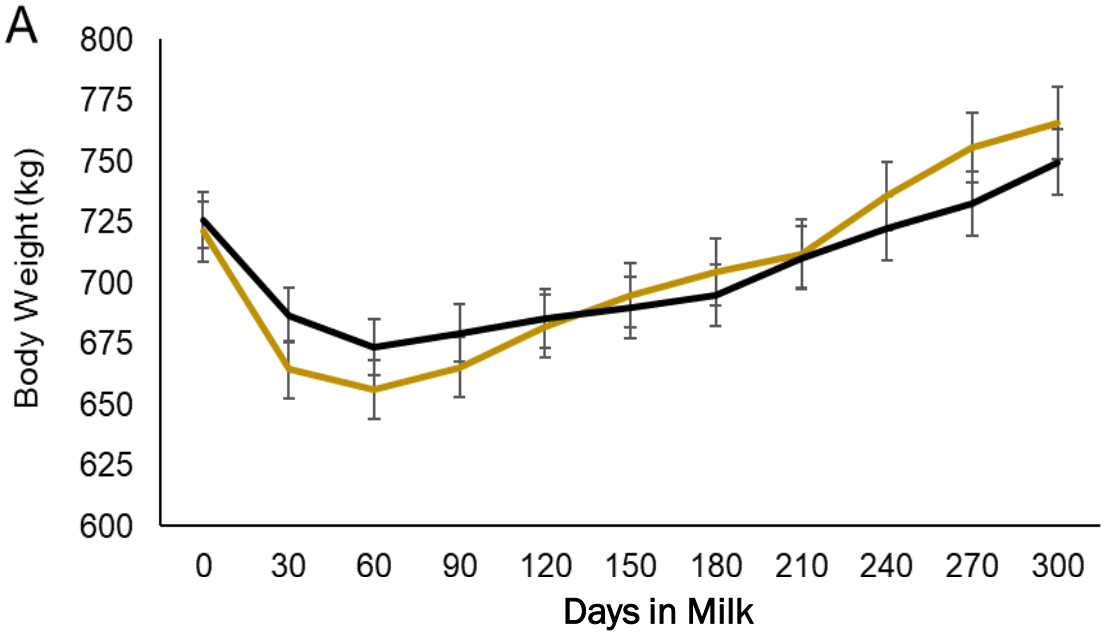
Hanno et al., 2025

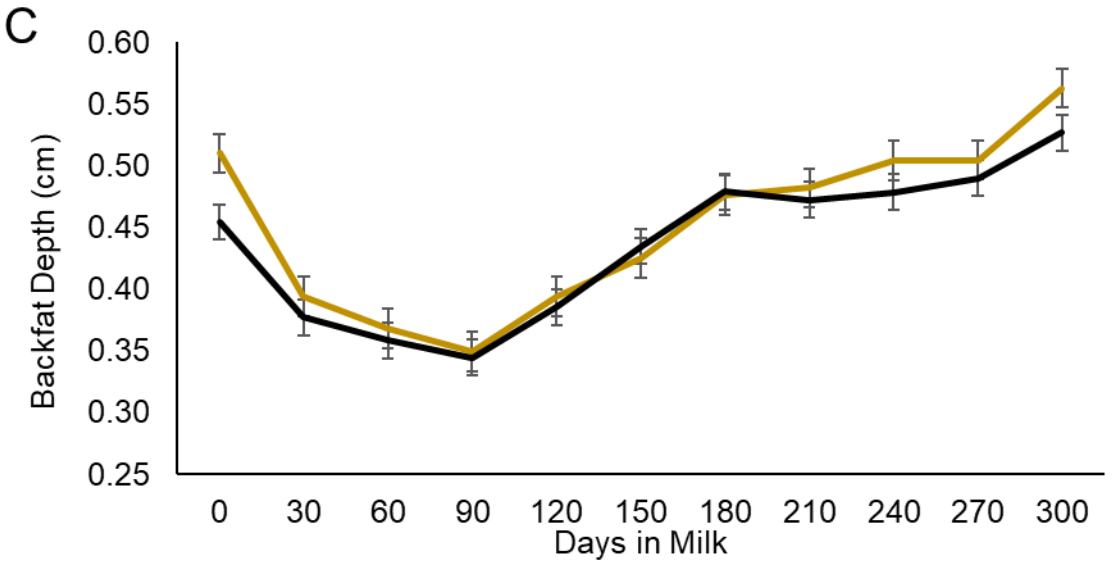
PURDUE UNIVERSITY

Milk Yield and Body Composition



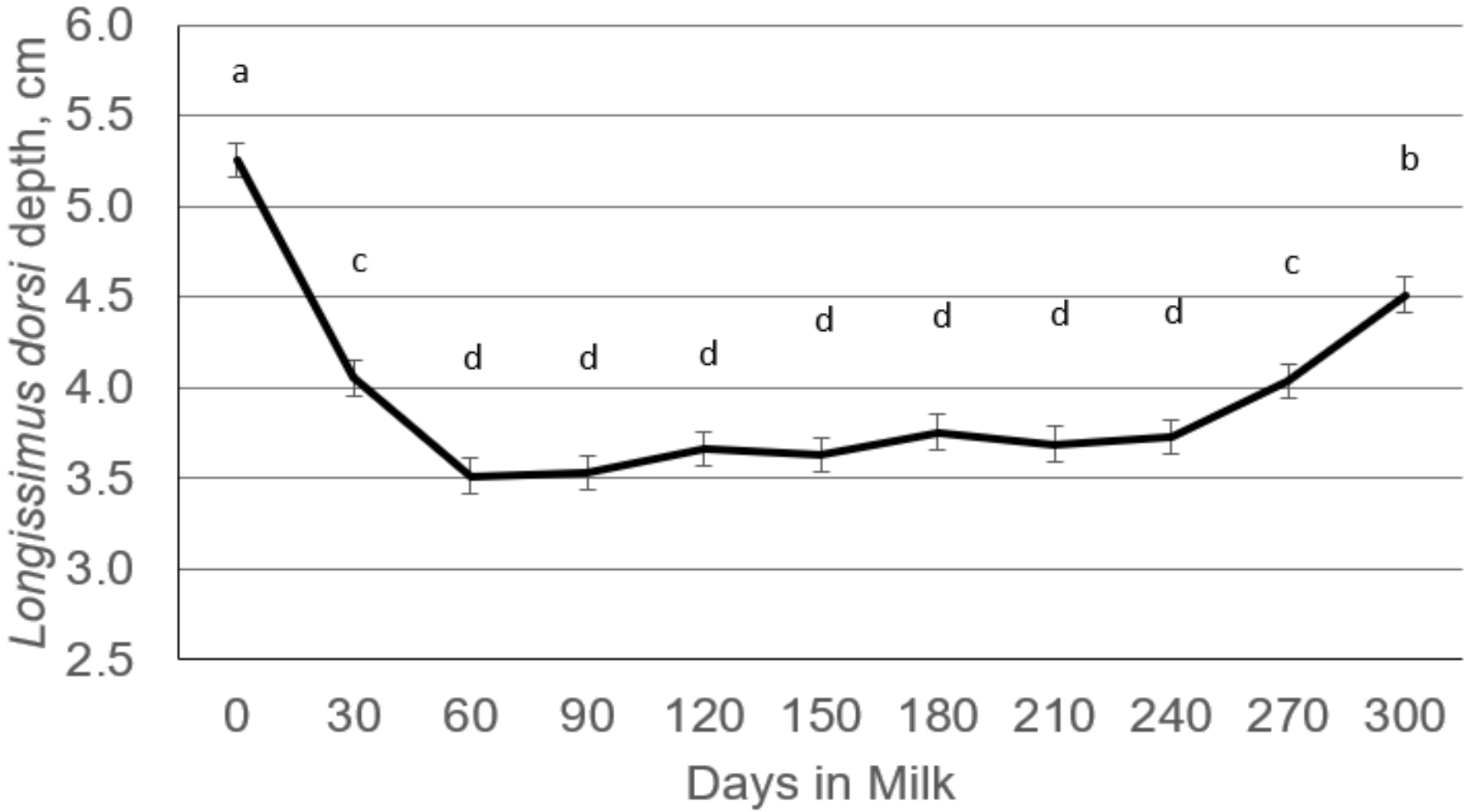






Hanno et al., 2025

Timing of Muscle Depletion and Accretion Throughout Lactation



PURDUE UNIVERSITY

Adapted from Hanno et al., 2025

Tissue Accretion/Depletion Related Metabolites Across Lattation

	7 DIM		150 DIM		300 DIM			*P*-values		
Variable	HM	LM	HM	LM	HM	LM	SEM	Muscle Group	Time	Muscle Group×Time
3-MH (ng/µL)	2.09	1.86	2.16	1.78	0.99	0.97	0.18	0.19	<0.01	0.54
Creatinine (ng/µL)	5.95	5.75	4.43	4.43	5.97	5.80	0.27	0.60	<0.01	0.91
3-MH: Creatinine	0.35	0.33	0.49	0.46	0.17	0.17	0.04	0.60	<0.01	0.89
NEFA (mmol/L)	0.54	0.54	0.13	0.12	0.11	0.12	0.04	0.97	<0.01	0.99
Insulin (µIU/mL)	0.39	0.37	0.40	0.35	0.64	0.62	0.08	0.52	<0.01	0.97

Higher mobilization in early and mid-lactation.
Lowest muscle mass in mid-lactation.
Highest NEFA in early lactation.
Highest insulin in late lactation.

Hanno et al., 2025

PURDUE UNIVERSITY®

Parity Differences Between Heifers and Cows

- Meta-analysis of 27 studies suggests that heifers benefit more from additional MP prepartum compared with cows where only milk protein was impacted with additional MP prepartum (Husnain and Santos, 2019). INTAKE DIFFERENCES, GROWTH REQUIREMENTS

- Tebbe and Weiss (2021), more of a response in multiparous cows with addition MP supplementation postpartum and best response with less fNDF compared with other treatments, not the same for primiparous cows.

- What we have observed from ultrasounding and measuring metabolites of both groups
  - Heifers/primiparous cows → have more muscle, don't lose muscle until right before calving, if they transition ok they may lose a smaller % of muscle compared to multiparous cows. Primiparous cows have higher insulin/glucose concentrations → which may reduce the need for muscle mobilization.

  - Multiparous cows → if they are higher muscle one lactation, the next lactation they will also be high muscle. They end their lactation with less muscle than when they calved. The reduction in muscle depth is related to a reduction in myofiber cross sectional area (primarily Type IIA).

PURDUE UNIVERSITY®

Summary

- Cows lose skeletal muscle postpartum but also can lose muscle prepartum, amount dependent on muscle reserves
  - On average mobilize 30-35% of their muscle depth (not all protein)

- Cows can accrete skeletal muscle at the end of lactation (during the dry period)
  - Ended lactation with less muscle than at calving

- High muscle reserves → higher calf birthweights and more milk yield (most of the time in multiparous cows)
  - Primiparous cows and LM cows don't mobilize muscle until right before calving → therefore no extra AA for calf and no extra AA for mammary gland development

- Prepartum there are parity effects, heifers are not depleting muscle until right before parturition but after calving they deplete muscle similar to cows
  - Primiparous cows have higher insulin concentrations, which may limit some muscle depletion

PURDUE UNIVERSITY®

Take Away Messages

- Considerable variation exists between cows for tissue mobilization, extent of mobilization is dependent on amount of tissue → cows are also depleting muscle when they have mastitis or lameness events, we can see it in ultrasounds

- Muscle mobilization occurs prior to fat mobilization, need for AA at the end of gestation

- We are not accounting for muscle gain/loss during the dry period in transition cows when it comes to MP requirements
  - Cows with little muscle reserves can gain muscle during this time and can draw on it in early lactation
  - Cows with higher muscle reserves use this muscle in late gestation and early lactation → fetus or mammary gland

- We are starting to do work on commercial farms to have larger numbers of cows to look at impacts of muscle mobilization on reproduction, health events, and the role of genetics on muscle amount and extent of muscle mobilization.

PURDUE UNIVERSITY®

Acknowledgements

- Dr. Theresa Casey – Lactation Biologist
- Graduate students on muscle projects:
  - Tabby Hurst
  - Dr. Becca Klopp Briggs
  - Dr. Conor McCabe
  - Kyrstin Gouveia
  - Sam Hanno
  - Madi Simonds
  - Becky Coombe
- Postdocs – Dr. Ary Suarez-Trujillo, Dr. Linda Beckett
- Purdue Dairy Farm Staff and Undergraduate Student Researchers
- USDA – NIFA # 2022-67015-36317
  - Zinpro for providing product
- USDA – NIFA # 2025-67015-44843



PURDUE UNIVERSITY

UF College of Veterinary Medicine
UNIVERSITY of FLORIDA

UF IFAS
UNIVERSITY of FLORIDA

Precision Dairy Management:

Targeted Reproductive Strategies

Ricardo C. Chebel, DVM, MPVM, PhD

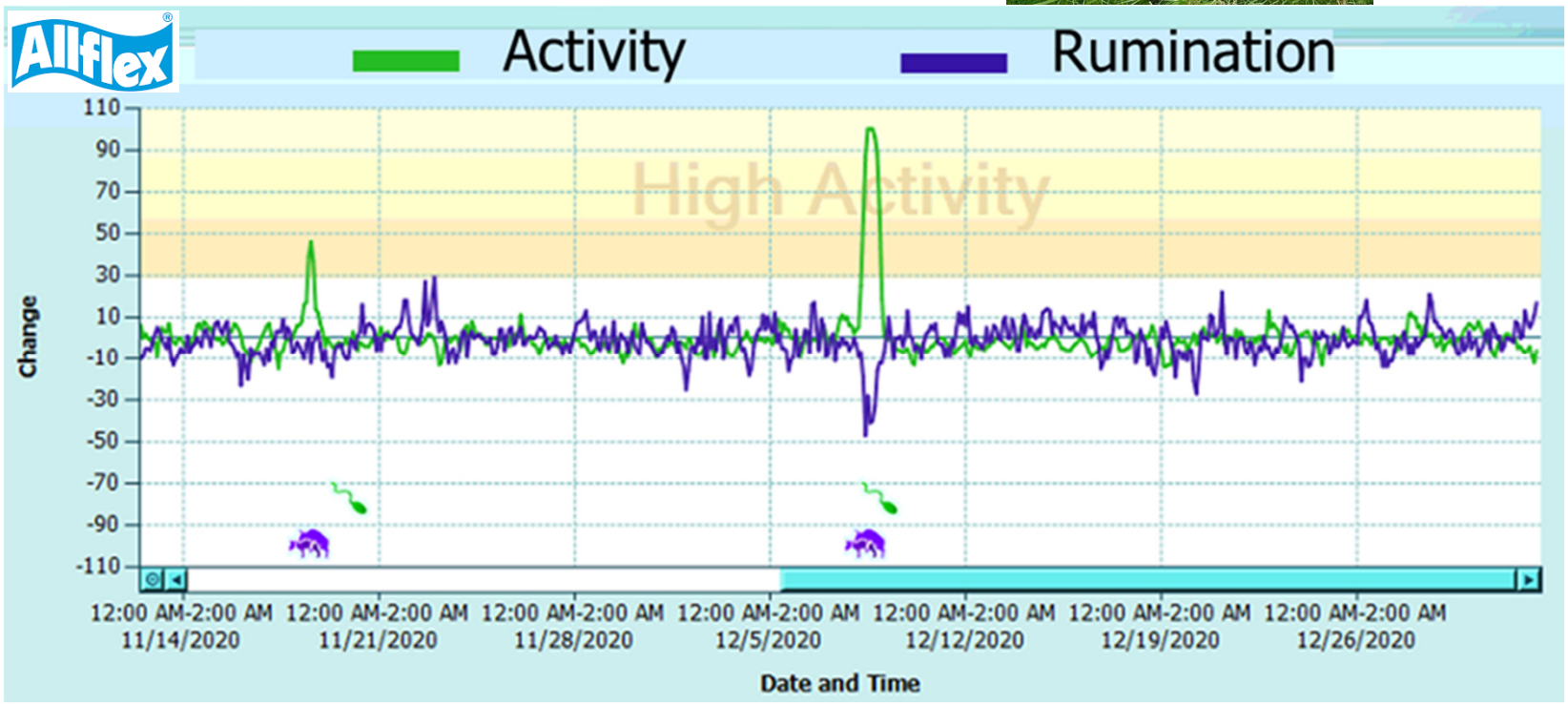
DairyHTE
Dairy Health Technology & Extension

Automated Estrus Detection

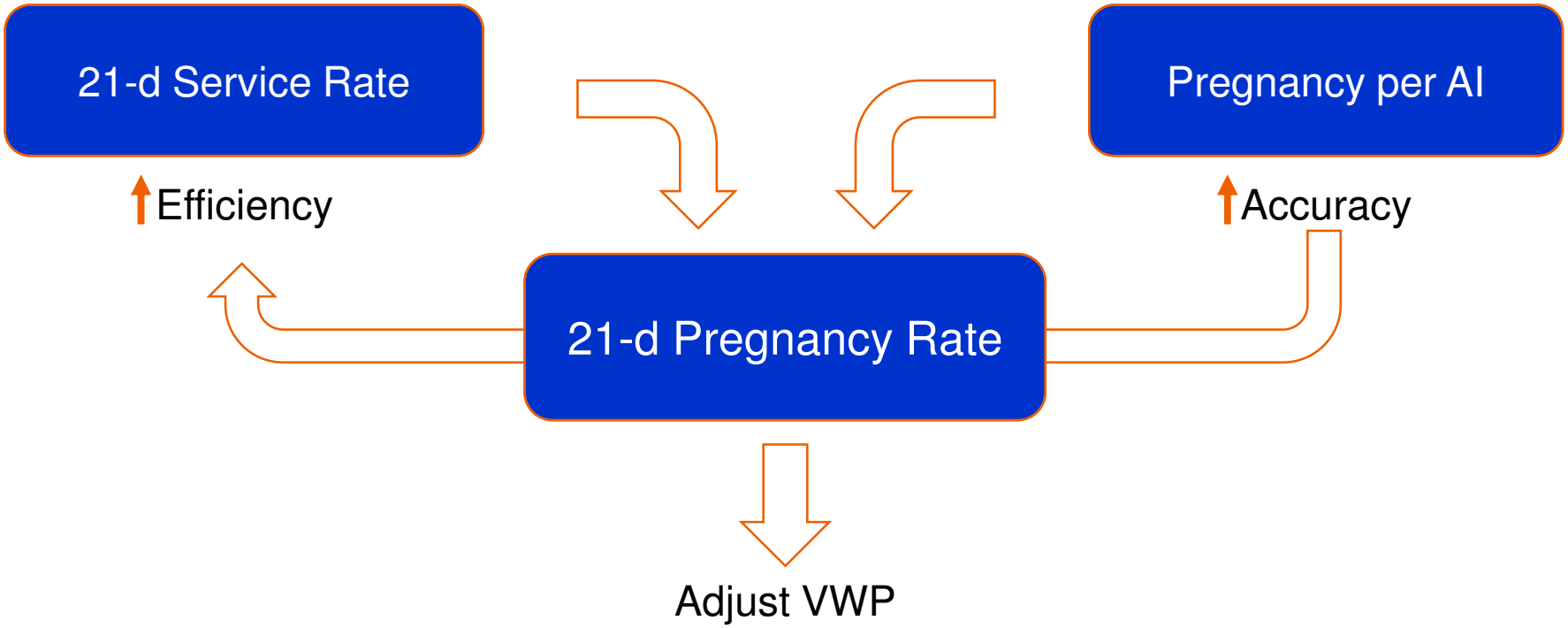
DairyHTE
Dairy Health Technology & Extension







How can AMD help with reproductive management?



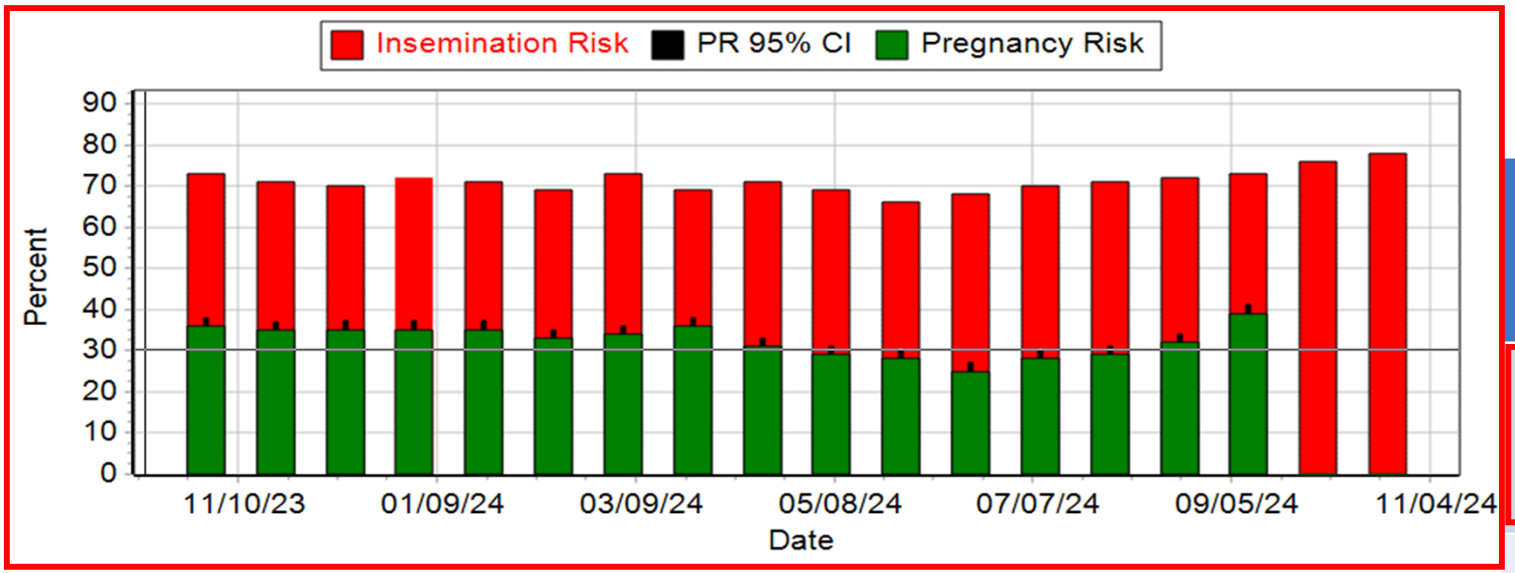
Targeted reproductive management

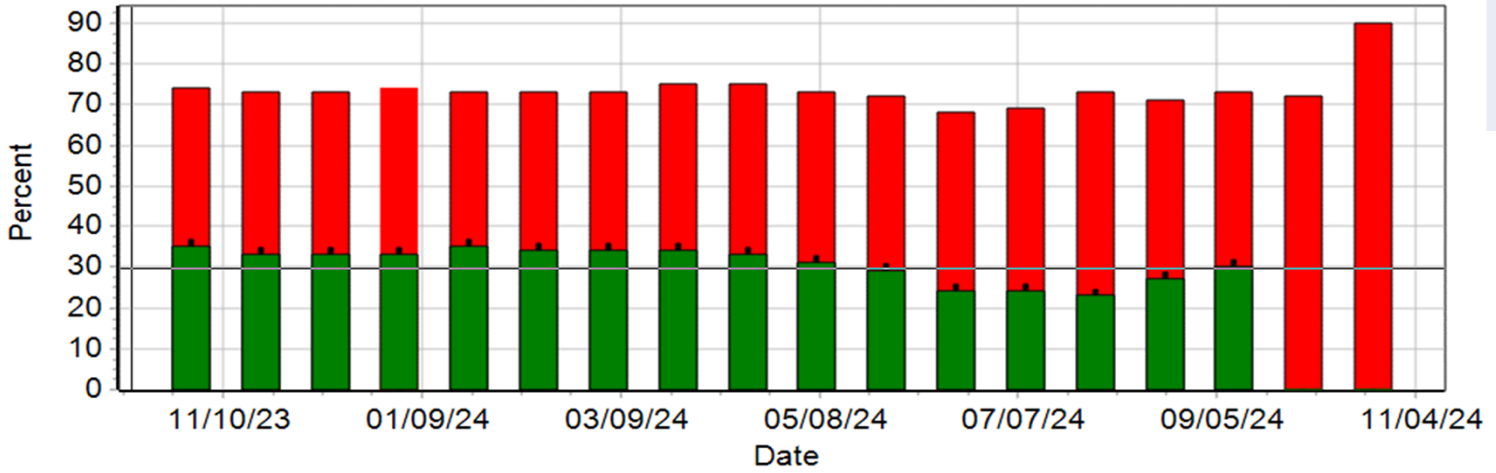
- The benefits of AMD systems depend on: 1. Current reproductive strategy, 2. Current reproductive performance, and 3. Opportunity cost (initial cost and longevity)

(Rutten et al., 2014; Dolecheck et al., 2016; Giordano et al., 2015)

DairyHTE
Dairy Health Technology & Extension

Which Herd has Automated Monitors?





21-d AI rate	21-d PR
71%	33%
73%	31%

DairyHTE
Dairy Health Technology & Extension

What Does the Evidence Say?

AMD Favored

Stevenson et al., 2014

80 vs 90 d

Calving to Pregnancy Interval

Shorter interval from calving to pregnancy for cows managed with AMD vs. Presynch-Ovsynch fixed-time AI protocol

No Difference

Fricke et al., 2014

79 DIM

FTAI vs. AMD from 52 DIM

No difference in calving-to-pregnancy interval: FTAI at 79 DIM vs. AMD-based insemination starting at 52 DIM

Conditional

Burnett et al., 2017

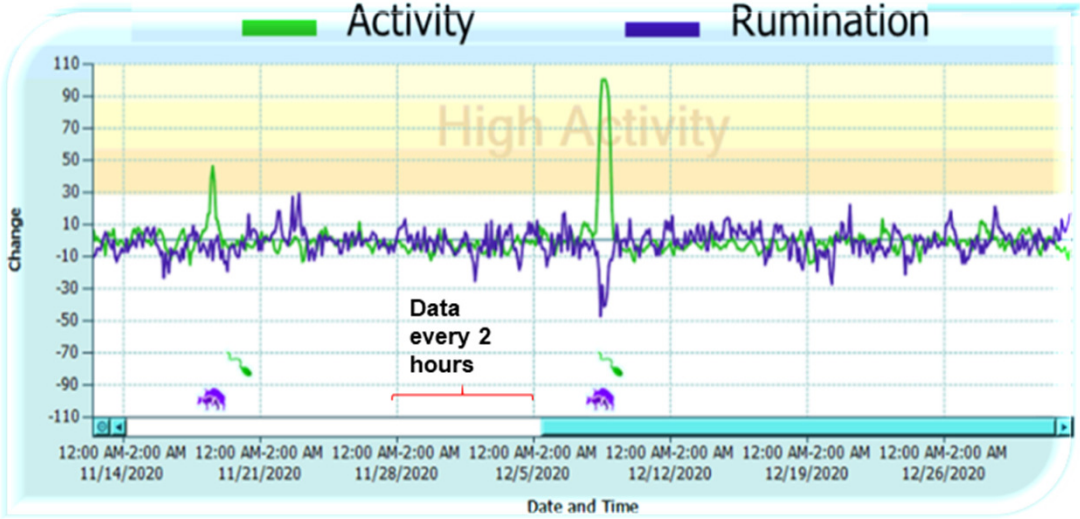
P/AI

Dependent on Cyclic Status

Pregnancy per AI for AMD-detected estrus inseminations was dependent on the cyclic status of the cow

Key Insight: AMD outcomes are not universal — results depend on the reproductive program being replaced

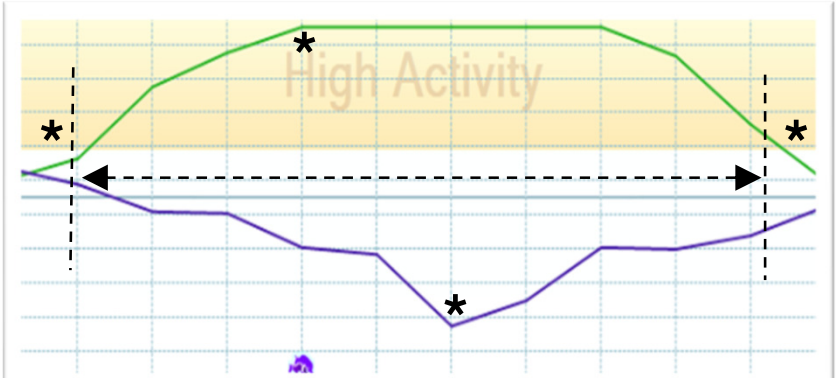
Characteristics of Estrus



www.allflex.global/uk/product/heatime-pro/



www.allflex.global/uk/product/heatime-pro/



Estrus behavior

- Onset of estrus
- Activity peak
- Rumination nadir
- End of estrus
- Duration
- Heat index

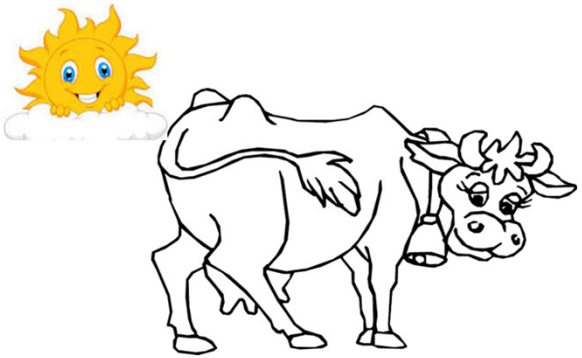
DairyHTE
Dairy Health Technology & Extension

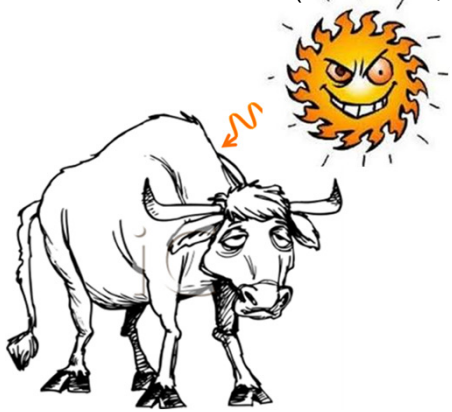
Environment





Mounting activity = 15-fold when housed on dirt (Britt et al., 1989)





⬇Activity = 4.5 vs. 8.6 mounts/evt (Nebel et al., 1997)

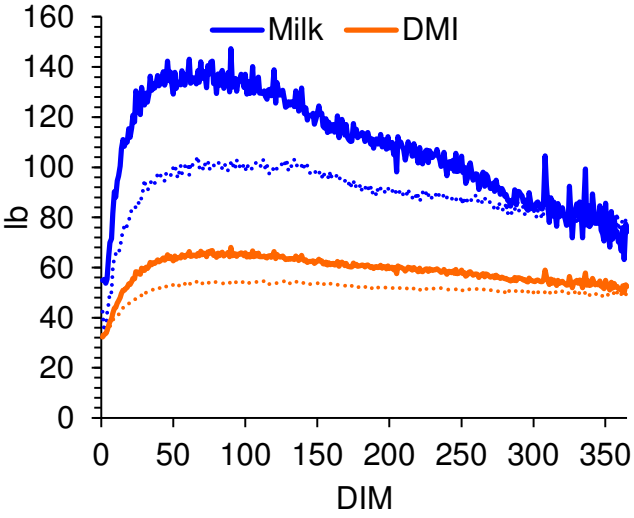
⬇Estrus expression = 6.2 vs. 10.9 h (Mirzaei et al., 2007)

⬆Anestrous & silent ovulations = 78 vs. 54% (Thatcher and Collier, 1986)

⬇Resumption of estrus postpartum (41 DIM) = 45 vs. 55% (Chebel et al., 2025)

DairyHTE
Dairy Health Technology & Extension

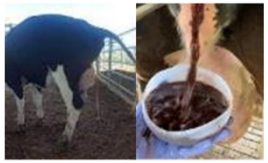
Cow Factors

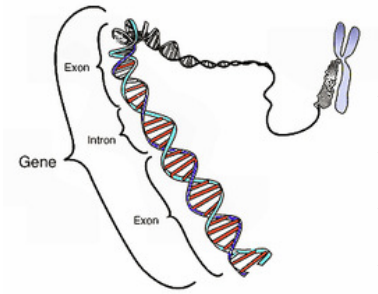


⬇Duration = ~5 vs. 14 h, -2.3 min/kg
⬇Intensity = 1%/kg
⬇Activity = 1.6%/kg

Lopez et al., 2004
López-Gatius et al., 2005
Tippenhauer et al., 2021







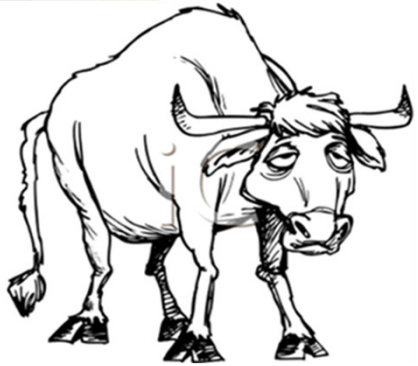
⬆Estradiol = 4.5 vs. 3.8 pg/mL
⬆Resumption = 65 vs. 50%
⬆Duration = 18 vs. 16 h
⬆Intensity = -33.7 vs. -30 min/d

Daughter pregnancy rate

Veronese et al., 2019a,b
Chebel and Veronese, 2020

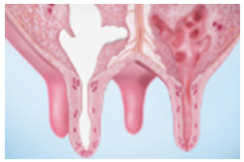


Source: Zinpro

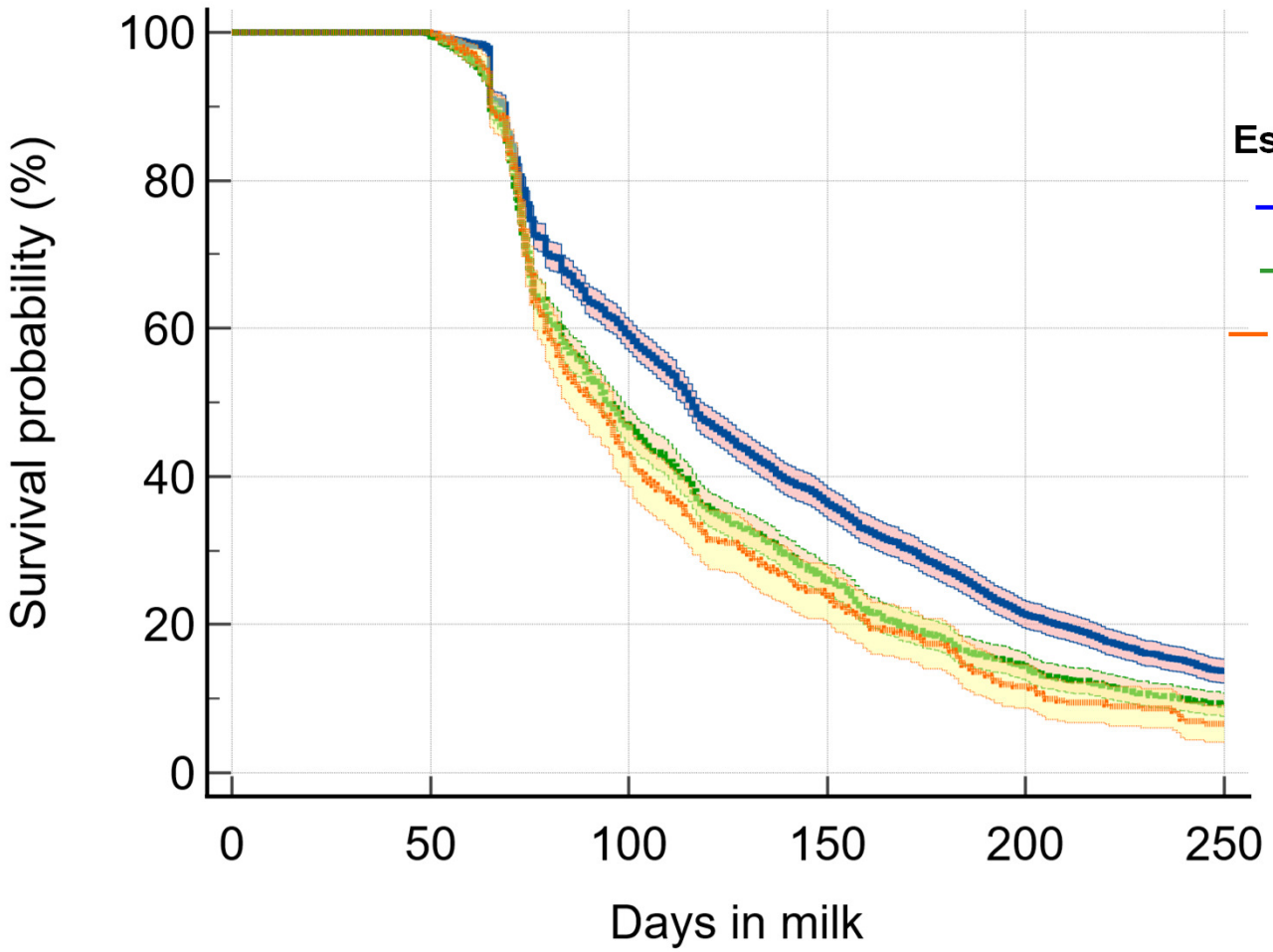


⬇Resumption = 35 vs. 52%
⬇Duration = 16.5 vs. 17.1 h
⬇Intensity = 46 vs. 57%

Chebel et al., 2025



Association between Early Postpartum Estrus and Hazard of Pregnancy



Estrus status	Median days	Censored, %
Anestrus	116	26.2
1 Estrus	95	17.6
≥2 Estruses	90	15.3

Chebel et al. (JDS https://doi.org/10.3168/jds.2025-27175)

DairyHTE
Dairy Health Technology & Extension

Predicted Fertility Applied to Reproductive Management

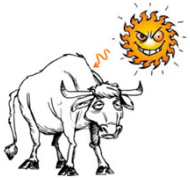










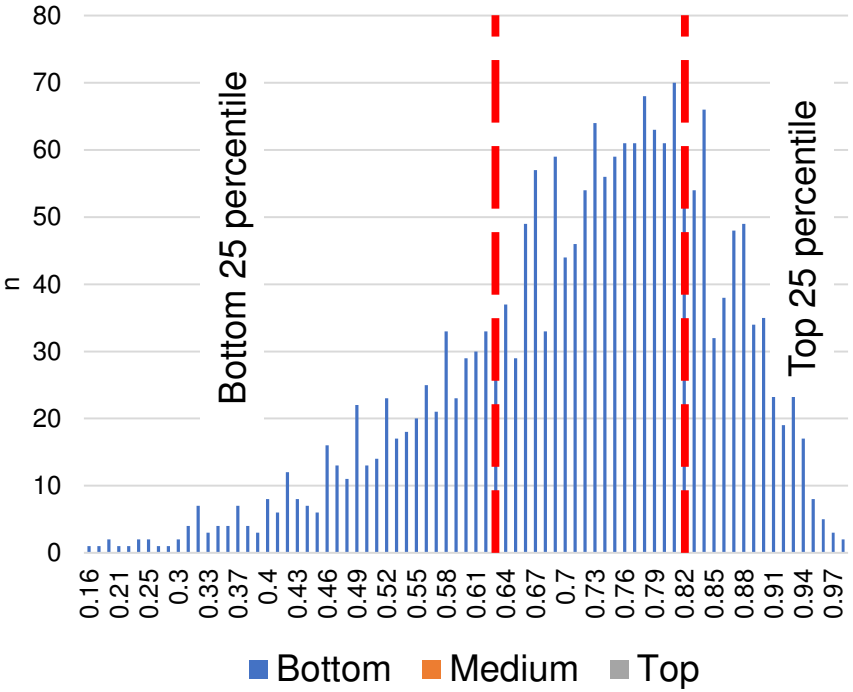


- Training Set to Predict High Fertility (Preg 1st service vs. Open to 3 services):
  - Data from “Exp3-Herd1” and “Exp4-Herd3” (highest AUC, large sample size)
  - Models Developed:
    - PredModel1 (n = 1,415): lactation number, calf sex, calving problems, uterine/non-uterine diseases, estrus events ≤ 41 DIM, gDPR, milk yield, and days with THI ≥ 68
    - PredModel2 (n = 862): all variables included in PredModel1 + rumination nadir & max heat index
- Testing & Classification:
  - Test set: “Exp1-Herd1”, “Exp2-Herd1”, “Exp3-Herd2” (n = 1,993)
  - Classification: Bottom (10th/25th percentiles), Moderate, Top (25th/10th percentiles)
- Outcome Analysis:
  - Time to pregnancy and censoring compared across fertility groups

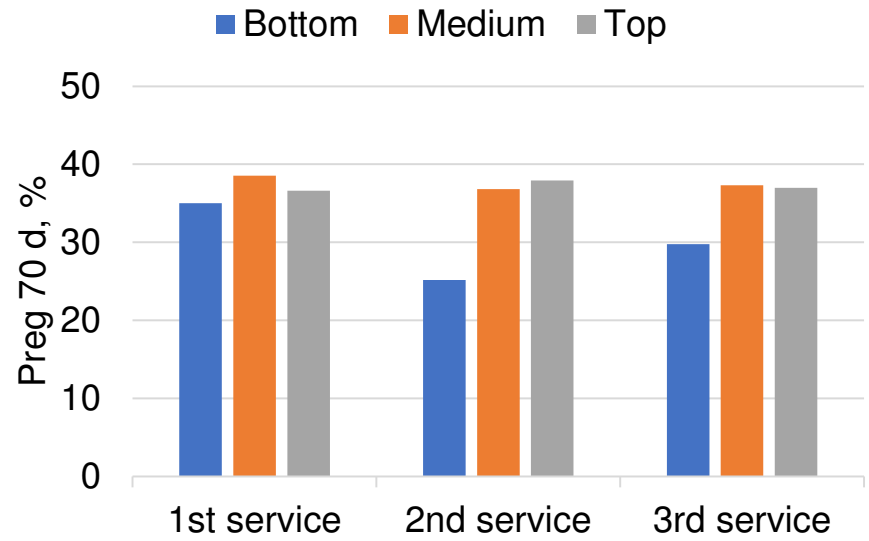
Chebel et al. (JDS https://doi.org/10.3168/jds.2025-27175)

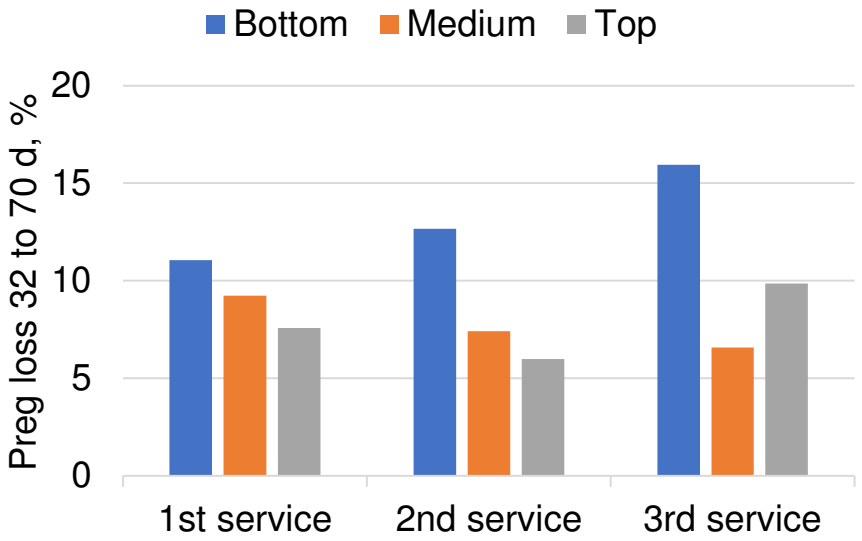
DairyHTE
Dairy Health Technology & Extension

Predicted Fertility Applied to Reproductive Management



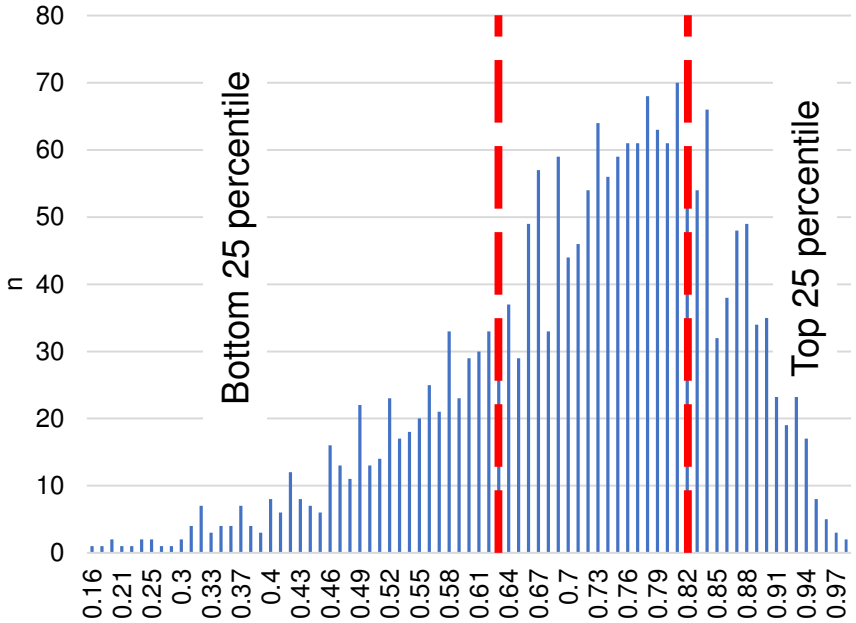
	Bottom	Medium	Top
Male, %	52.2	43.5	31.4
Uterine disease, %	30.6	11.3	7.5
Estrus ≤ 41 DIM	0.24	0.56	0.89
gDPR	-0.69	0.85	2.29
4 wk milk, kg	38.6	38.1	36.8

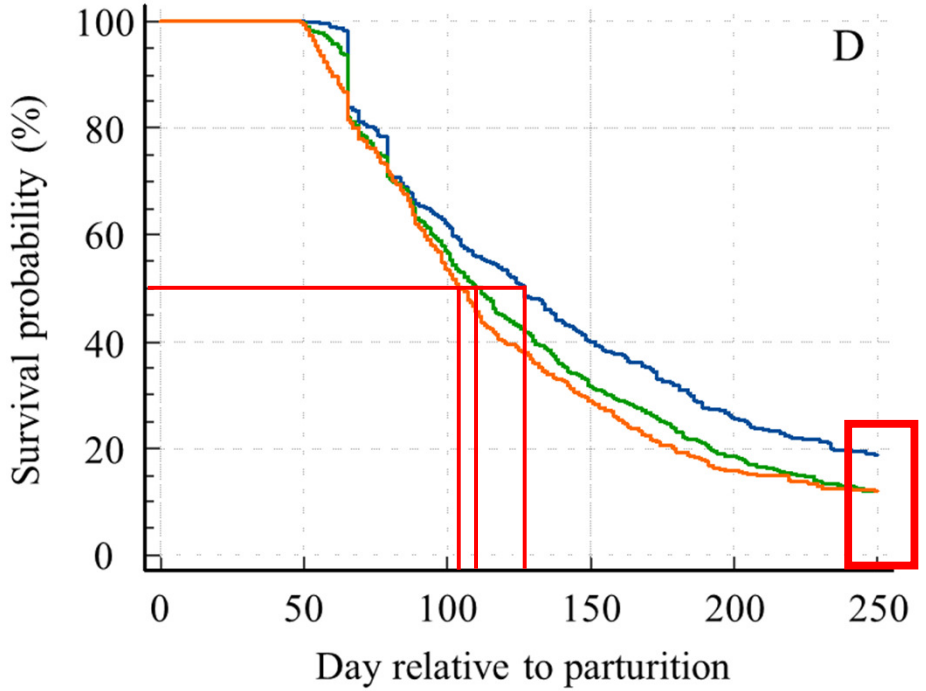




Chebel et al. (JDS https://doi.org/10.3168/jds.2025-27175)

Predicted Fertility Applied to Reproductive Management





Class	Median days
Bottom	127
Medium	111
Top	104

Possible use of such information:

- Adjustment of voluntary waiting period
- Selection of semen

NOT an option for culling policies

Chebel et al. (JDS https://doi.org/10.3168/jds.2025-27175)

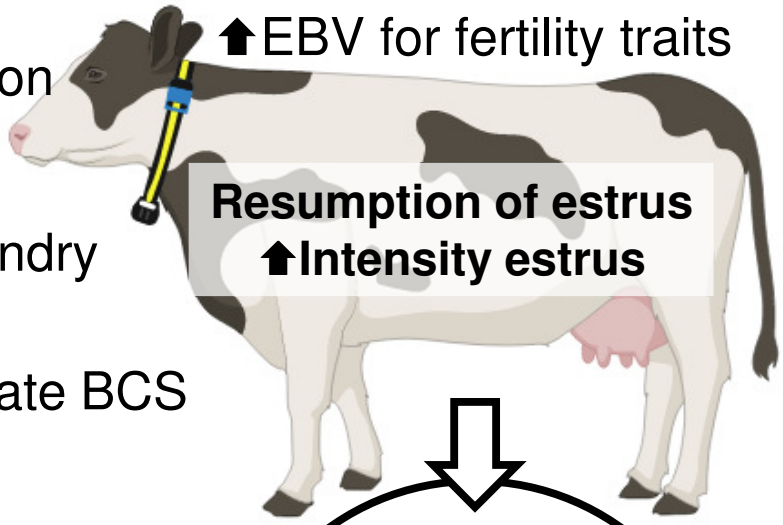
DairyHTE
Dairy Health Technology & Extension

Proper nutrition

Proper husbandry

Adequate BCS

⬆EBV for fertility traits



Resumption of estrus
⬆Intensity estrus

⬇Morbidity

- Uterine disease
- Lameness
- Metabolic disease
- Mastitis

Targeted reproductive management

Tailored hormonal therapy
⬆ Reliance on estrus
⬇ Handling
⬇ Labor
Faster DNB/culling decisions

DairyHTE
Dairy Health Technology & Extension

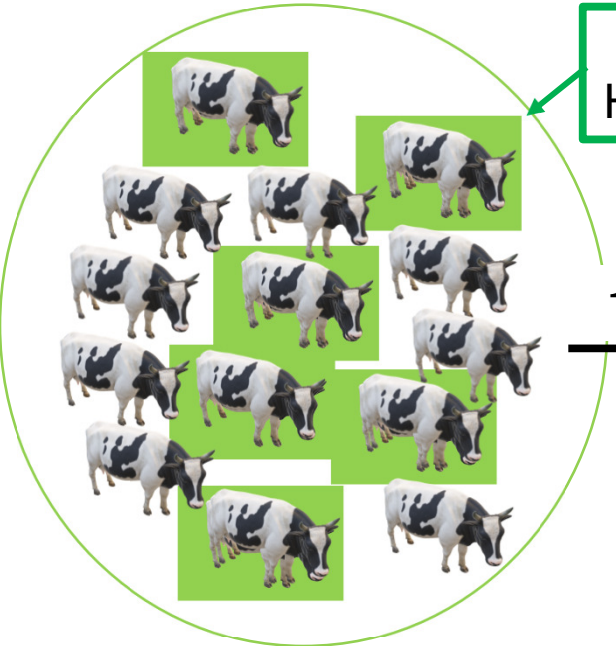
Traditional Reproductive Management



1st AI → 100% TAI (7 handlings) → 30 to 60% re-AI in estrus → 40 to 70% TAI (2 to 3 handlings)

45%+ P/AI **30%+ P/AI**

Targeted Reproductive Management



Resumed cyclicity
High intensity estrus
⬆GDPR
⬇Morbidity

1st AI → TAI as needed
AI in estrus when possible → >60% re-AI in estrus → <40% TAI

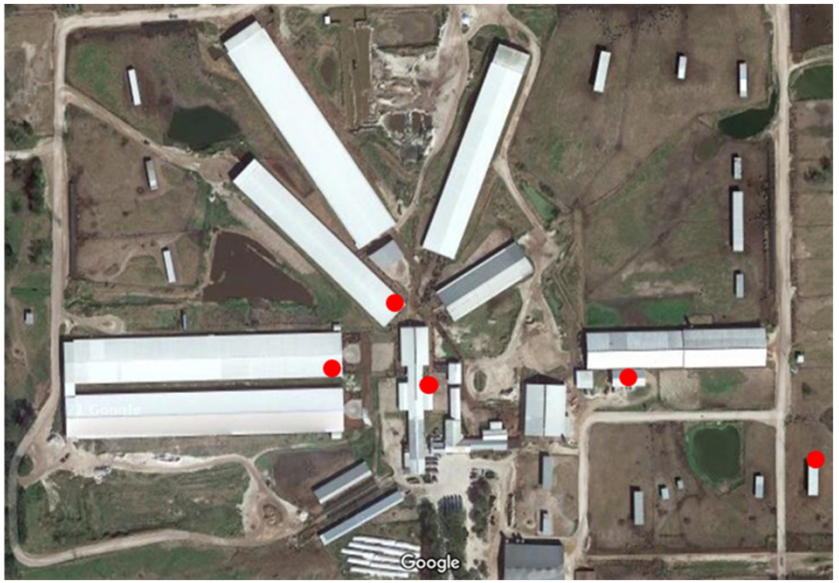
DairyHTE
Dairy Health Technology & Extension

Targeted Reproductive Management

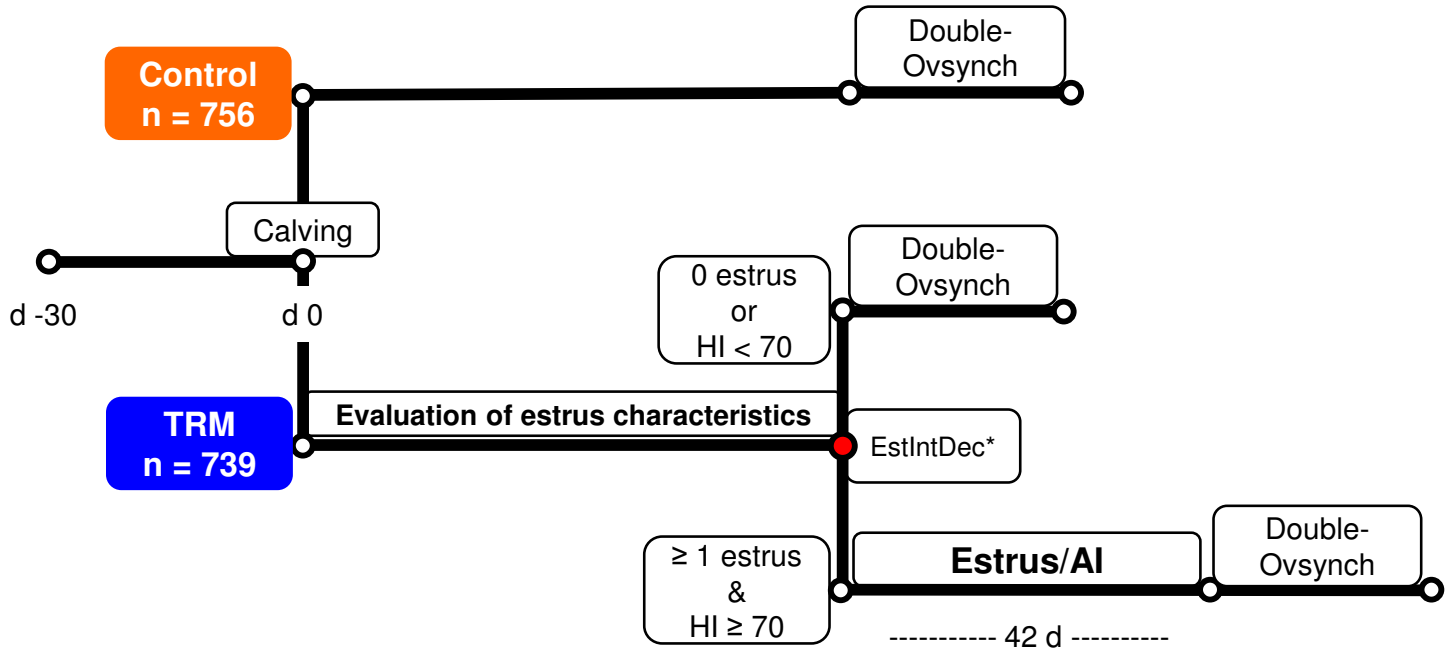
Herd characteristics before the start of the experiment

Variables	Farm A	Farm B
Average number of lactating cows	3,008	5,571
Breed	Holstein	Holstein
Housing type	Naturally-ventilated, freestall barn	Tunnel-ventilated, freestall barn
Rolling herd average 305-d milk yield, lb	26,864	28,519
Pregnancy to first AI, %	49 (P) & 51 (M)	35





Targeted Reproductive Management
(1st Insemination)



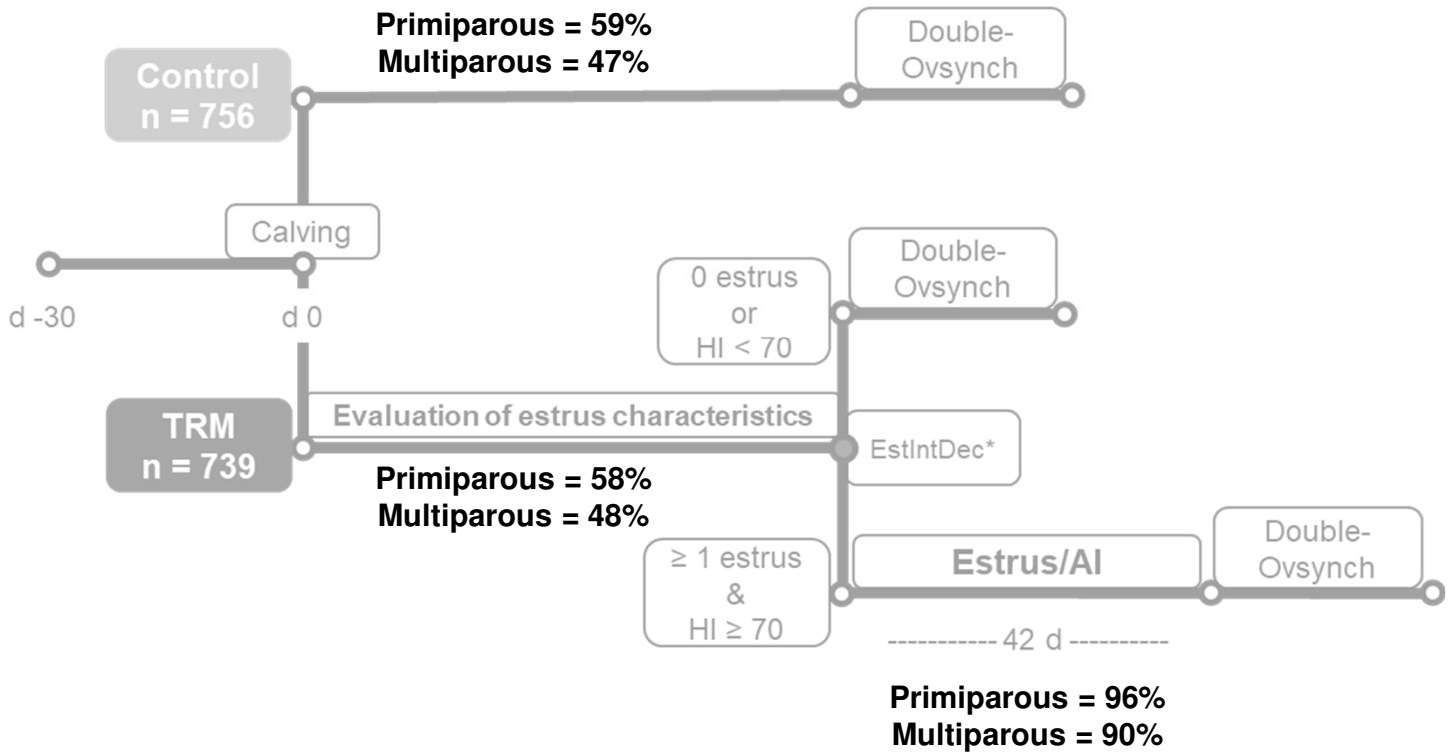
*EstIntDec

Estrus intensity decision, DIM	Primiparous	Multiparous
Farm A	54	40
Farm B	55	41

Control DIM at fixed time AI	Primiparous	Multiparous
Farm A	79	65
Farm B	83	69

Gonzalez et al., 2023 (*J Dairy Sci. 106:5788-5804*)

Targeted Reproductive Management
(1st Insemination)



DIM at 1st A:

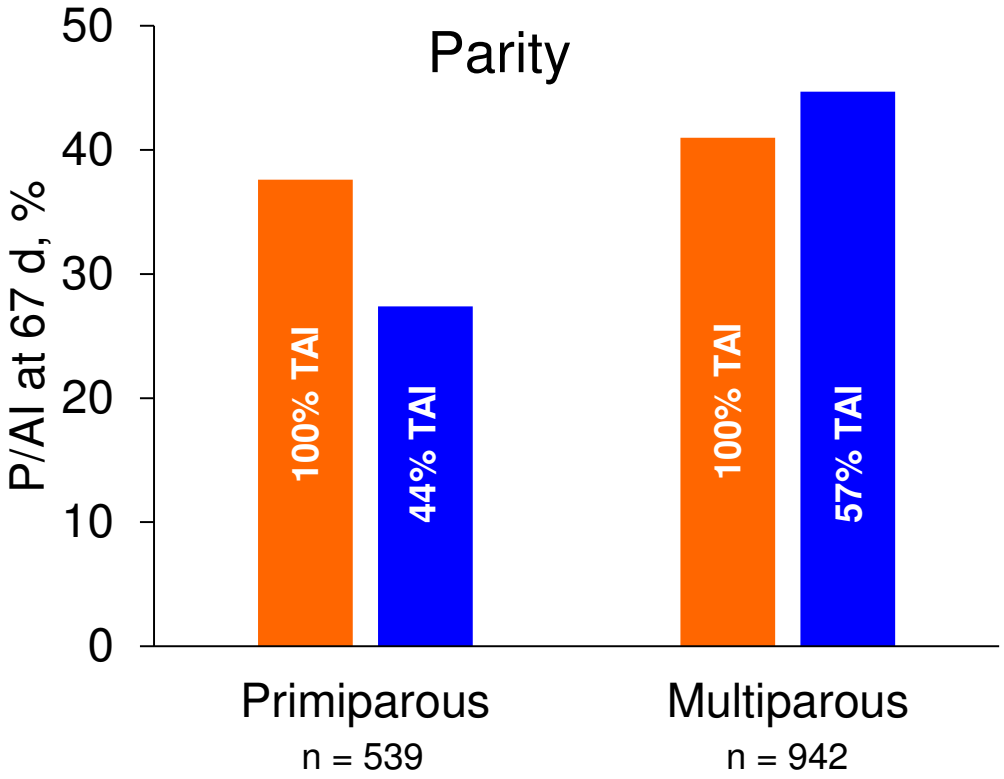
71.8 ± 0.3

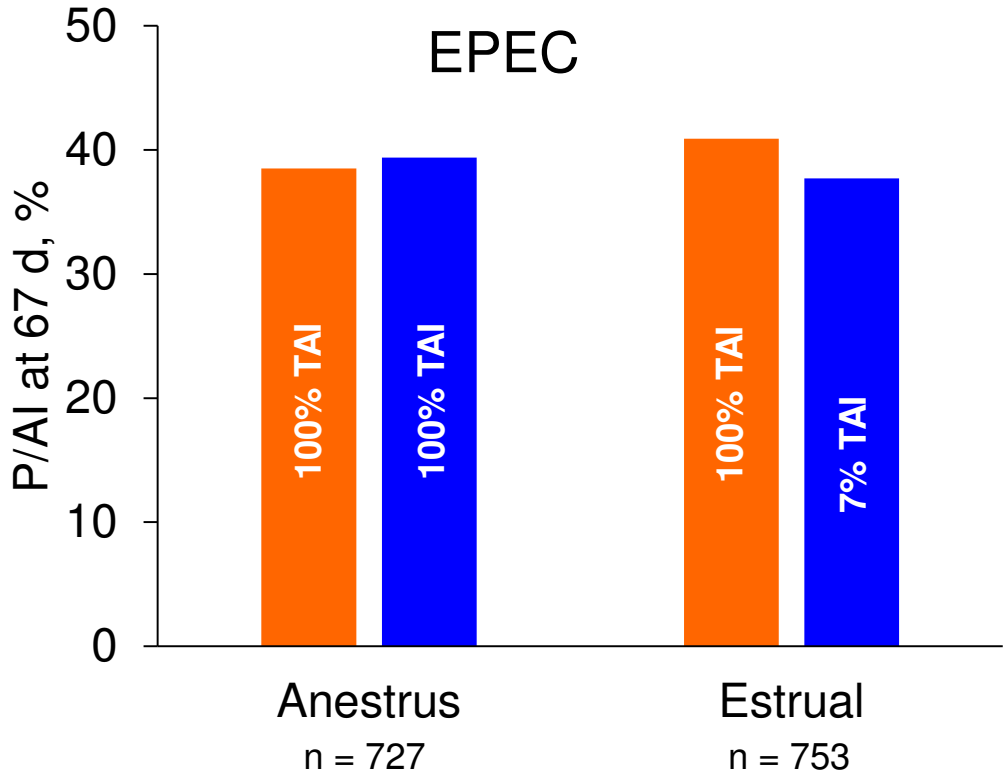
72.2 ± 0.5

Gonzalez et al., 2023 (*J Dairy Sci. 106:5788-5804*)

DairyHTE
Dairy Health Technology & Extension

Effect of Treatment on Pregnancy to 1st insemination





TRT – $P = 0.15$
Parity – $P < 0.01$
TRT x Parity – $P < 0.01$
EPEC – $P = 0.72$
TRT x EPEC – $P = 0.63$

Control
TRM

Gonzalez et al., 2023 (*J Dairy Sci. 106:5788-5804*)

DairyHTE
Dairy Health Technology & Extension

Targeted Reproductive Management

TAI Favored

Fricke et al., 2014

Pregnancy to first AI

38% vs 30%

No Difference

Stangaferro et al., 2018

Pregnancy to first AI

41% vs 35%

TAI Favored

Sitko et al., 2023

Pregnancy to first AI

55% vs 47%

TAI Favored

Chebel et al., 2025

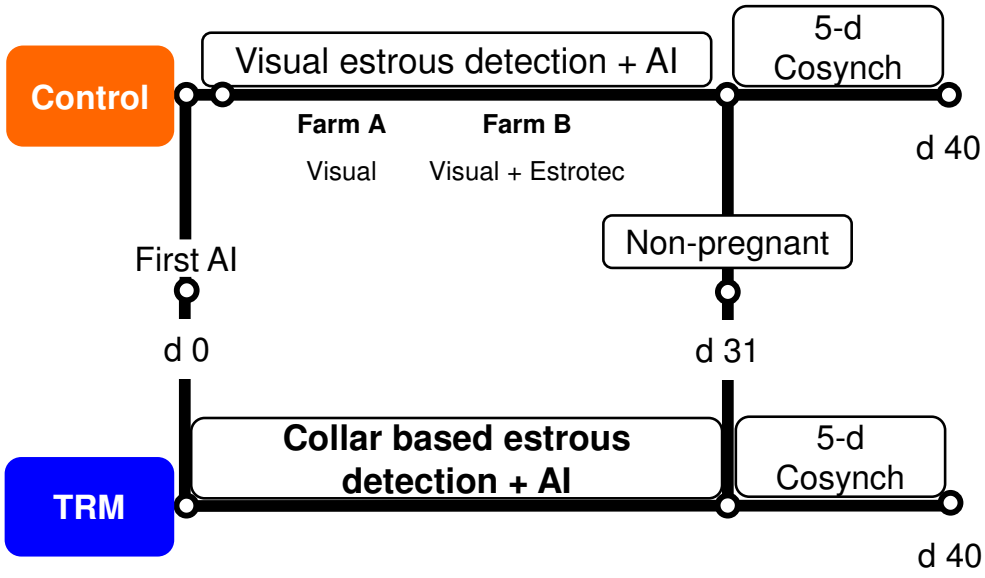
Pregnancy to first AI

54% vs 50%

Key Insight: Generally, 100% timed AI yields 1st AI pregnancy ~6 percentage points ↑

DairyHTE
Dairy Health Technology & Extension

Targeted Reproductive Management
(Re-insemination)

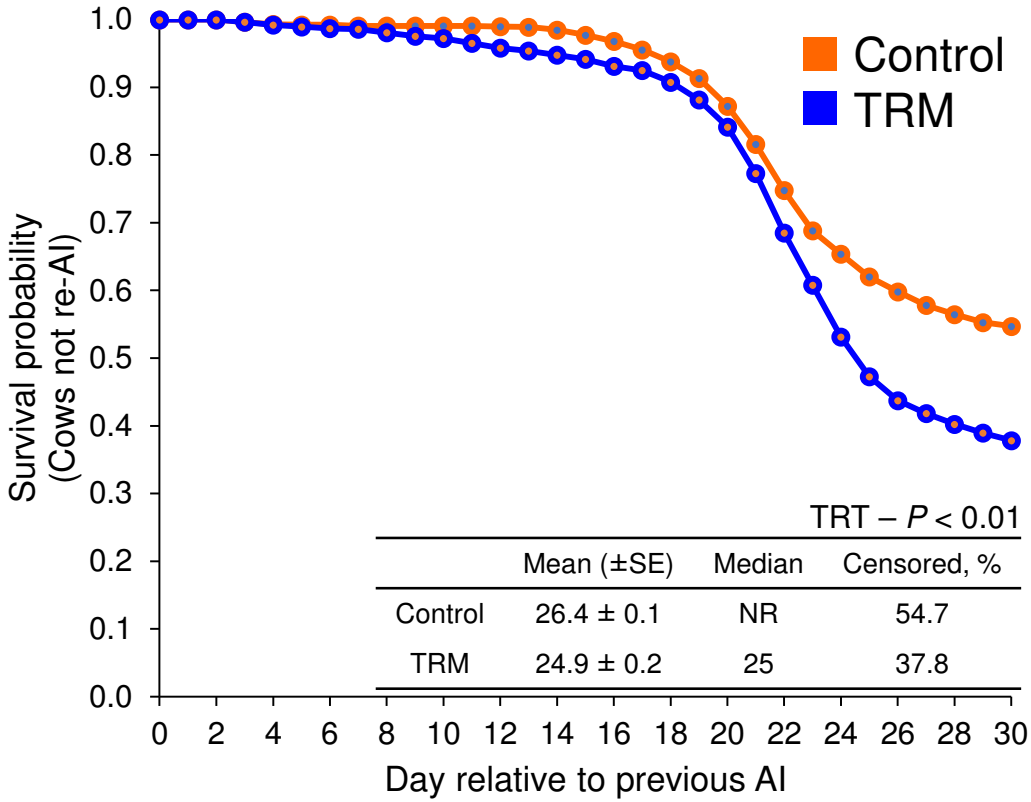


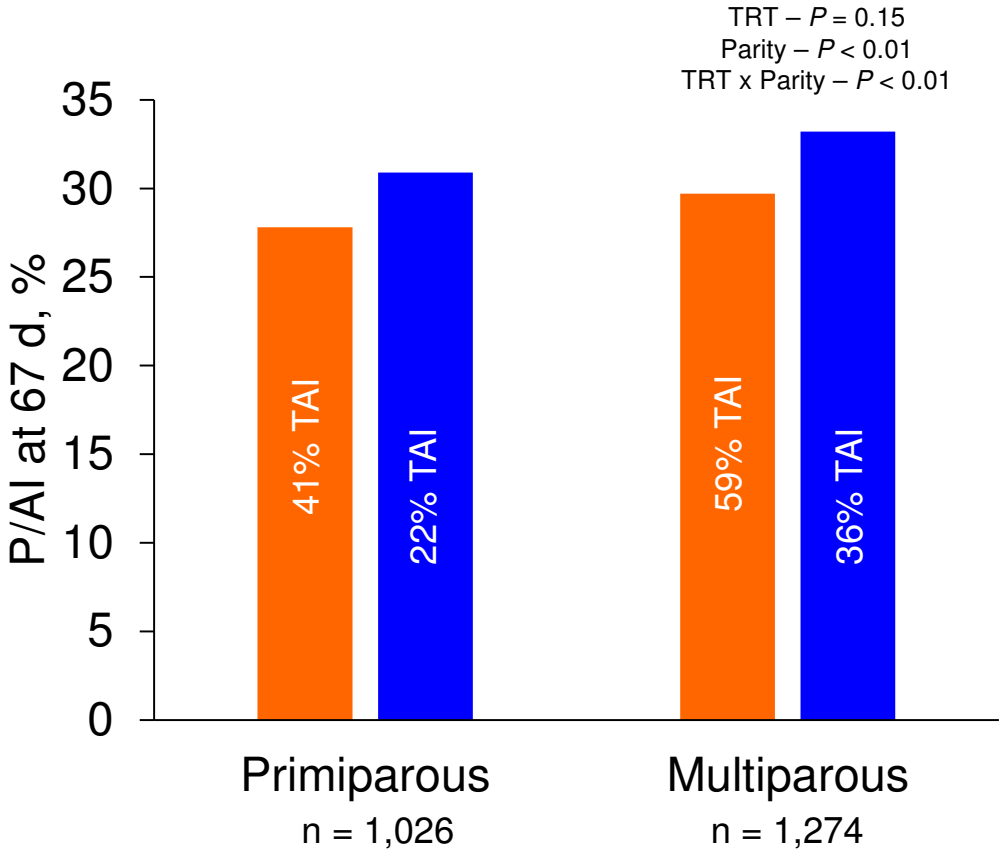


Gonzalez et al., 2023 (*J Dairy Sci. 106:5788-5804*)

DairyHTE
Dairy Health Technology & Extension

Effect of Treatment on Hazard of Re-Insemination and Pregnancy to Re-Insemination

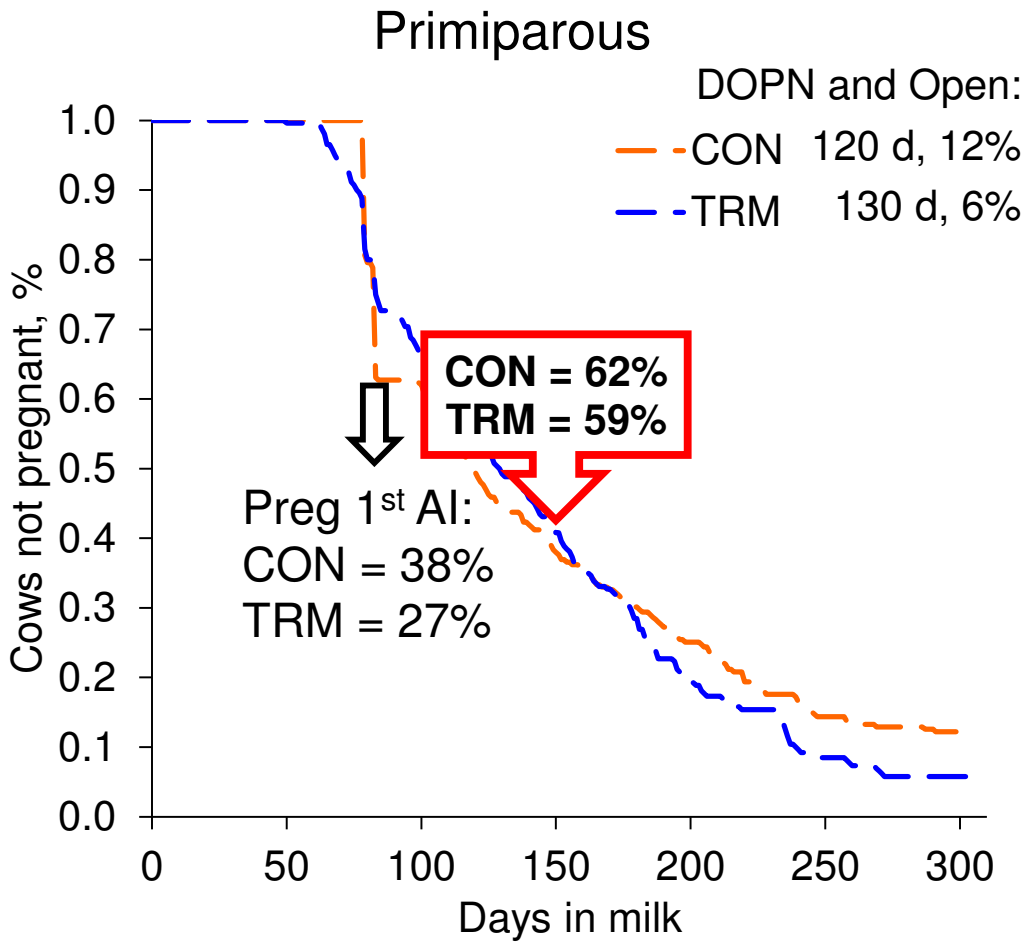


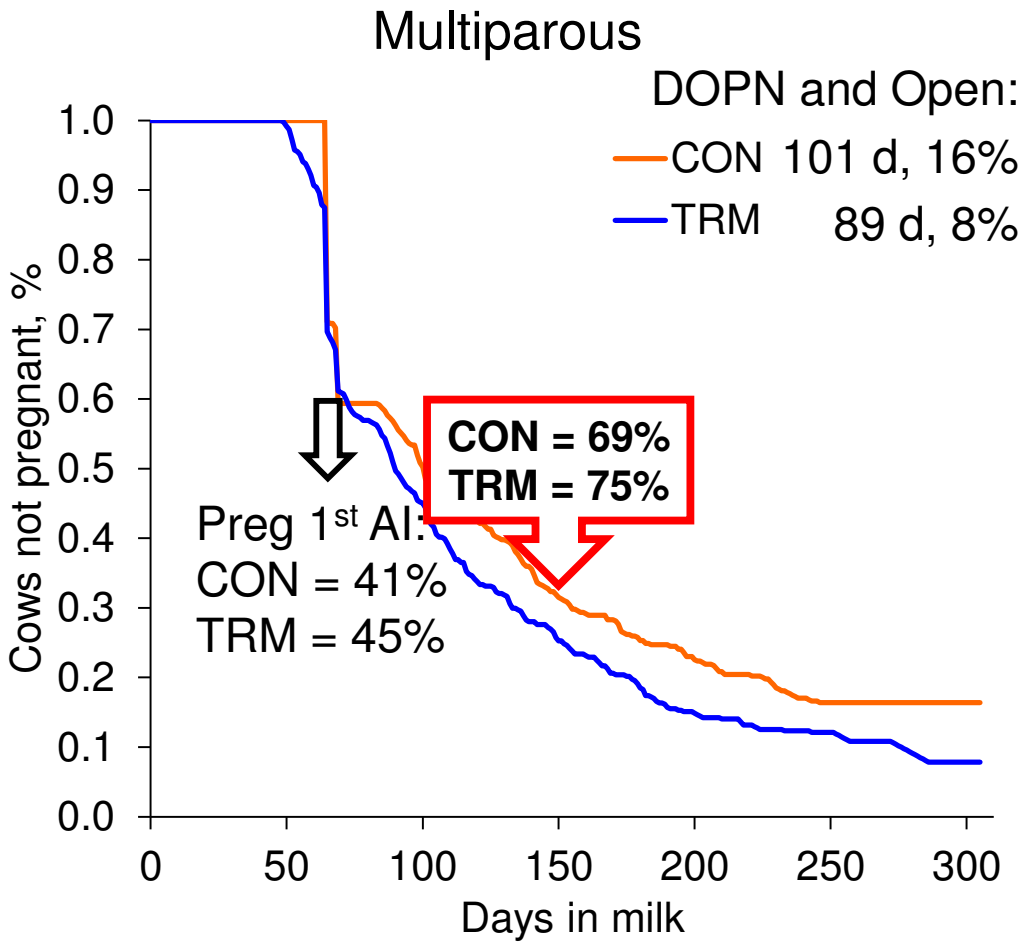


Gonzalez et al., 2023 (*J Dairy Sci. 106:5788-5804*)

DairyHTE
Dairy Health Technology & Extension

Effect of Treatment on Pregnancy Rates





Gonzalez et al., 2023 (*J Dairy Sci. 106:5788-5804*)

DairyHTE
Dairy Health Technology & Extension

Targeted Reproductive Management

DairyHTE
Dairy Health Technology & Extension

TAI Favored

Fricke et al., 2014

Pregnancy to first AI

38% vs 30%

No Difference

Stangaferro et al., 2018

Pregnancy to first AI

41% vs 35%

TAI Favored

Sitko et al., 2023

Pregnancy to first AI

55% vs 47%

TAI Favored

Chebel et al., 2025

Pregnancy to first AI

54% vs 50%

Key Insight: Generally, 100% timed AI yields 1st AI pregnancy ~6 percentage points ↑

No Difference

Median days open

103 vs 102

Pregnant by 150 DIM

66% vs 68%

No Difference

Median days open

90 vs 96

Pregnant by 150 DIM

75% vs 71%

No Difference

Median days open

87 vs 85

Pregnant by 150 DIM

76% vs 78%

Conditional

Median days open

76 vs 90

Pregnant by 150 DIM

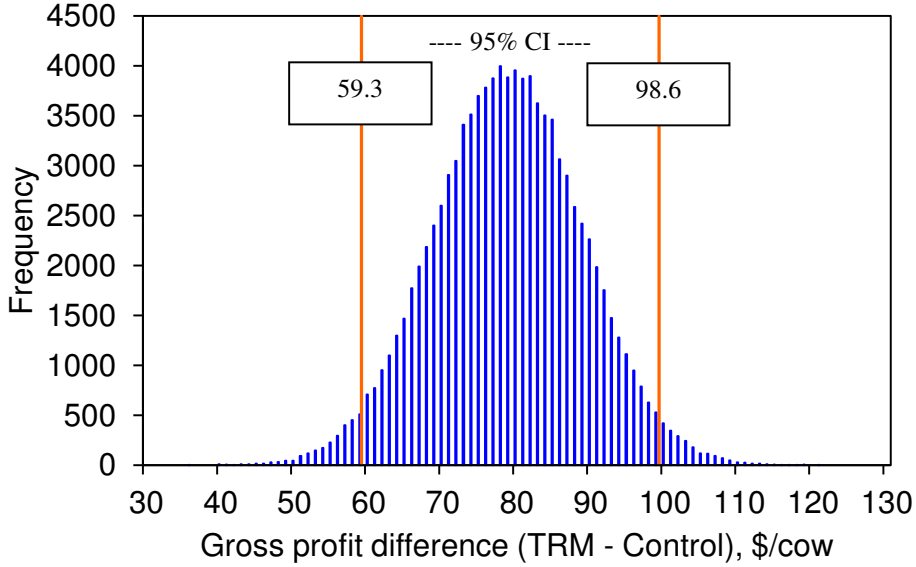
80% vs 79%

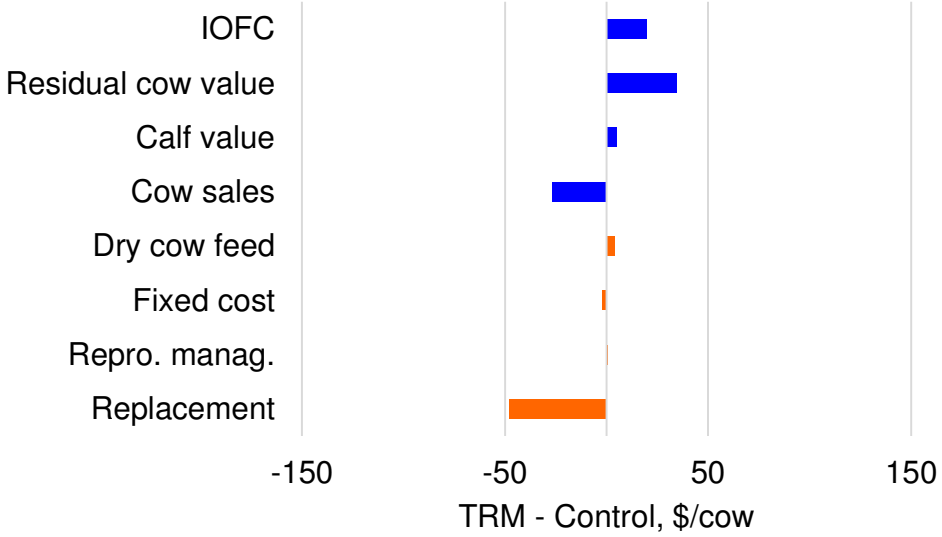
Key Insight: Overwhelmingly, ↓ P/AI to 1st AI is overcome by 150 DIM

Effect of Treatment on Profitability

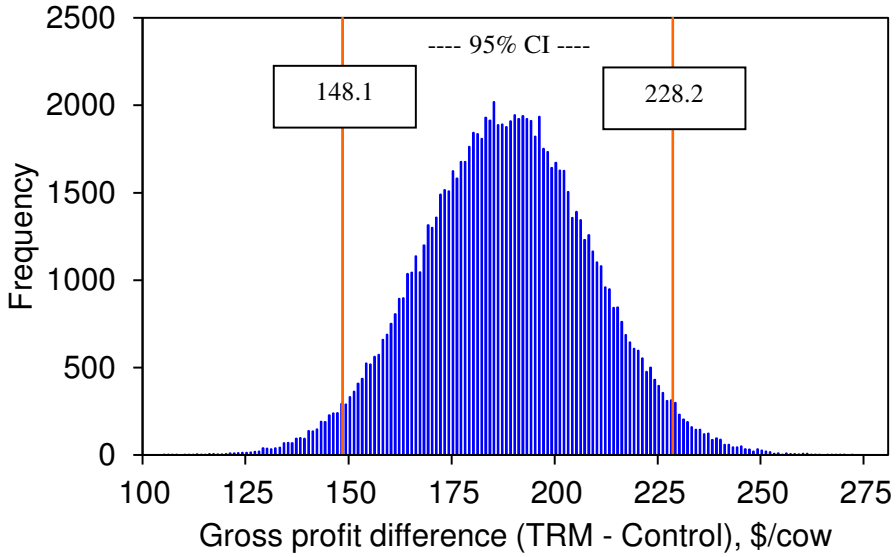
DairyHTE
Dairy Health Technology & Extension

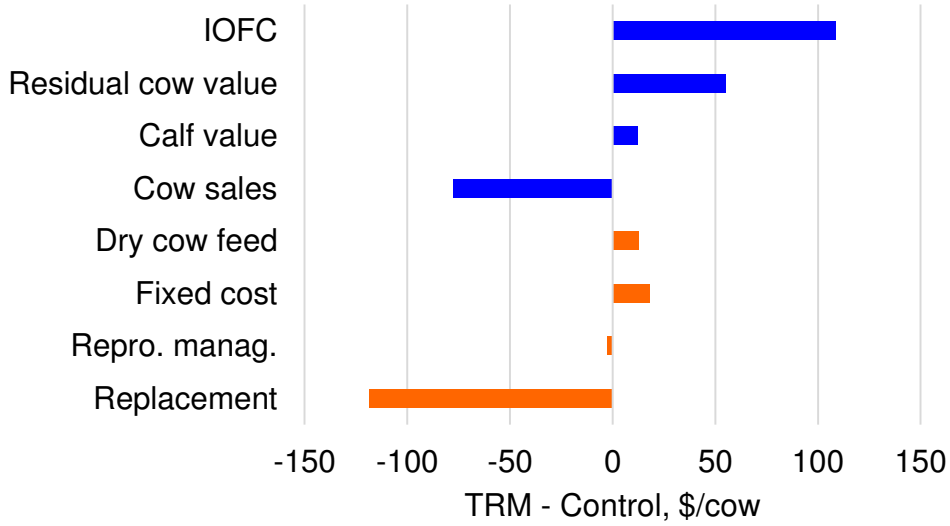
Primiparous





Multiparous

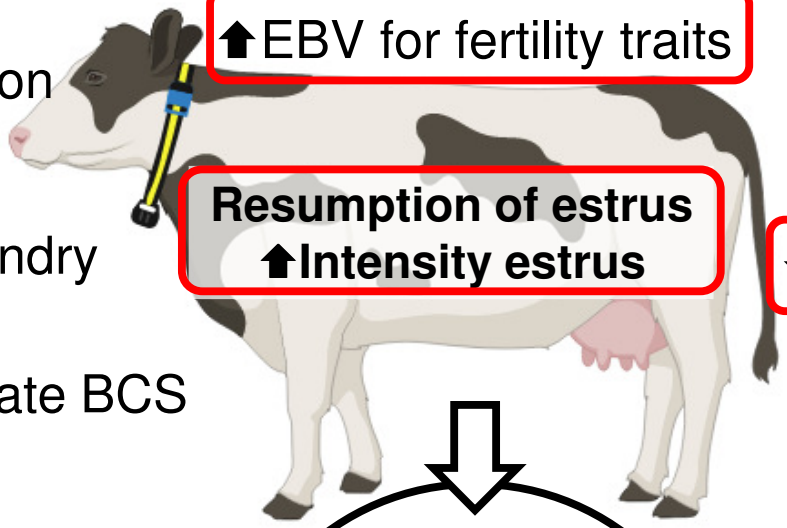




Proper nutrition

Proper husbandry

Adequate BCS



⬆EBV for fertility traits

Resumption of estrus
⬆Intensity estrus

⬇Morbidity

- Uterine disease
- Lameness
- Metabolic disease
- Mastitis

Targeted reproductive management
FIRST AI

Tailored hormonal therapy
⬆ Reliance on estrus
⬇ Handling
⬇ Labor
Faster DNB/culling decisions

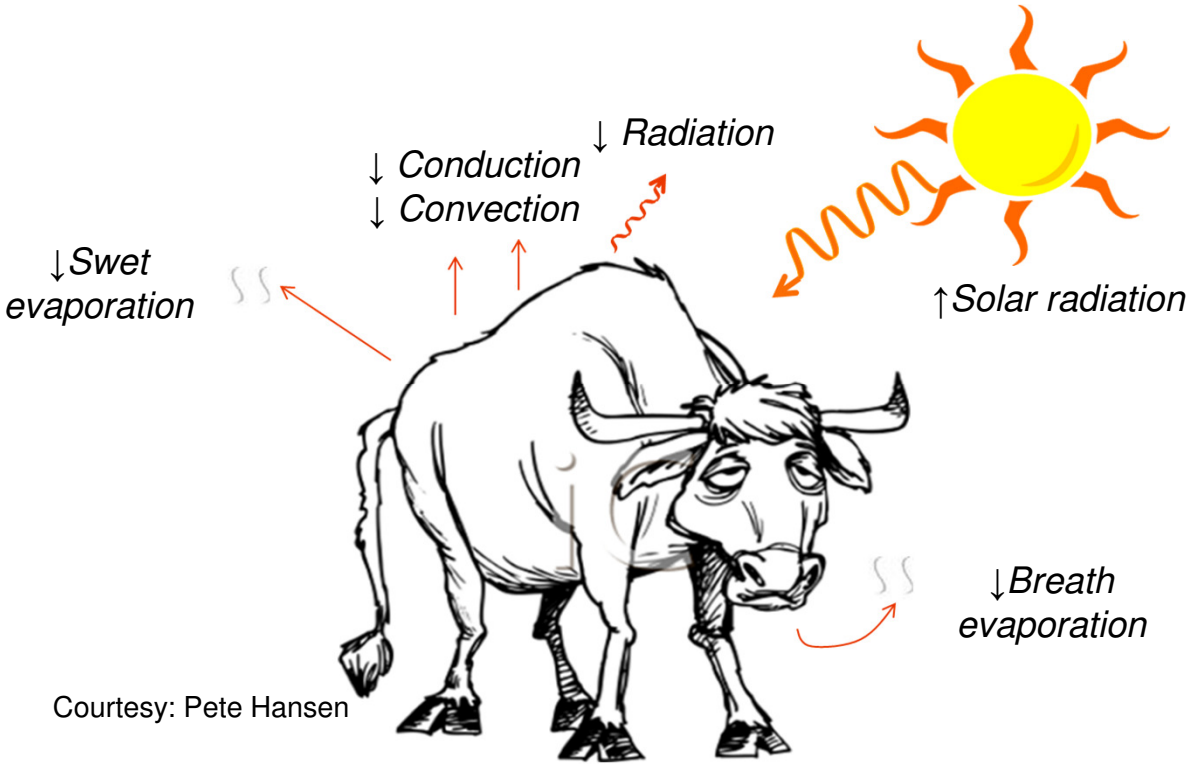
BASIC PREREQUISITES:

- ⬆ Pregnancy rates
- "Back-fence" TAI protocol
- Aggressive re-insemination

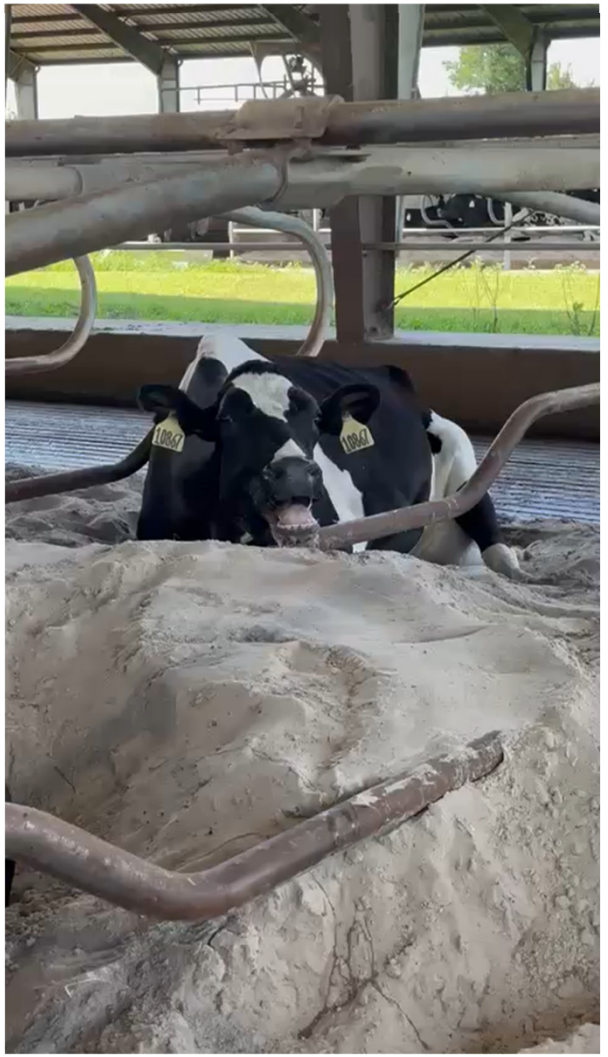
DairyHTE
Dairy Health Technology & Extension

Heat stress and Thermoregulation



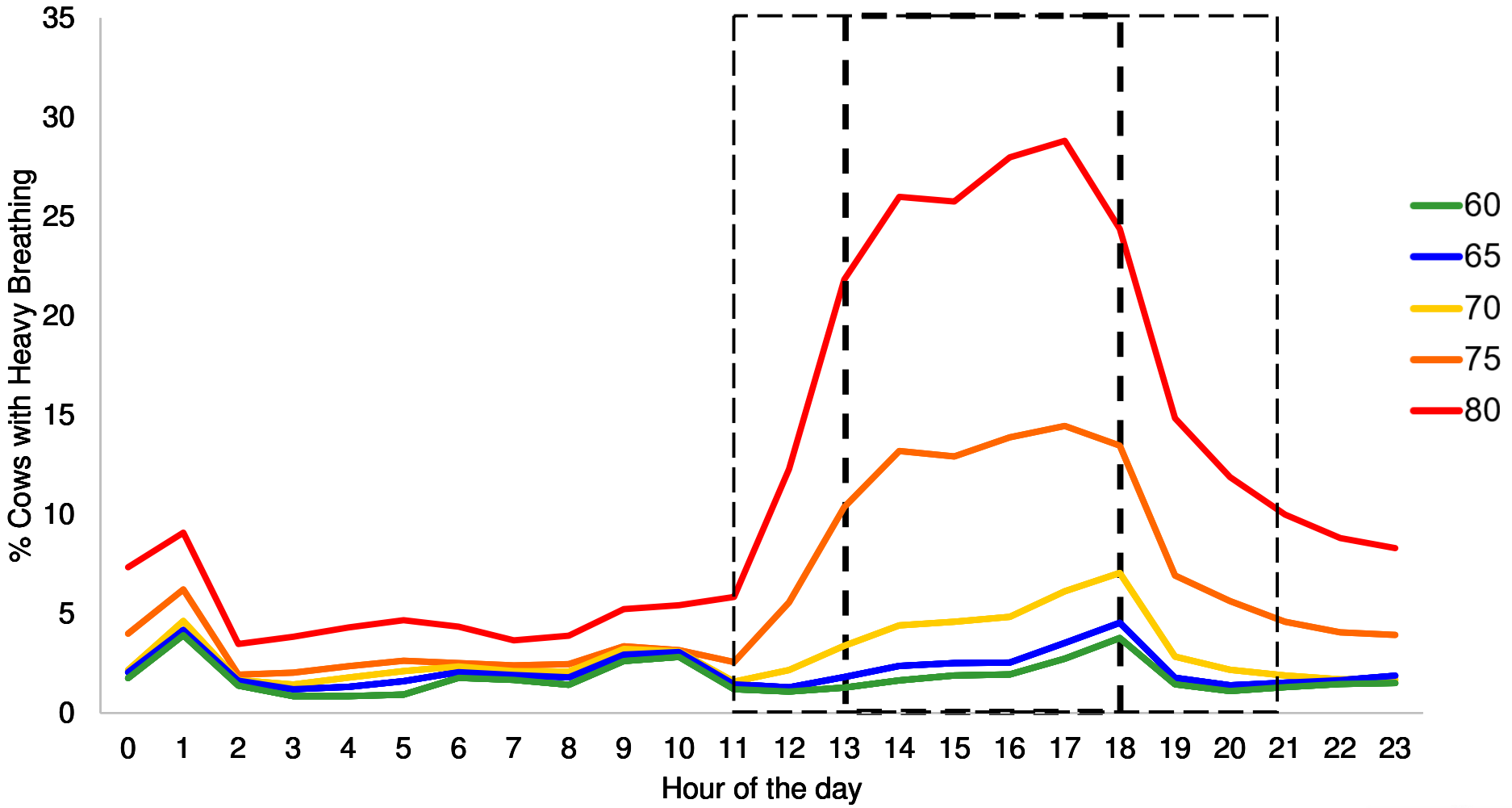


Courtesy: Pete Hansen



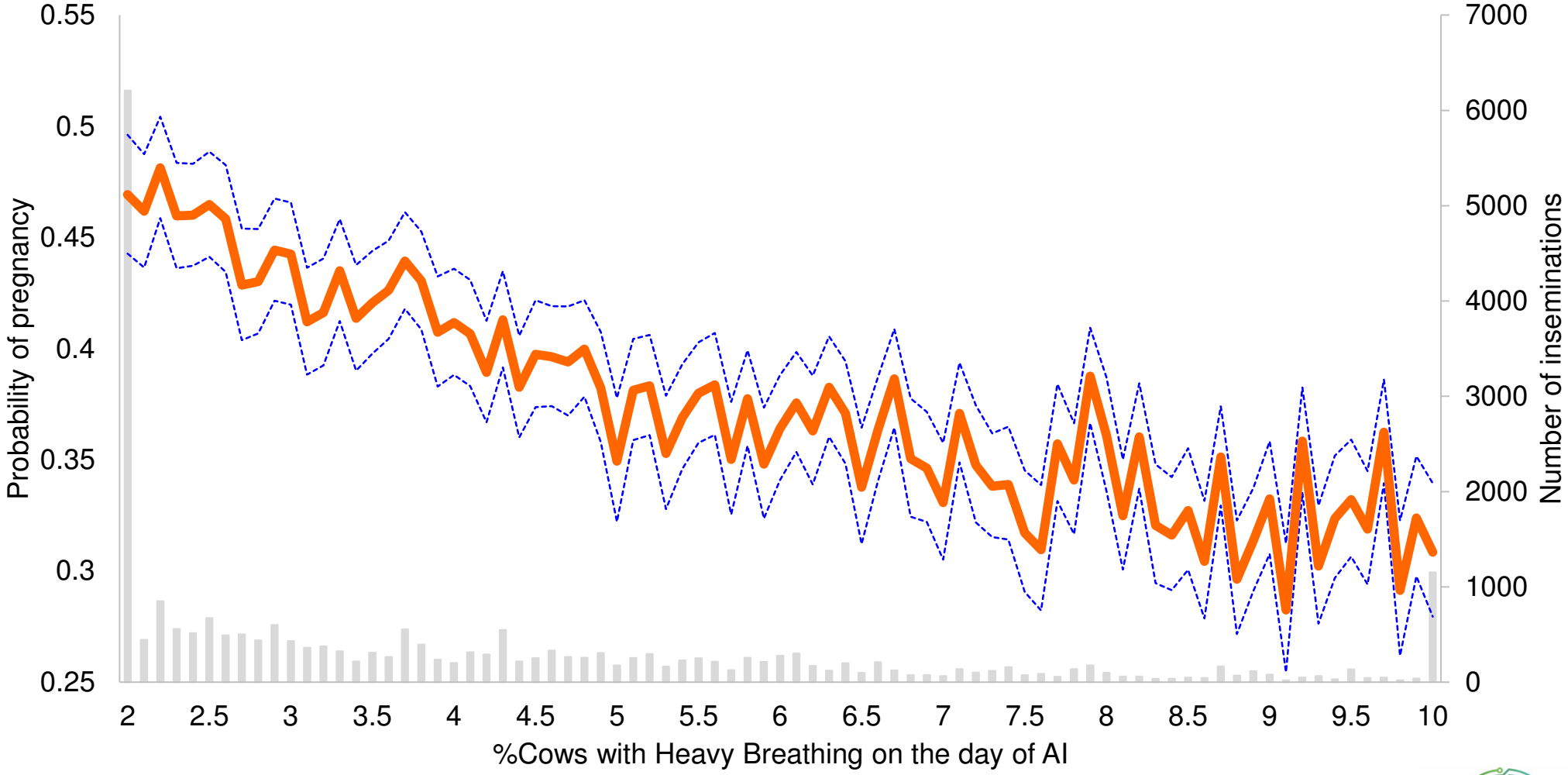
DairyHTE
Dairy Health Technology & Extension

Daily Pattern of Heavy Breathing According to THI



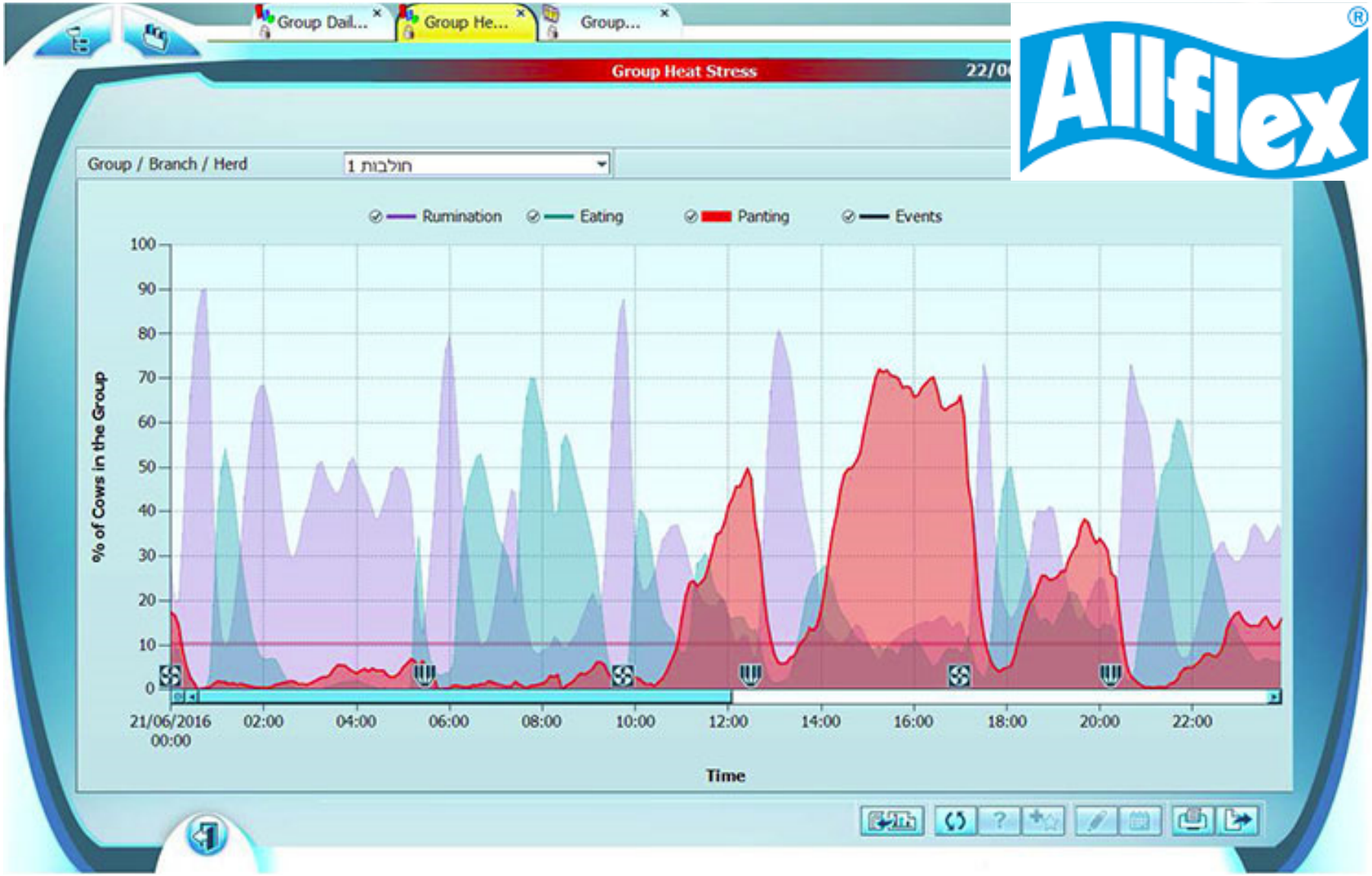
DairyHTE
Dairy Health Technology & Extension

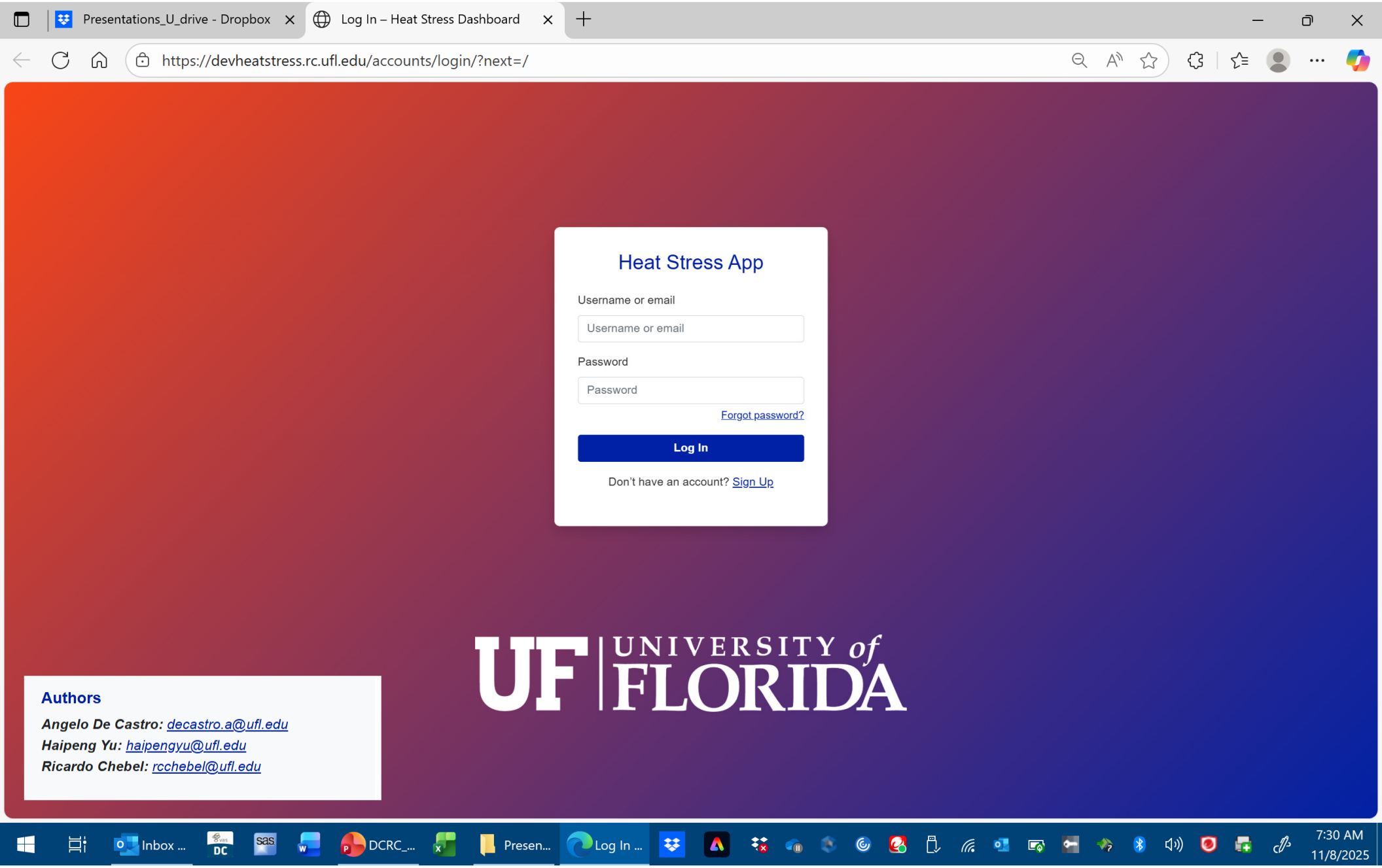
Association between %Cows with Heavy Breathing and Pregnancy Outcomes



DairyHTE
Dairy Health Technology & Extension

Parsing Information from 10+ Graphs Daily is Challenging




Presentations_U_drive - Dropbox
Log In – Heat Stress Dashboard
https://devheatstress.rc.ufl.edu/accounts/login/?next=/
Heat Stress App
Username or email
Username or email
Password
Password
Forgot password?
Log In
Don't have an account? Sign Up
UF UNIVERSITY of FLORIDA
Authors
Angelo De Castro: decastro.a@ufl.edu
Haipeng Yu: haipengyu@ufl.edu
Ricardo Chebel: rcchebel@ufl.edu
Inbox ...
DCRC_...
Presen...
Log In ...
7:30 AM
11/8/2025

Presentations_U_drive - Dropbox | Heat Stress Dashboard

https://devheatstress.rc.ufl.edu

UF UNIVERSITY of FLORIDA — AI-based Cloud System for Heat Stress Monitoring Using Panting Sensor Data

admin

Input Parameters

Select Farm

Calculation Mode

Dynamic (percentile)

Percentile Threshold

Top 10%

Period Mode

Default (11 – 21 hot, 22 – 10 cool)

Flag Threshold (% of Hours)

>15%

Date Range

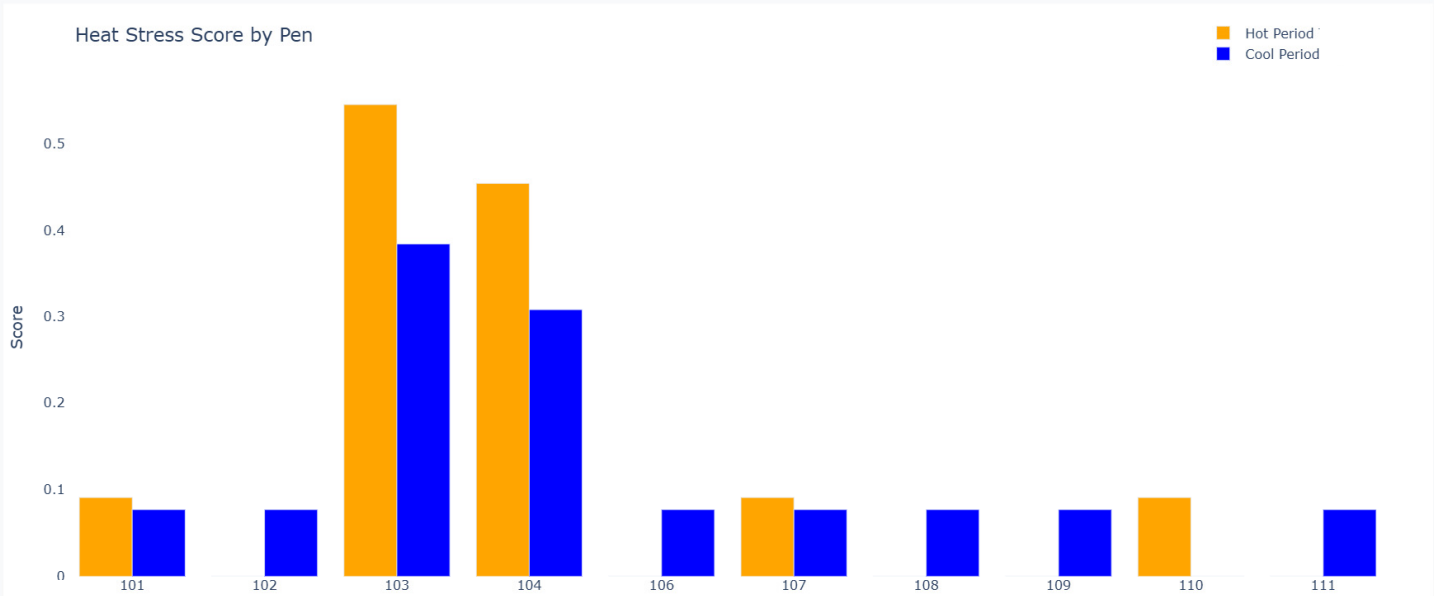
2024-08-14 → 2024-08-14

Load Data

Complete!

Heat Stress Overview | Breathing Pattern | Data Table

Heat Stress Score by Pen

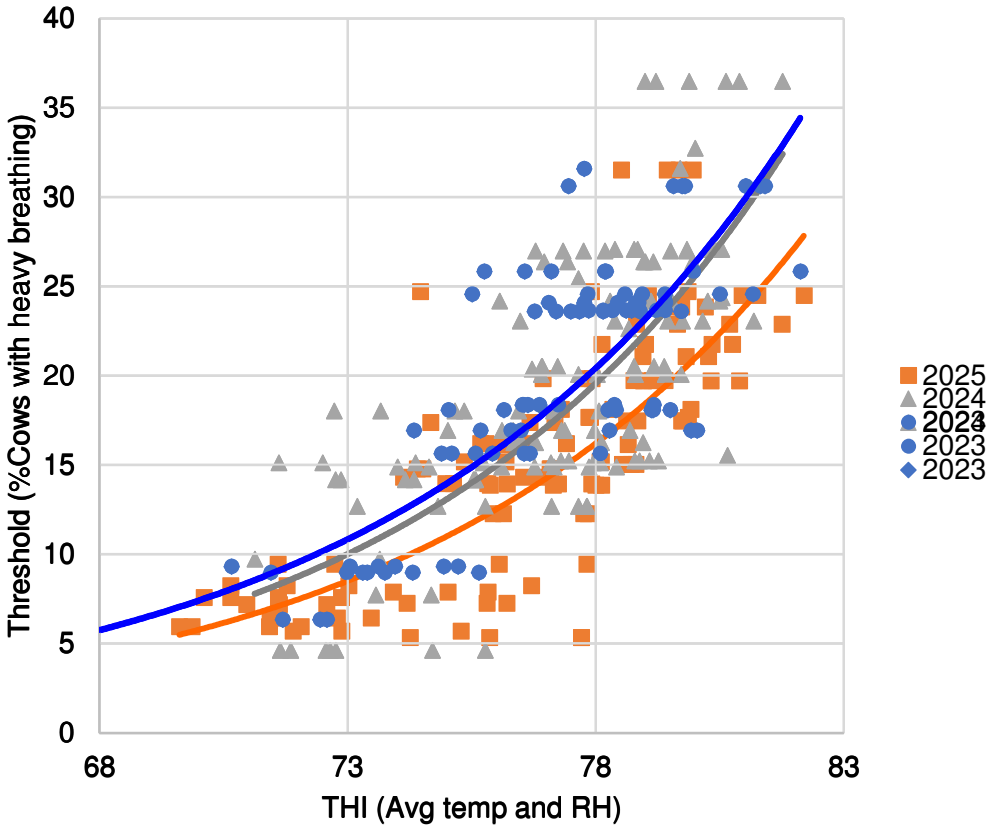


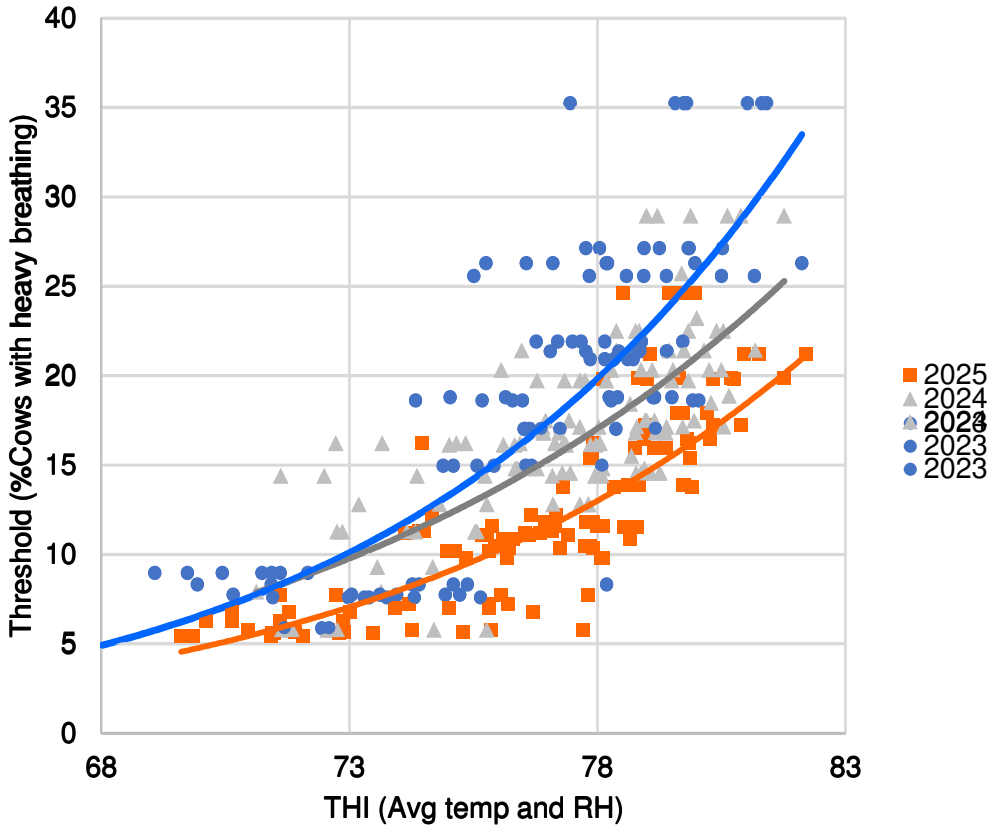
Flagged Pens: % of Hours Above Threshold

7:32 AM
11/8/2025

Using group behavior to identify pens with poor heat abatement

- Immediate action in pens with a high “% of panting cows”



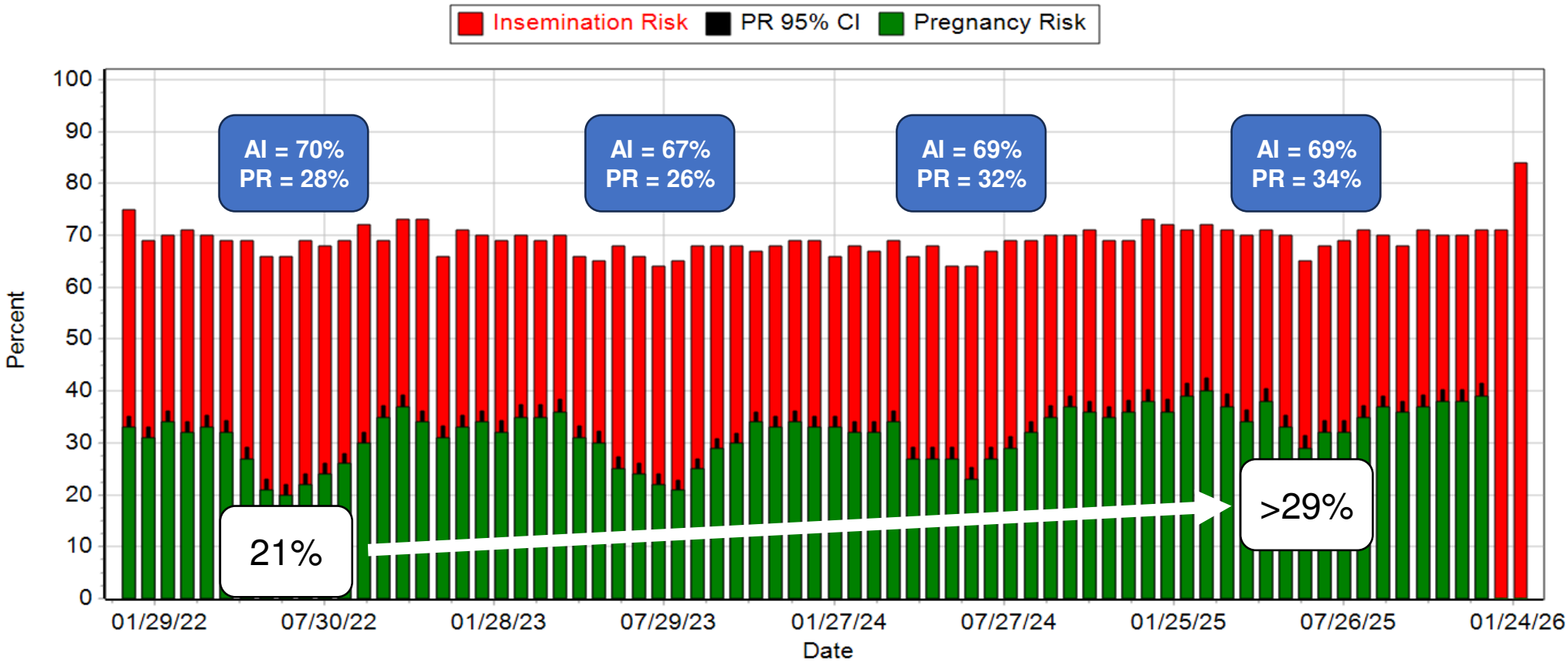


- Reduced the “threshold” by 3 to 5 percentage points

DairyHTE
Dairy Health Technology & Extension

Using Group Behavior to Identify Pens with Deficient Heat Abatement

- 21-d AI submission and pregnancy rates

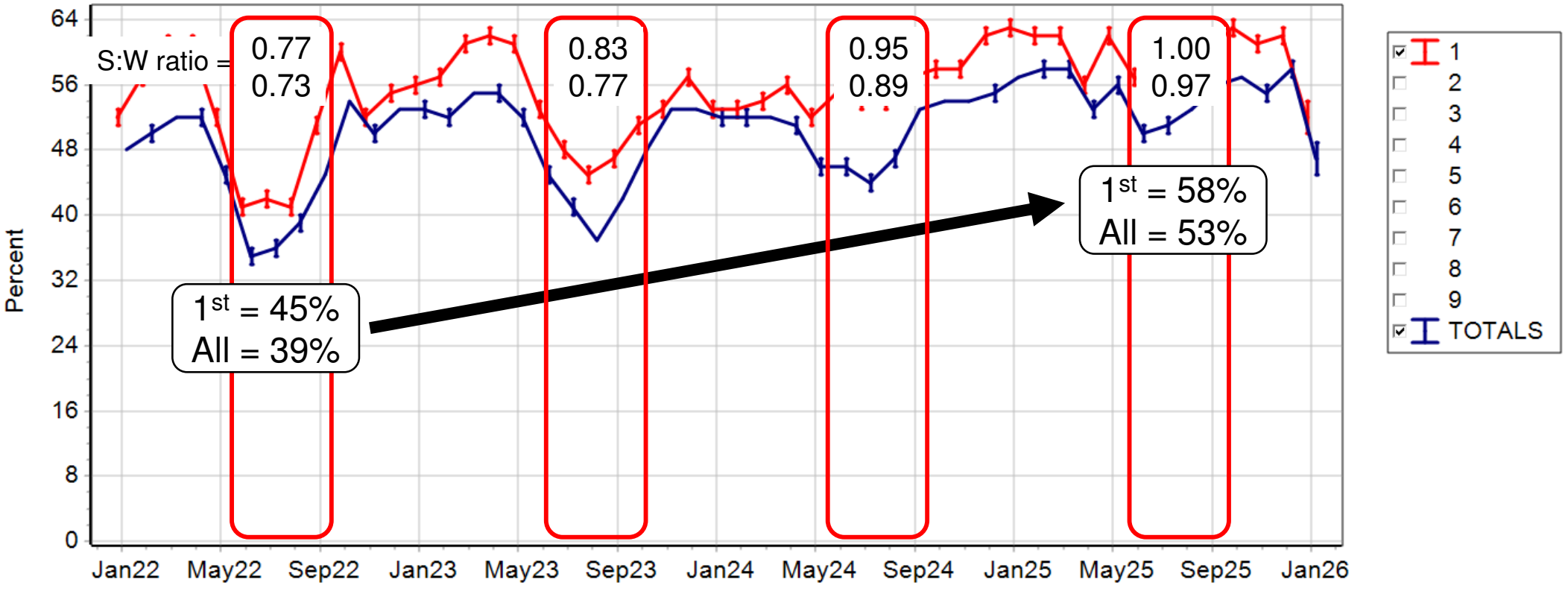


- Anecdotal information, based purely on observation
- No cause-and-effect

DairyHTE
Dairy Health Technology & Extension

Using Group Behavior to Identify Pens with Deficient Heat Abatement

- Pregnancy to 1st AI and overall over time

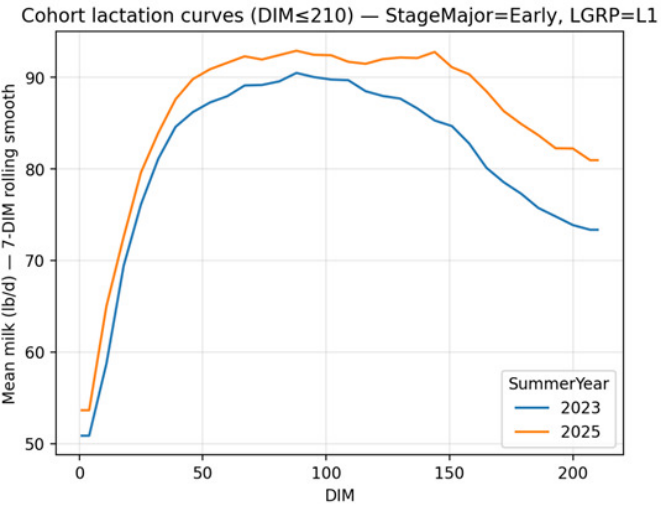


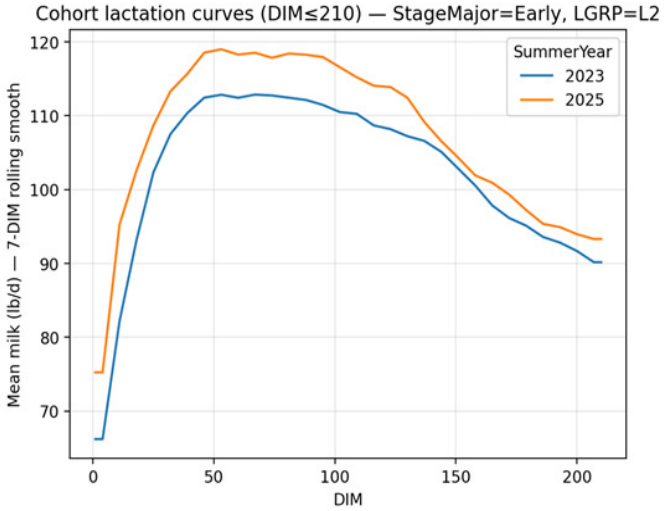
- Anecdotal information, based purely on observation
- No cause-and-effect

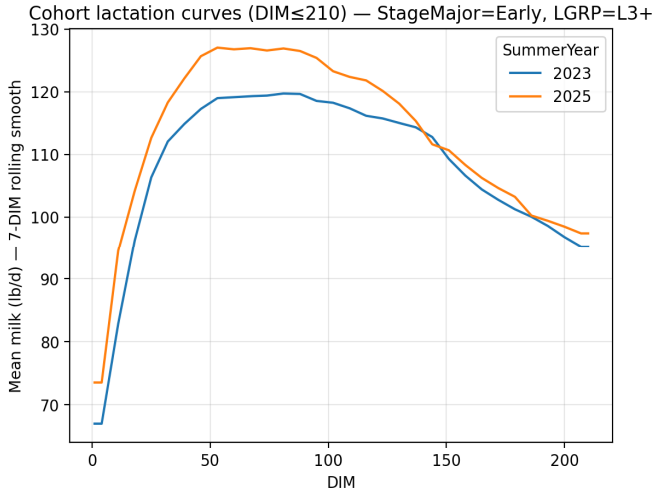
DairyHTE
Dairy Health Technology & Extension

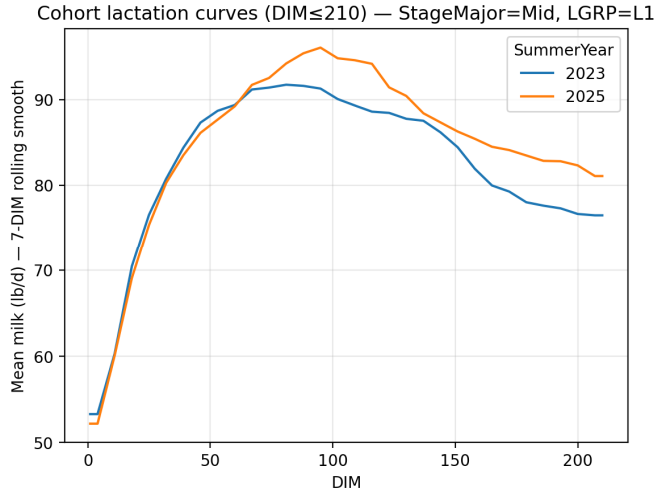
DairyHTE
Dairy Health Technology & Extension

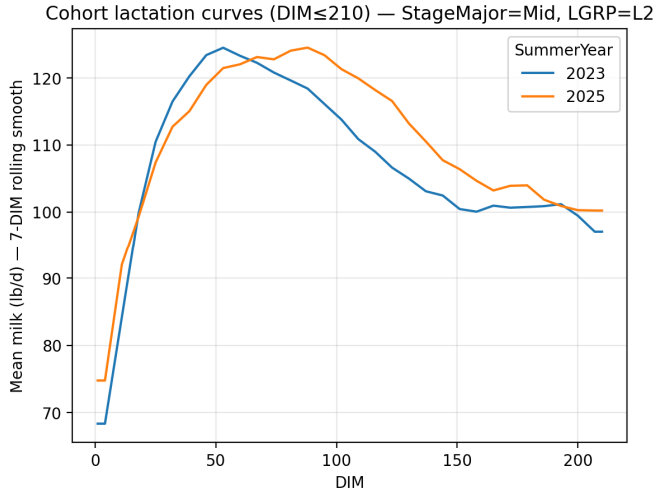
Differences in Milk Yield across Summers

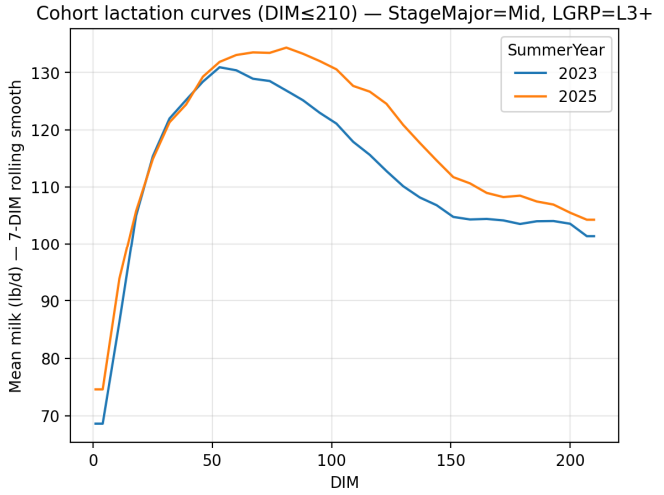












Possible Economic Benefits of Using Pen-Level Heat Stress Reports

- Using monthly average milk yield (based on “List test day records”), number of pregnancies generated (from “Bred” report I use in the Monthly reports), cows sold and dead (from “DDEAD” and “DSOLD” data I use in the Monthly reports) the return per cow per month from Jun-Oct 2023 vs Jun-Oct 2024 and from Jun-Oct 2023 Jun-Oct 2025 were compared
- Assumptions of monetary values were: $6/cwt, $400/pregnancy, $900/beef cow, and $2,500/replacement

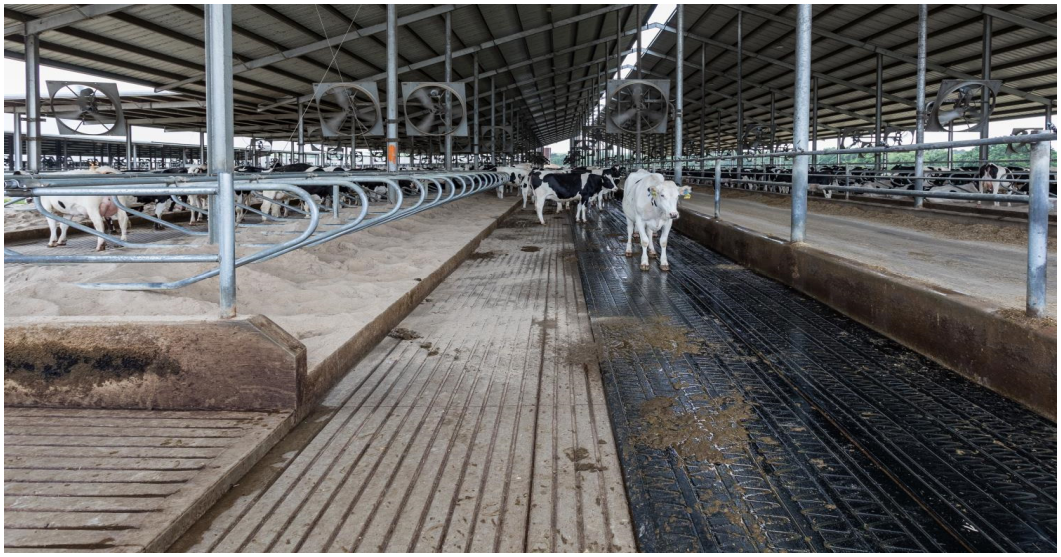
	Lact 1	Lact 2	Lact ≥ 3
2024	$ 5.97	$ (2.83)	$ (7.04)
2025	$ 7.09	$ 15.36	$ 15.54

- Assuming cost of automated monitor = $32.85/cow per year ($0.09/cow per day)
- If summer is 5 months, return summer – yearly cost: Lact 1 = $2.54, Lact 2 = $43.82, Lact ≥ 3 = $44.72
- Weighted average = $27.54/cow per year (15,000 cows ~ $400,000/year)

DairyHTE
Dairy Health Technology & Extension

Use of Group Heat Stress Monitoring

- Identification of pens in a dairy with the highest % of cows panting.
- Immediate response:
  - Inspection and repair of sprinklers, fans, thermostats and drinking fountains.
  - If no problem is identified, cows that are more sensitive to heat stress are moved to more suitable pens.





- **THERE IS NO PROMISE OF SIMILAR RESULTS, ONLY OF SIMILAR INFORMATION**

Thank you!!!

Ricardo C. Chebel, DVM, MPVM, PhD
Dairy Health, Technology & Extension
LACS, University of Florida
rcchebel@ufl.edu

DairyHTE
Dairy Health Technology & Extension

Animal Omics Sciences Lab

Best Use of Available Data



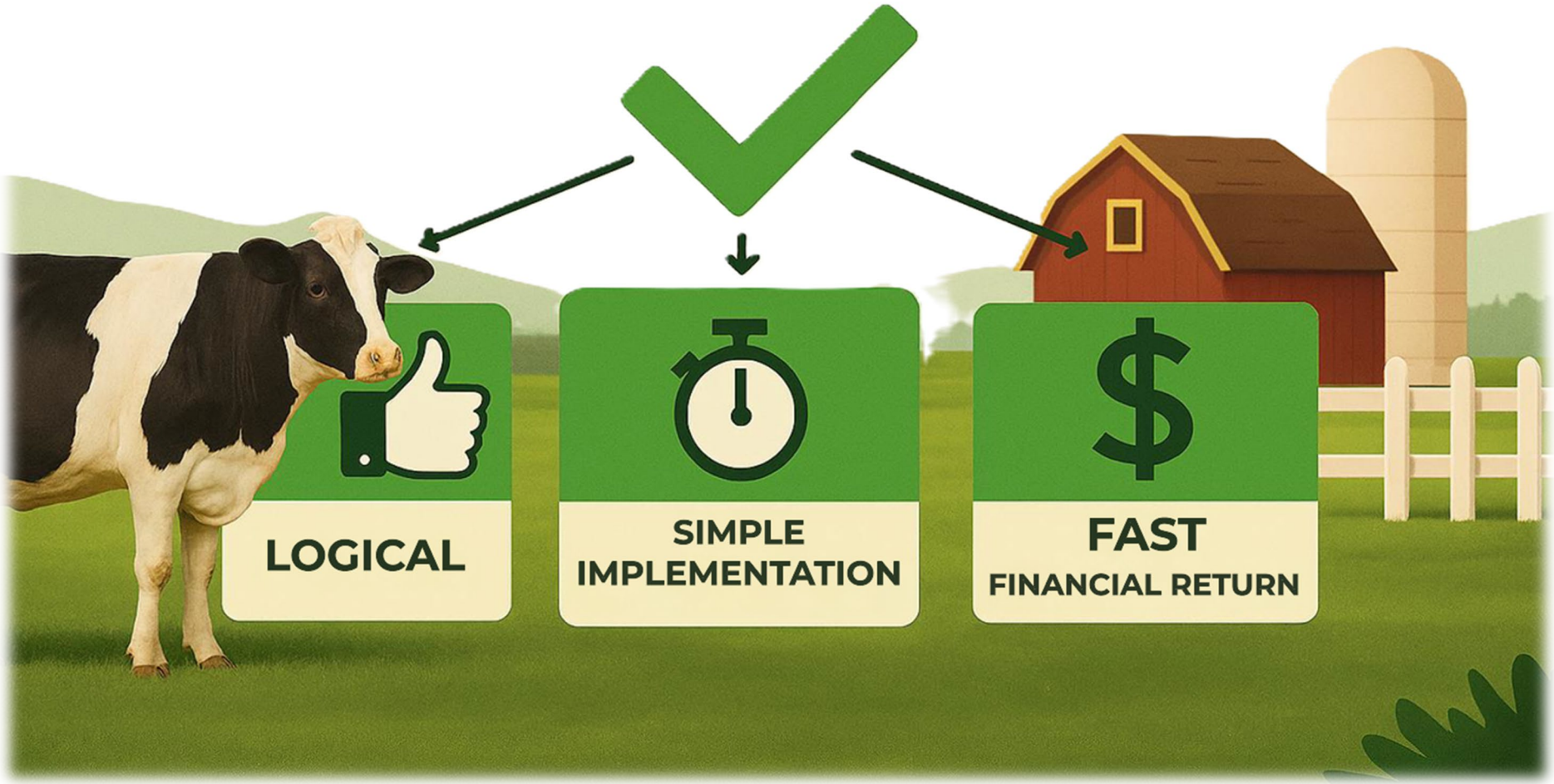
Caio Aranha Gamarra, DVM, MS
Customer Success Specialist – Key Accounts

SenseHub™ DAIRY

MERCK Animal Health

Confidential

WHEN DAIRY FARMERS WOULD EASILY ADOPT

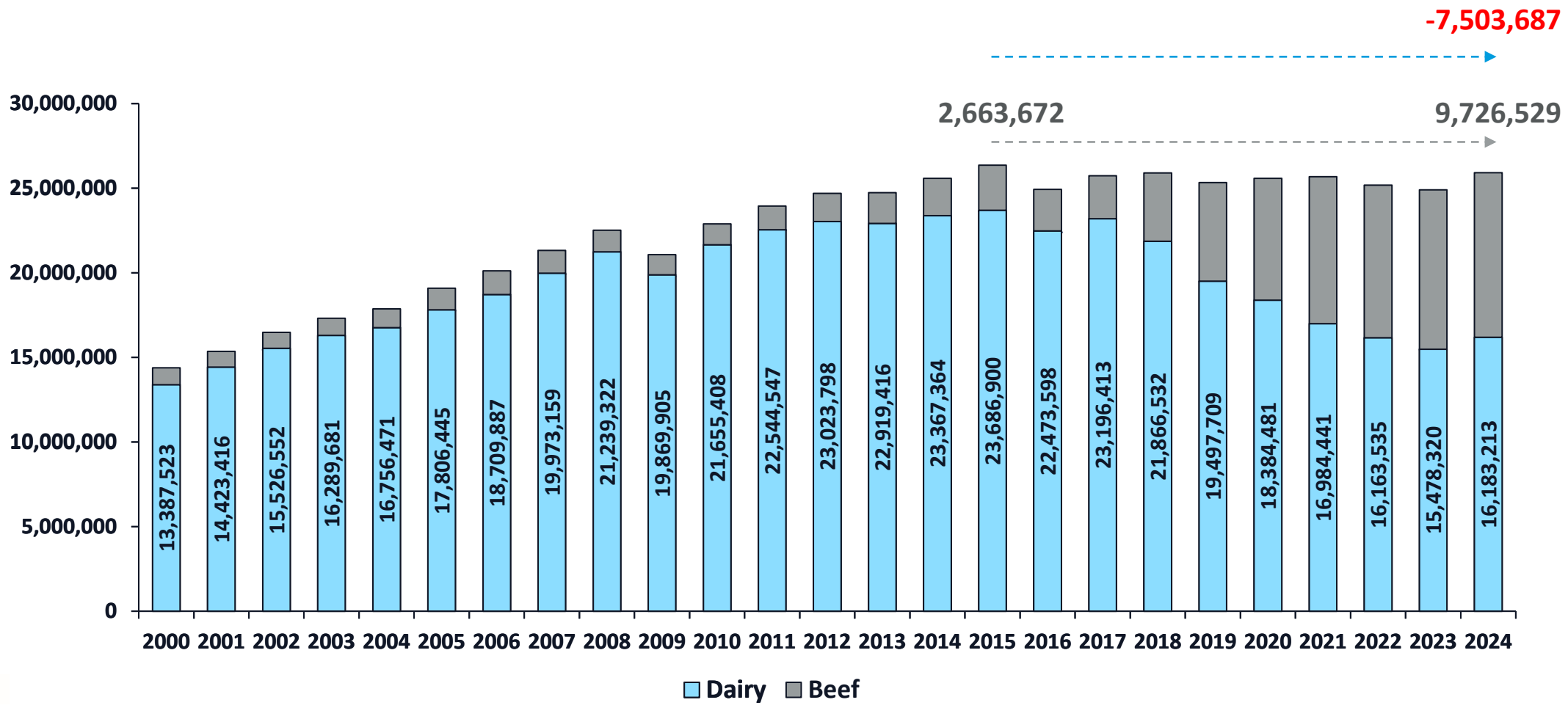


SenseHub™ DAIRY

MERCK Animal Health

Confidential

Semen Sales Reported Yearly

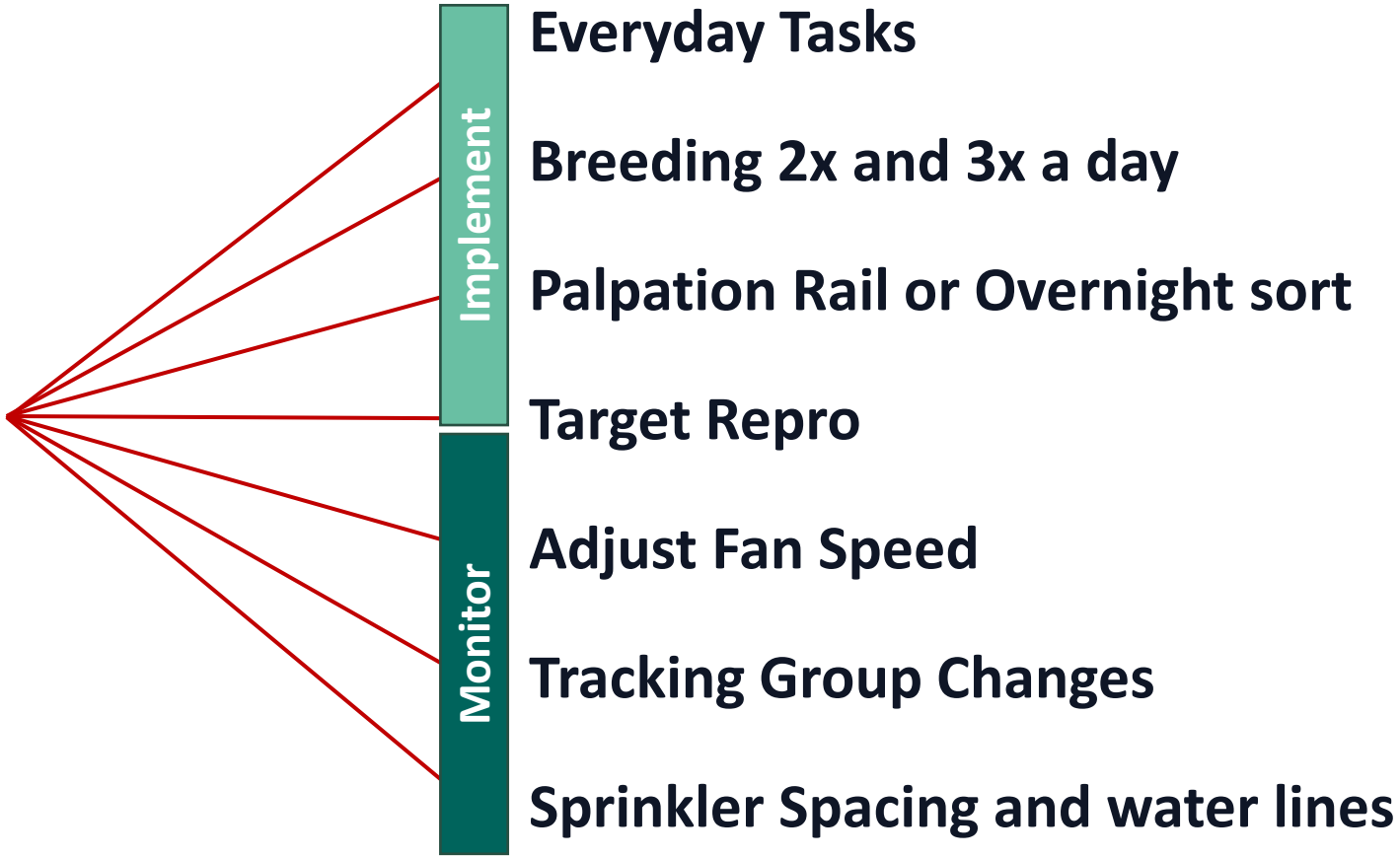


NAAB

SenseHub™ DAIRY

MERCK Animal Health

Confidential



Everyday Tasks

Breeding 2x and 3x a day

Palpation Rail or Overnight sort

Target Repro

Adjust Fan Speed

Tracking Group Changes

Sprinkler Spacing and water lines

Labor Efficiency

Maximize technology use

Herd monitoring

Data driven decisions

SenseHub™ DAIRY

MERCK Animal Health

Confidential

All Cows

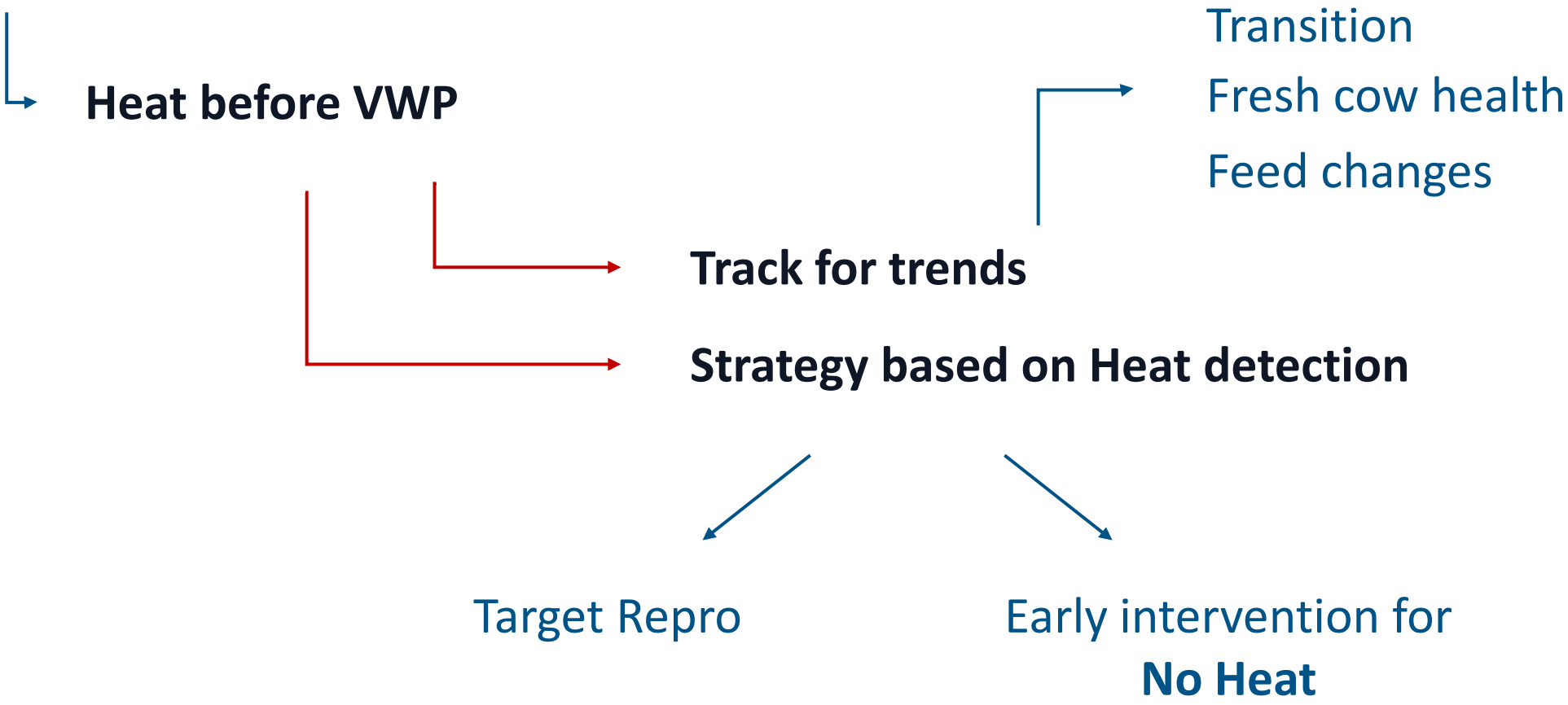
Date	Br Elig	Bred	Pct	Pg Elig	Preg	Pct	Aborts
12/31/24	292	217	74	286	102	36	5
1/21/25	282	216	77	278	83	30	10
2/11/25	294	223	76	289	100	35	7
3/04/25	319	257	81	309	106	34	13
3/25/25	313	245	78	306	115	38	12
4/15/25	345	274	79	341	114	33	13
5/06/25	321	241	75	311	94	30	12
5/27/25	299	214	72	289	73	25	11
6/17/25	274	192	70	265	58	22	2
7/08/25	263	183	70	249	51	20	4
7/29/25	298	229	77	286	69	24	3
8/19/25	329	246	75	314	80	25	8
9/09/25	320	247	77	304	83	27	6
9/30/25	338	243	72	326	81	25	0
10/21/25	356	291	82	346	130	38	5
11/11/25	349	269	77	333	112	34	5
12/02/25	312	248	79	0	0	0	0
12/23/25	281	245	87	0	0	0	0
Total	4992	3787	76	4832	1451	30	116

One or more Heat

Date	Br Elig	Bred	Pct	Pg Elig	Preg	Pct	Aborts
12/31/24	414	311	75	405	137	34	8
1/21/25	406	287	71	399	109	27	19
2/11/25	429	322	75	421	142	34	9
3/04/25	504	382	76	488	143	29	21
3/25/25	513	378	74	504	156	31	17
4/15/25	573	450	79	560	185	33	22
5/06/25	512	377	74	494	138	28	14
5/27/25	472	331	70	454	103	23	15
6/17/25	446	298	67	433	88	20	4
7/08/25	453	288	64	432	79	18	5
7/29/25	522	389	75	499	117	23	6
8/19/25	563	411	73	537	146	27	14
9/09/25	529	399	75	503	132	26	9
9/30/25	545	391	72	529	138	26	2
10/21/25	537	411	77	525	173	33	6
11/11/25	536	412	77	516	163	32	7
12/02/25	466	356	76	0	0	0	0
12/23/25	391	345	88	0	0	0	0
Total	7954	5837	73	7699	2149	28	178

Confidential

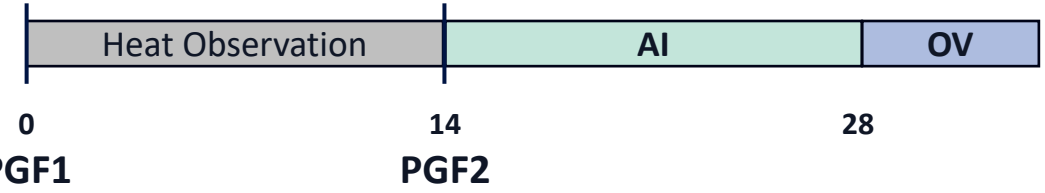
Heat Data

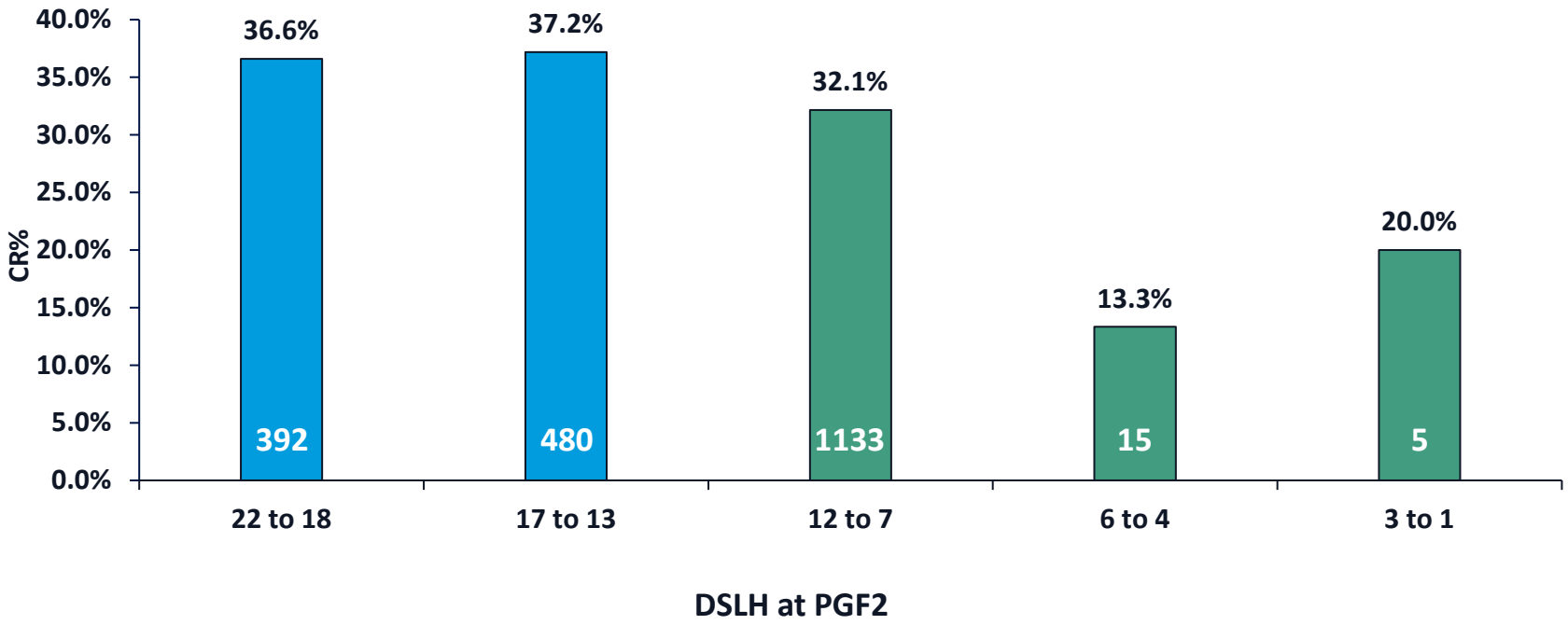


Confidential

PGF from Last Heat – Cows First Service

#2,025





SenseHub™ DAIRY

MERCK Animal Health

Confidential

Breeding Window

Time stamp

- Countdown from **25**

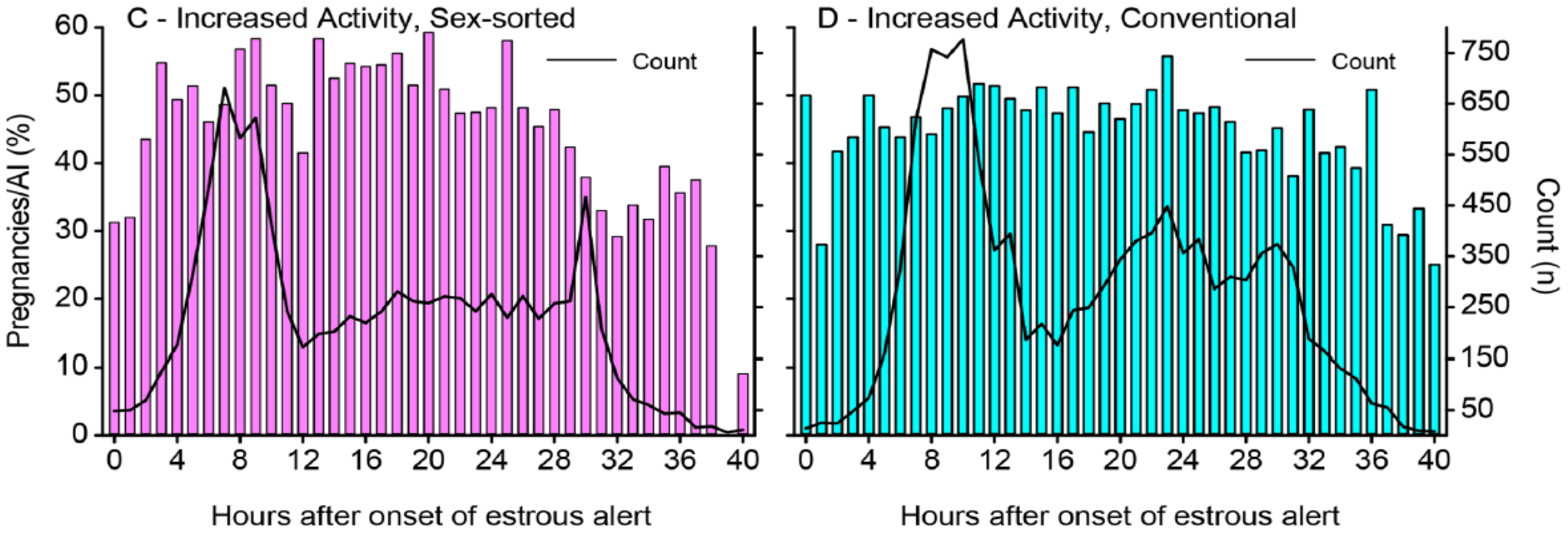
J. Dairy Sci. 108:8945–8958
https://doi.org/10.3168/jds.2025-26428
© 2025, The Authors. Published by Elsevier Inc. on behalf of the American Dairy Science Association®.
This is an open access article under the CC BY license (https://creativecommons.org/licenses/by/4.0/).

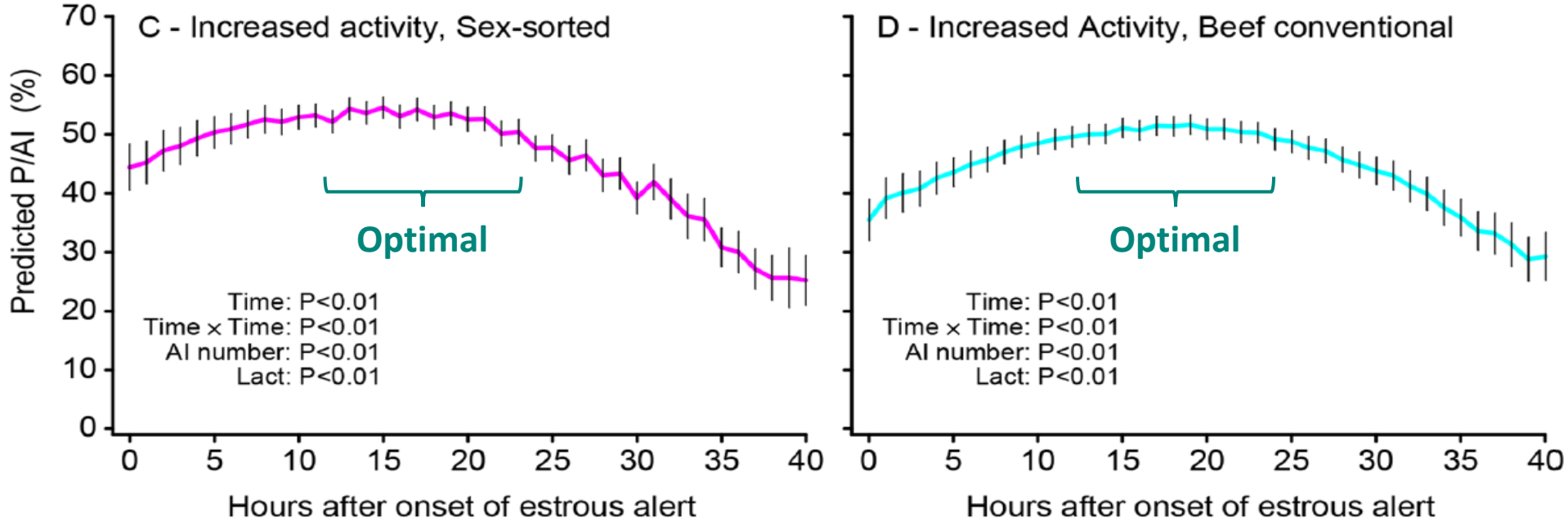
Effect of timing of artificial insemination with conventional or sex-sorted semen on fertility of lactating dairy cows

V. G. Santos,[1,2*] P. D. Carvalho,[3,4] A. H. Souza,[3] S. Priskas,[5] J. A. L. Castro,[1] A. M. F. Pereira,[1,2] P. J. Ross,[4] J. Moreno,[4] M. C. Wiltbank,[3] and P. M. Fricke[3]

TX and AZ open dry lot #10,000 cows enrolled

Confidei


C - Increased Activity, Sex-sorted
Count
Pregnancies/AI (%)
0
10
20
30
40
50
60
0 4 8 12 16 20 24 28 32 36 40
Hours after onset of estrous alert
D - Increased Activity, Conventional
Count
Count (n)
50
150
250
350
450
550
650
750
0 4 8 12 16 20 24 28 32 36 40
Hours after onset of estrous alert


C - Increased activity, Sex-sorted
Predicted P/AI (%)
0
10
20
30
40
50
60
70
Optimal
Time: P<0.01
Time x Time: P<0.01
AI number: P<0.01
Lact: P<0.01
0 5 10 15 20 25 30 35 40
Hours after onset of estrous alert
D - Increased Activity, Beef conventional
Optimal
Time: P<0.01
Time x Time: P<0.01
AI number: P<0.01
Lact: P<0.01
0 5 10 15 20 25 30 35 40
Hours after onset of estrous alert

Confidential

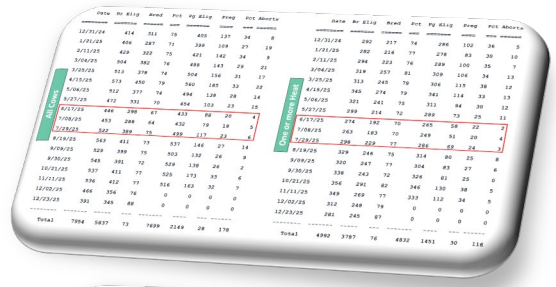
Breeding – Achieving The Next Percentage Point

Independent of X Breeding and sorting

% Cows in heat by VWP – Herd KPI

Early intervention for no-heat cows

Target **R**eproductive **M**anagement

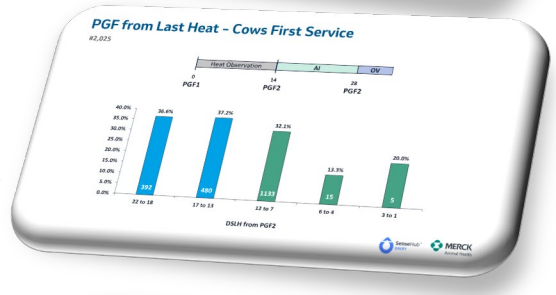


Transition cow health

Resume Estrus

Repro shots; TAI breeding

1+ day a week of shots

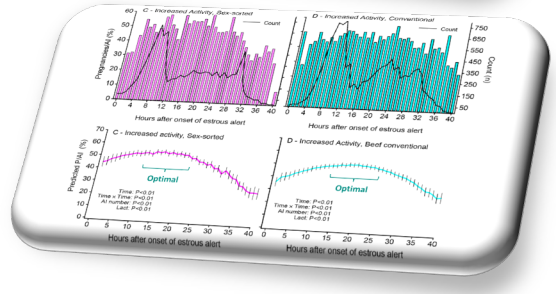


Improved by sorting

Breeding 2x or 3x

Overnight + Morning sort

Daily tasks



Optimum breeding time

Avoid later breeding

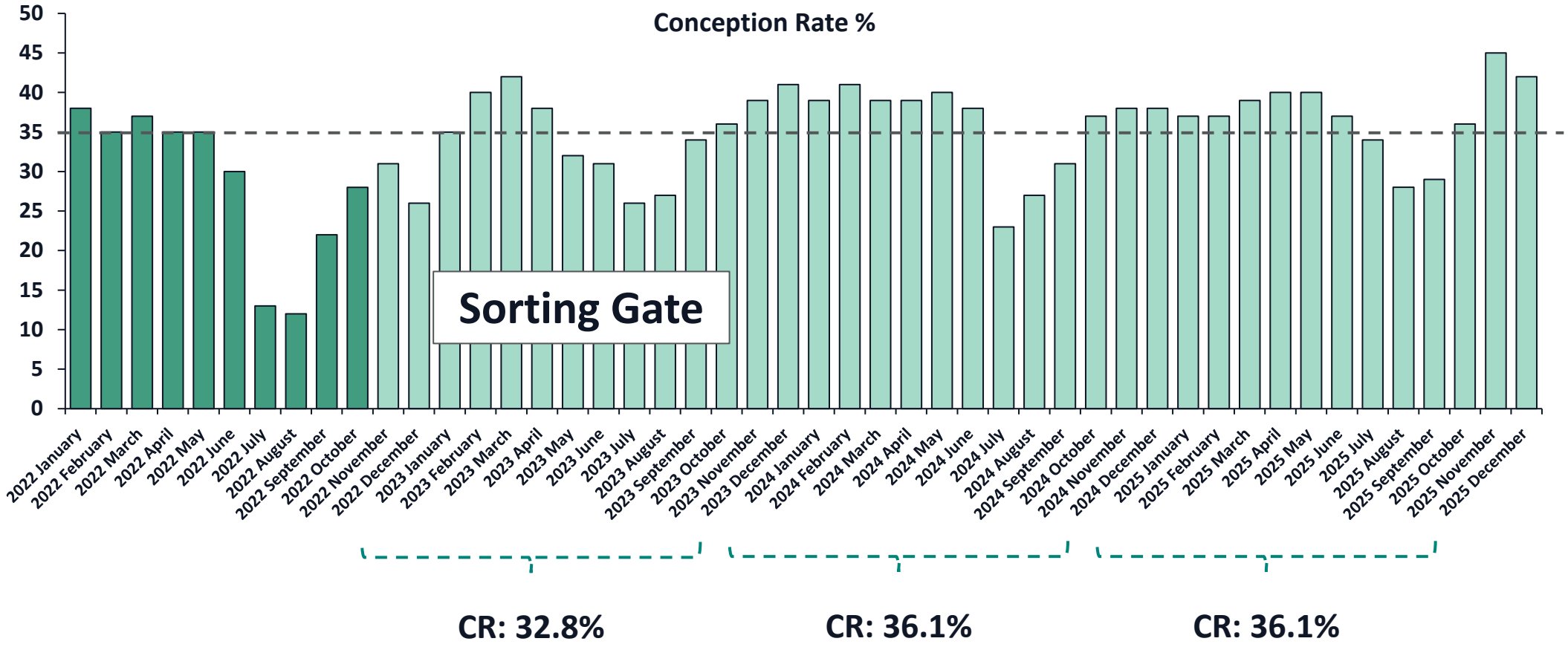
Compliance on DIM for task

SenseHub™ DAIRY

MERCK Animal Health

Confidential

Is my KPI of Interest Preventing Improvement?

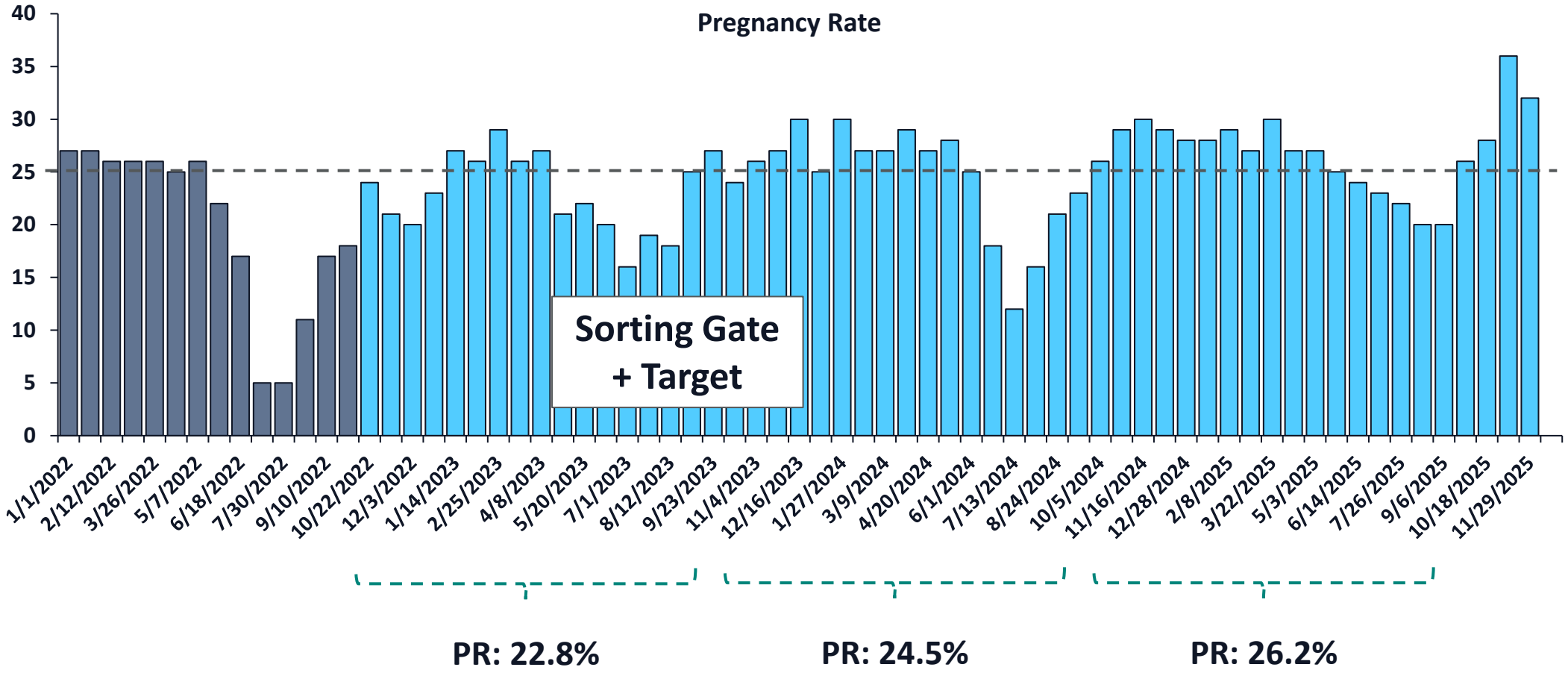


SenseHub™ DAIRY

MERCK Animal Health

Confidential

Is my KPI of Interest Preventing Improvement?

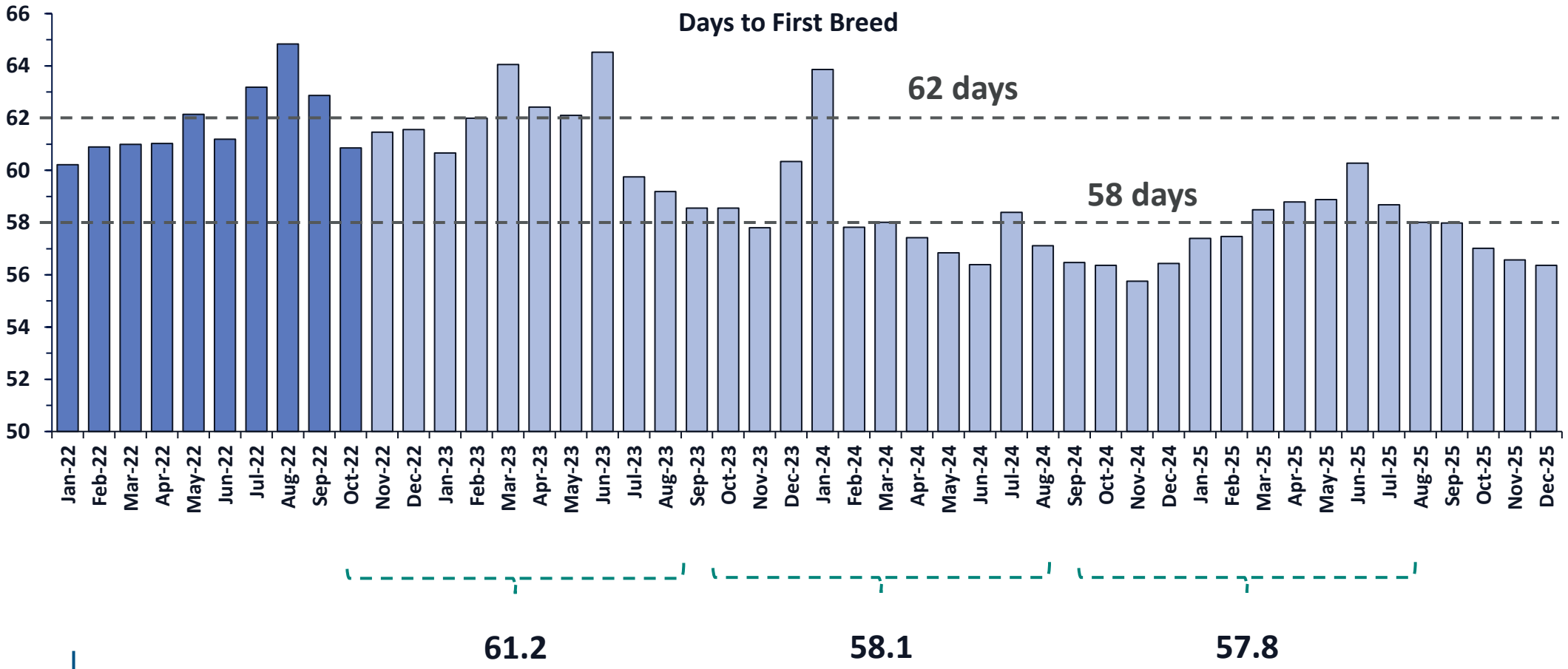


SenseHub™ DAIRY

MERCK Animal Health

Confidential

Is my KPI of Interest Preventing Improvement?



 # 12,184 fresh cows 2025 -> Cost savings $

SenseHub™ DAIRY

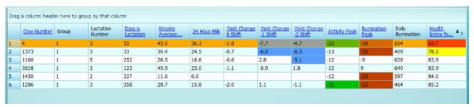
MERCK Animal Health

Confidential

Cow Health – What Should I Look for?

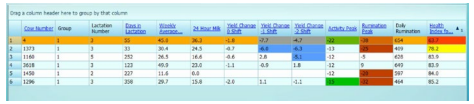
Health Index -> Calculate Value; cows on health list

Animal on report, clinical symptoms present



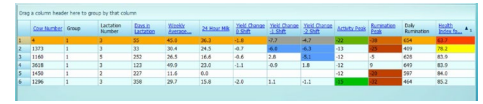


Animal on report, no clinical symptoms





Animal not on report, clinical symptoms present





SenseHub™ DAIRY

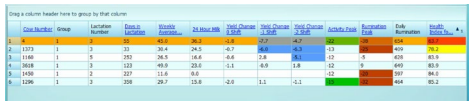
MERCK Animal Health

Confidential

Cow Health – What Should I Look for?

Health Index -> Calculate Value; cows on health list

Animal on report, no clinical symptoms





-> **What should I do?**

- **Intervention based on clinical signs**
- **Nothing wrong, wait for tomorrow**
- **Something, hopefully tomorrow she is fine**

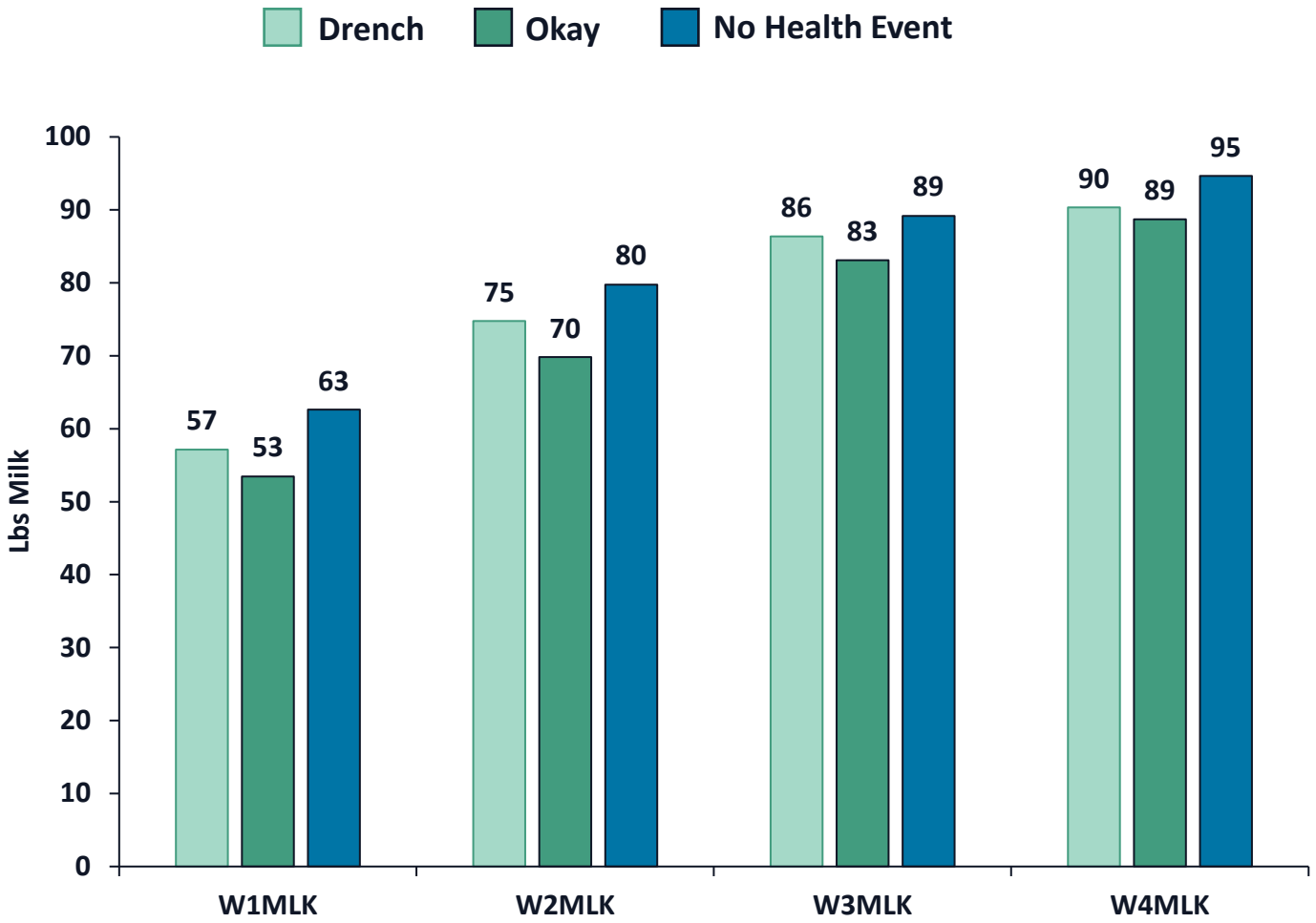
Assign **OK** to non-treated

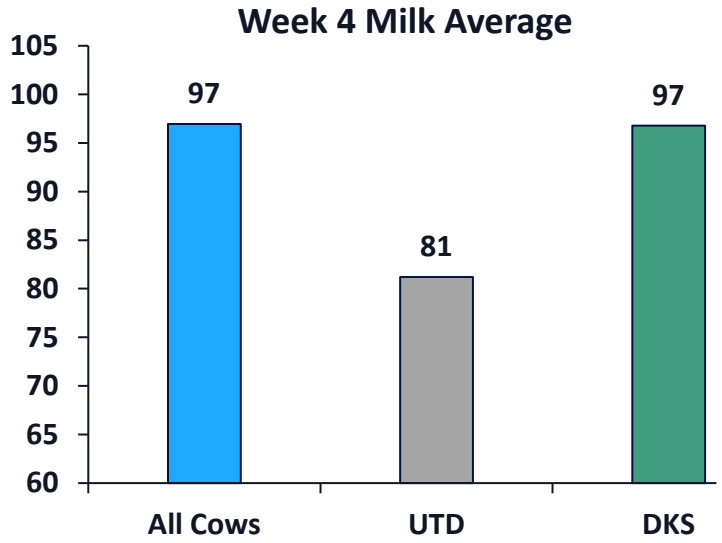
SenseHub™ DAIRY

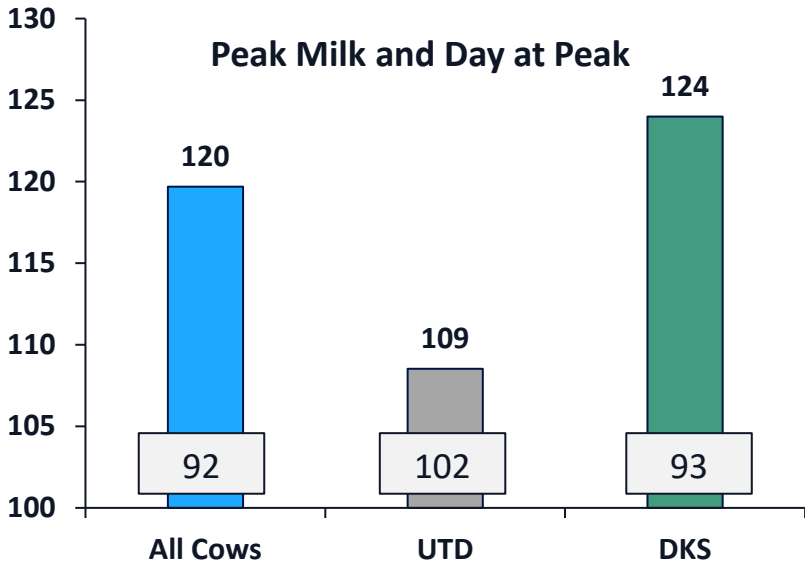
MERCK Animal Health

Confidential

Milk Production Based on Intervention







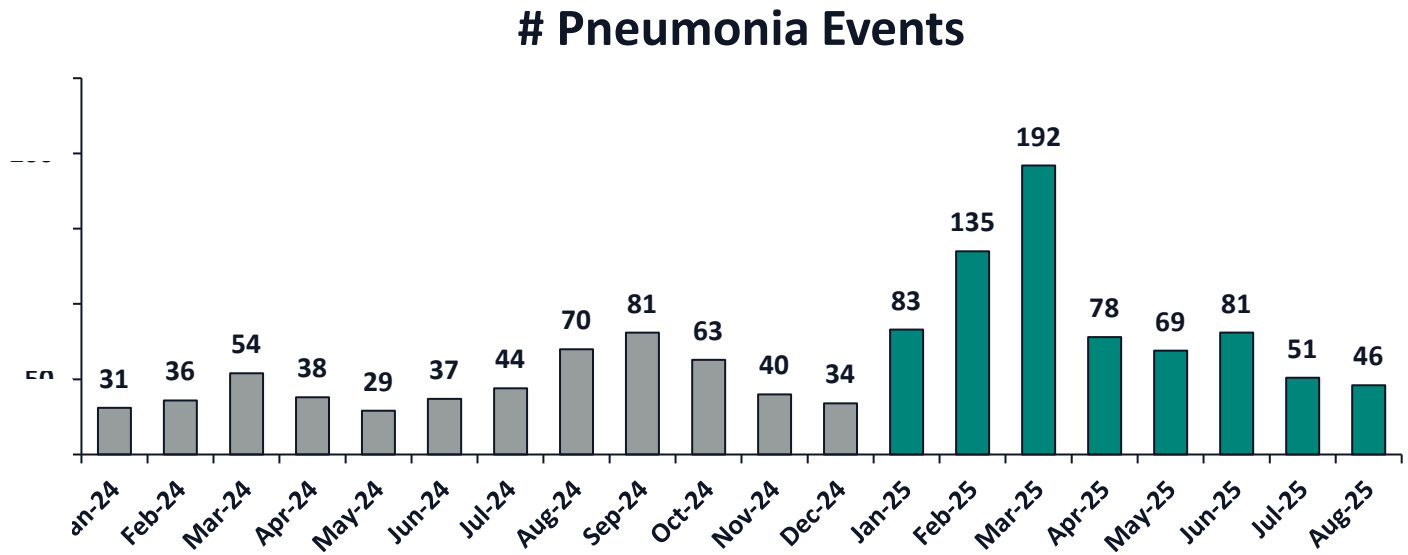
UTD: RP and/or Metritis

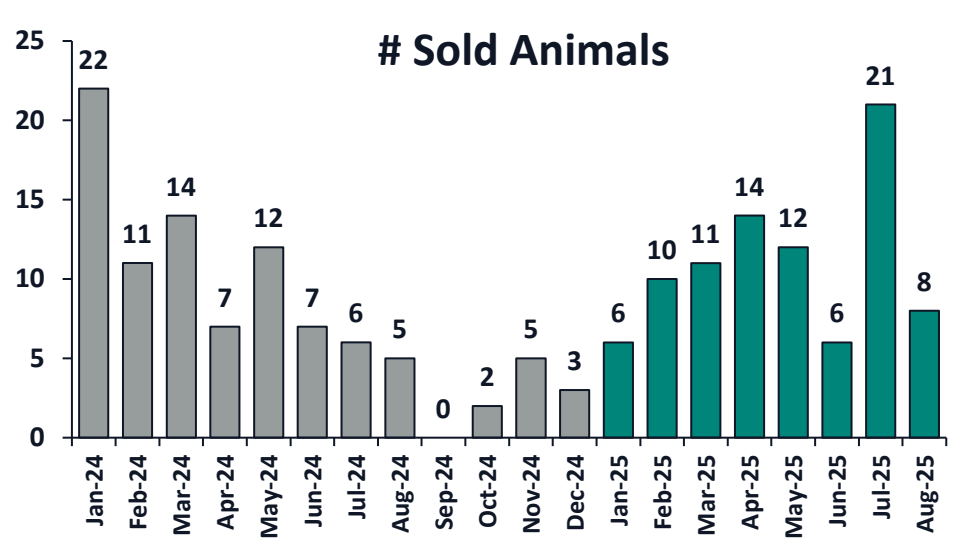
DSK: digestive, Ketosis, Sick

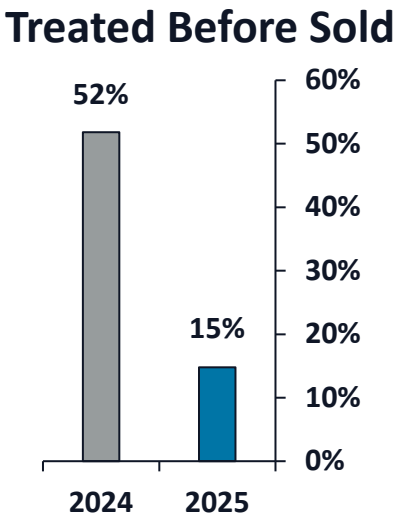
Confidential

Cow Health – What Should I Look for?

- Cows I don't need to touch
- Dry week events
- Close up alerts
- Mid Lactation alerts
- Late Lactation Alerts

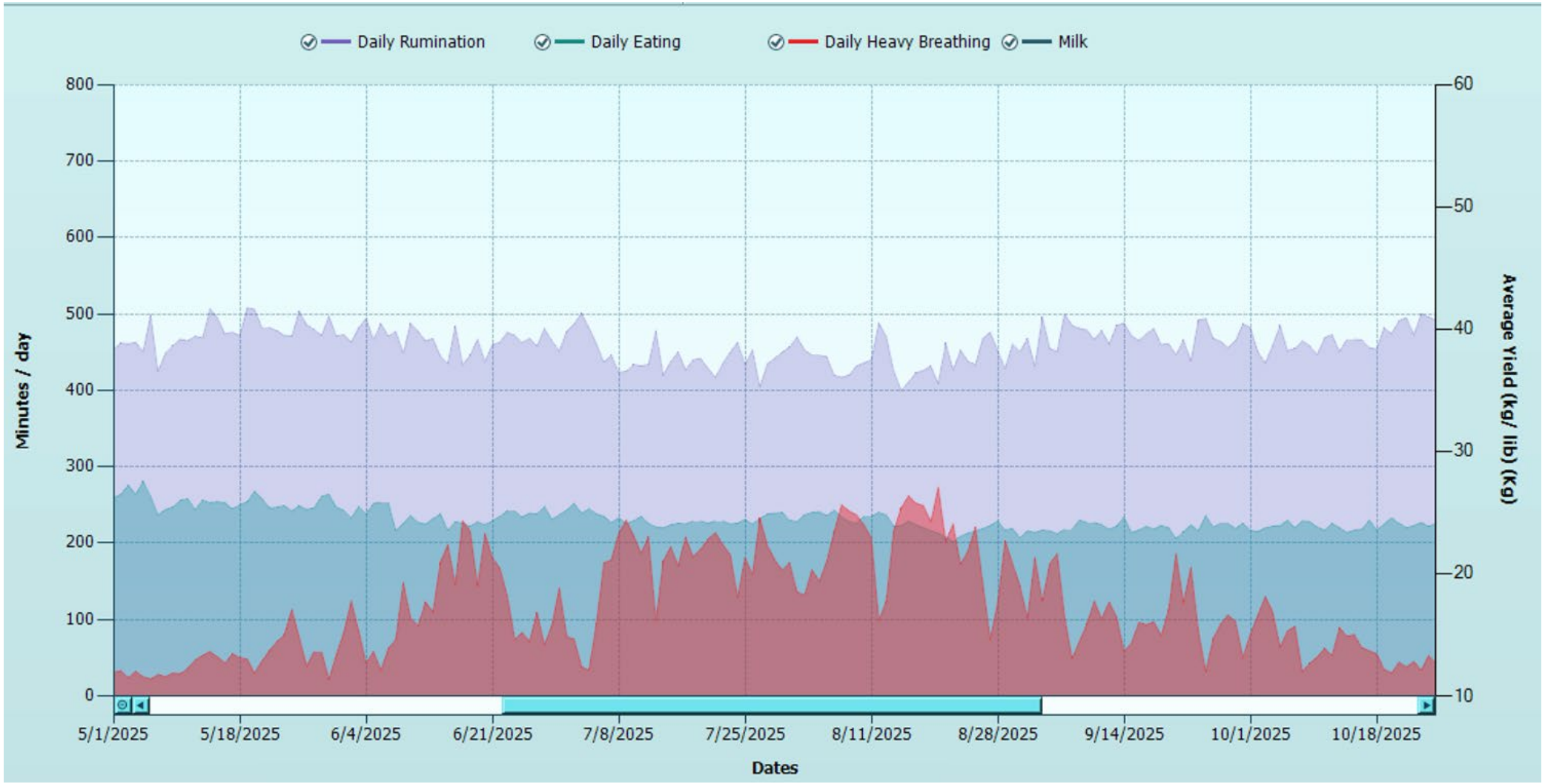






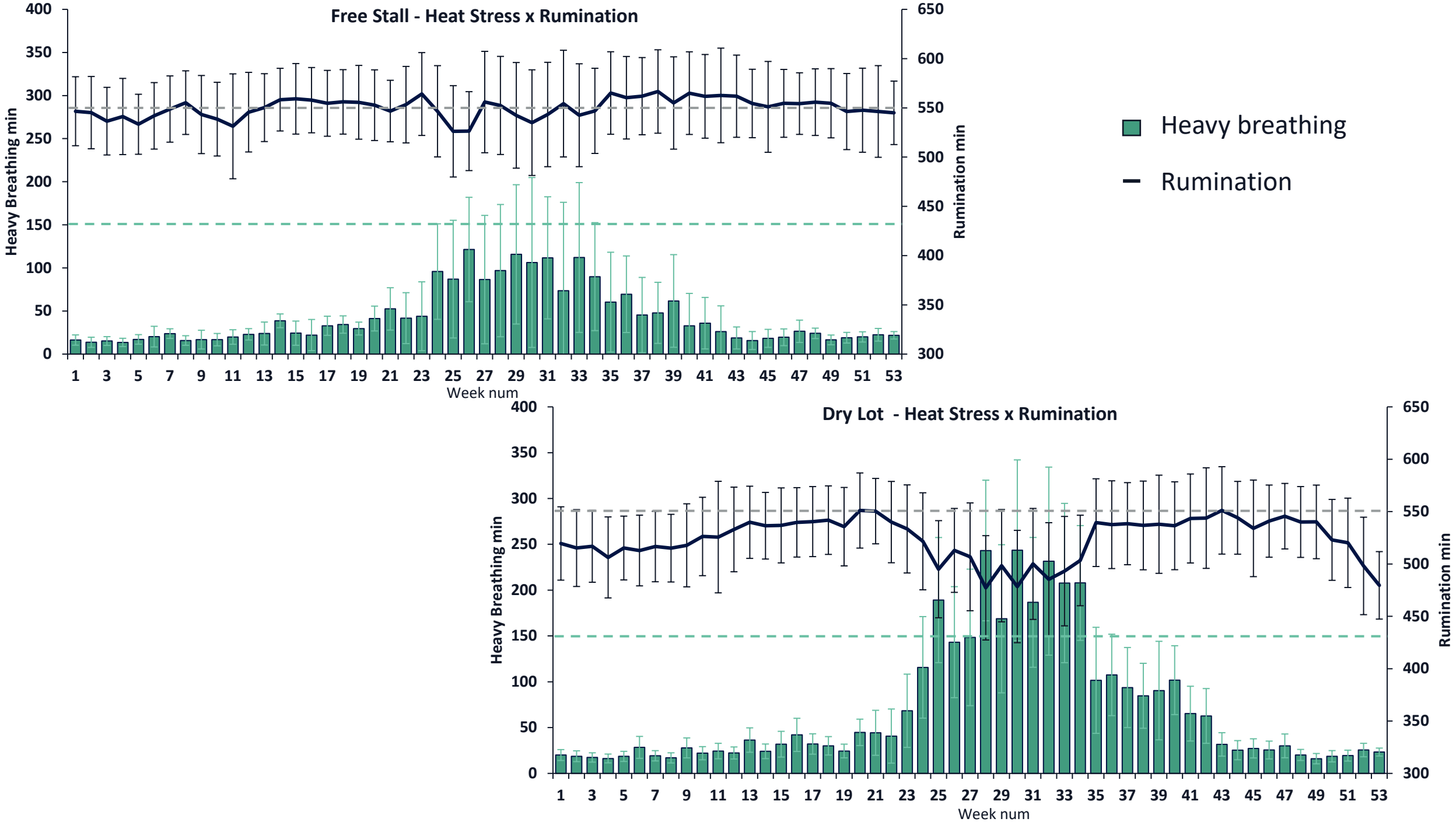
Confidential

Heat Stress



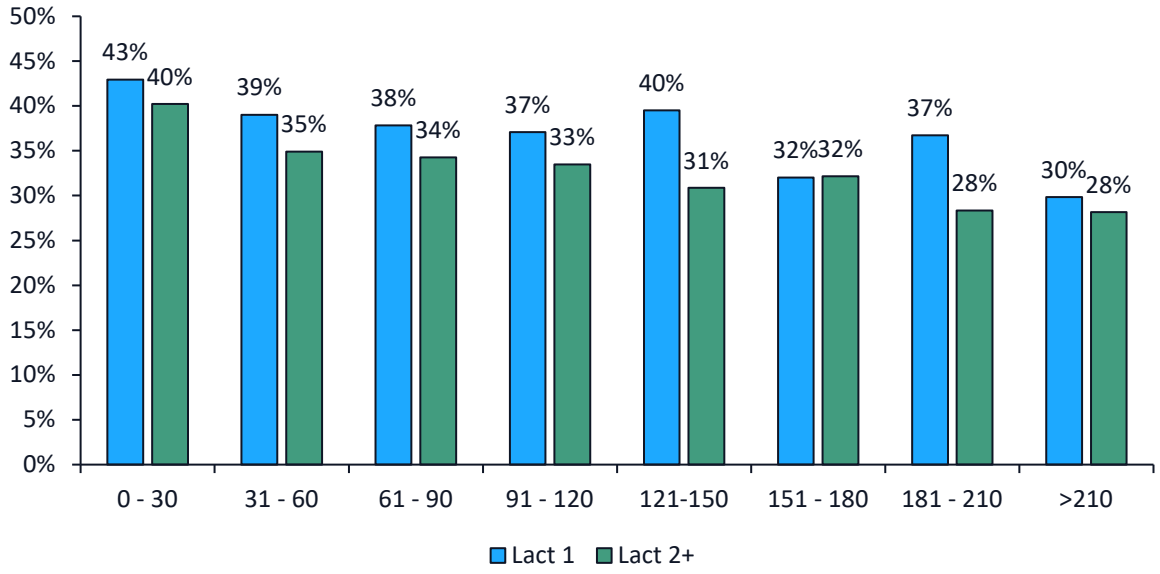
SenseHub™ DAIRY

MERCK Animal Health

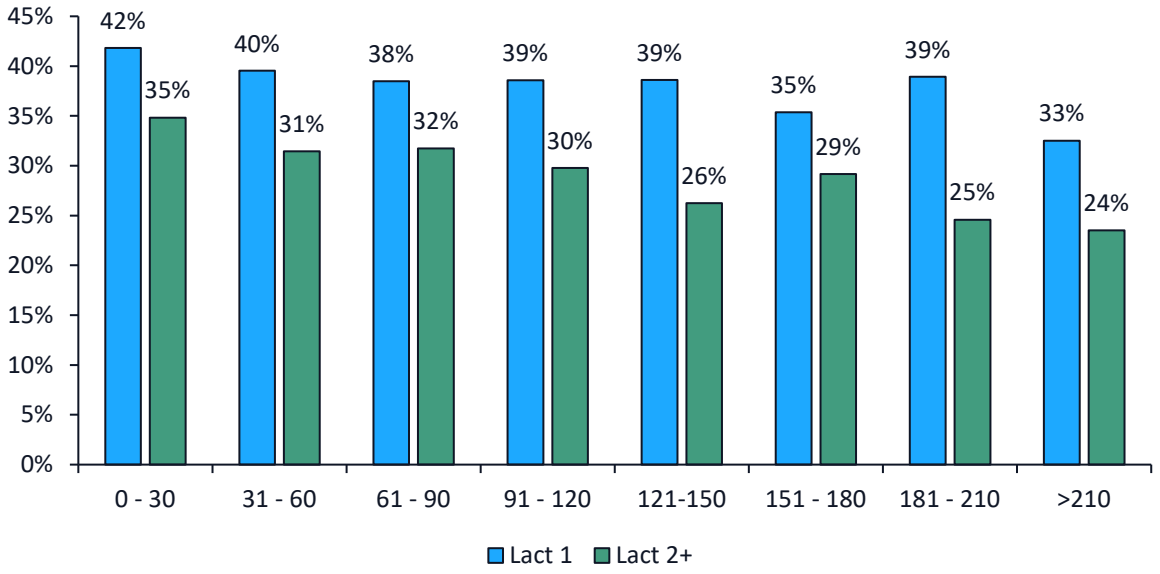

Free Stall - Heat Stress x Rumination
Heavy Breathing min
Rumination min
Week num
Heavy breathing
Rumination
Dry Lot - Heat Stress x Rumination
Heavy Breathing min
Rumination min
Week num

Confidential

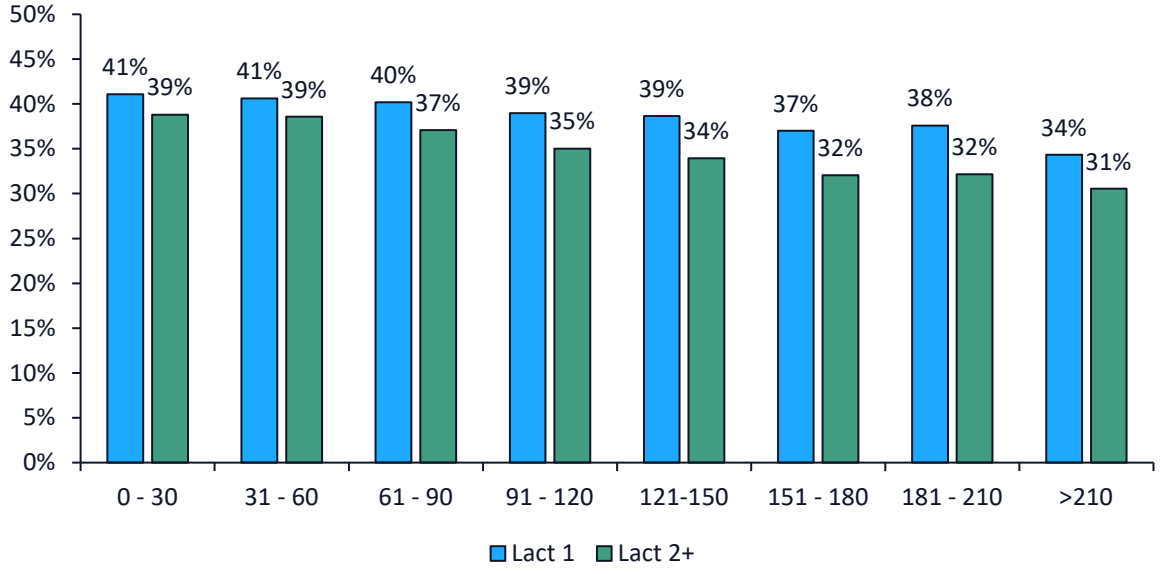
FS - All Cows and Services



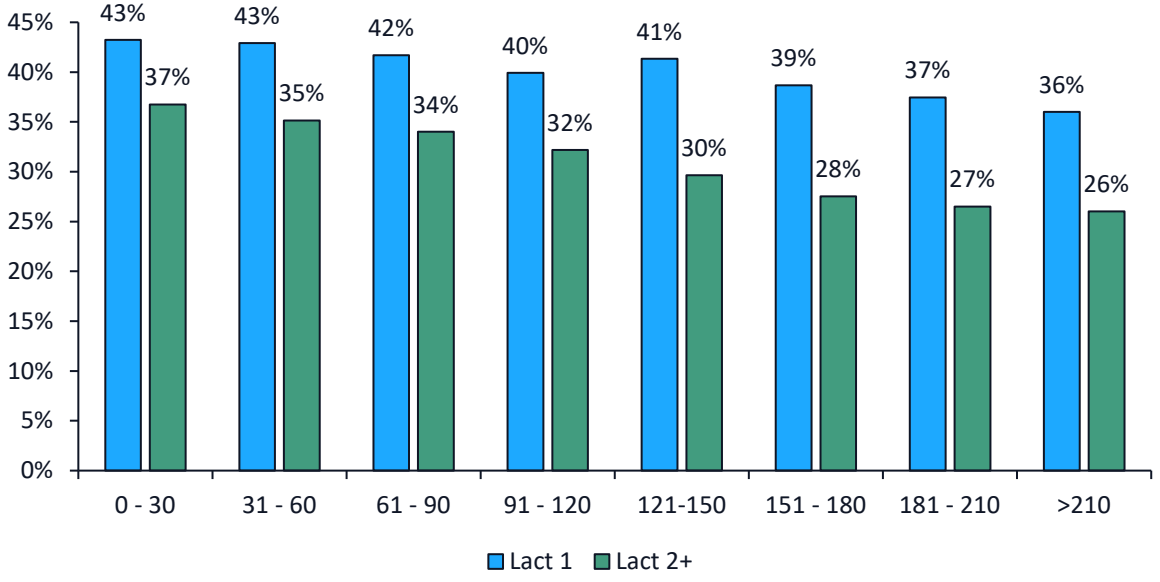
FS - All cows - Sexed



DL - All Cows and Services

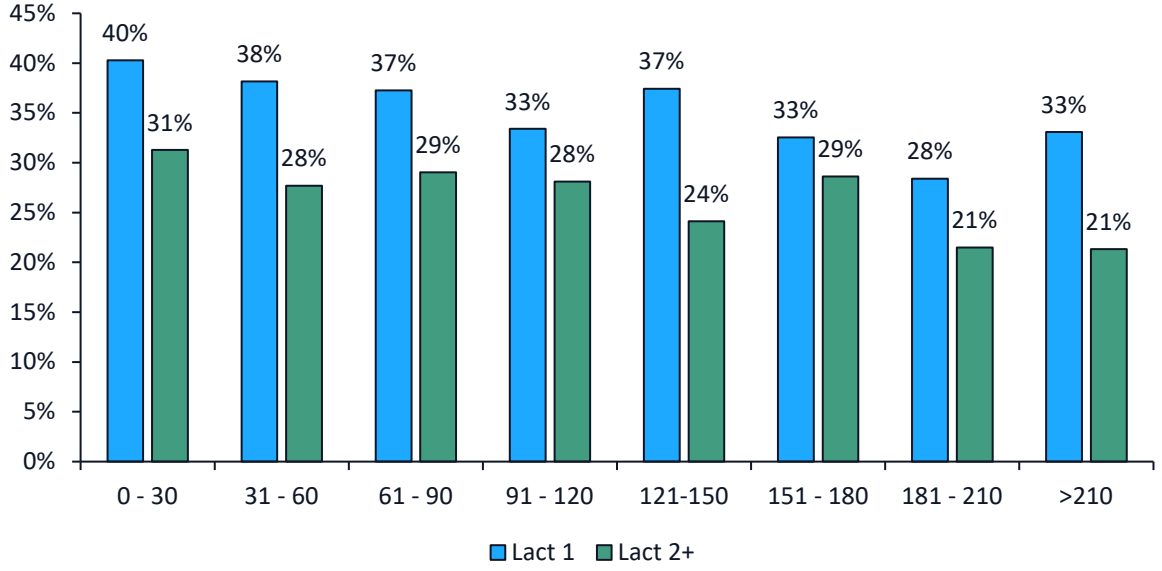


DL - All cows - Sexed

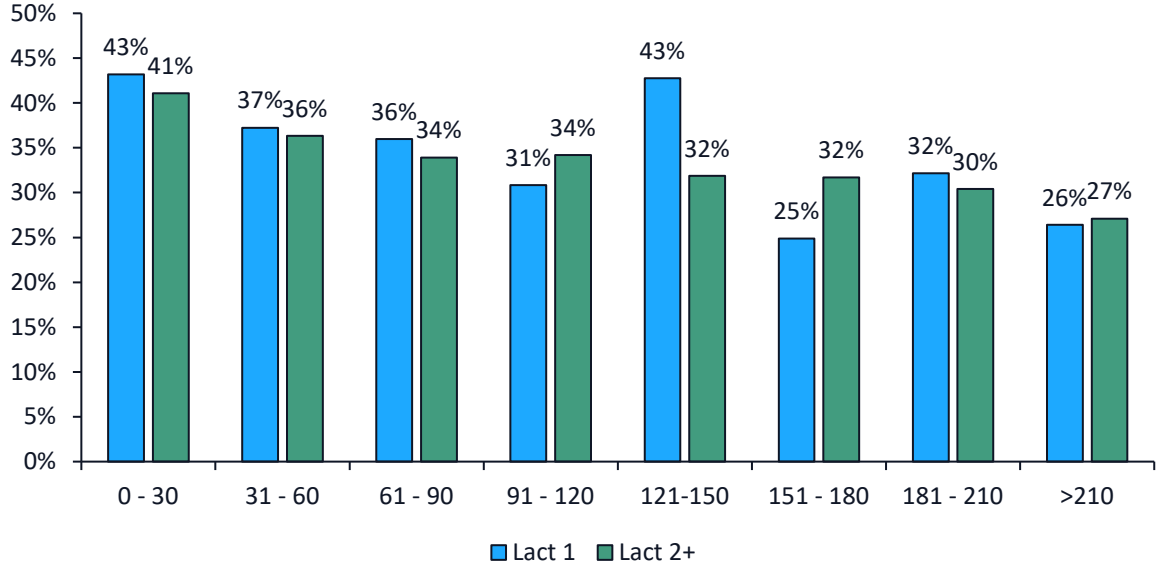


Confidential

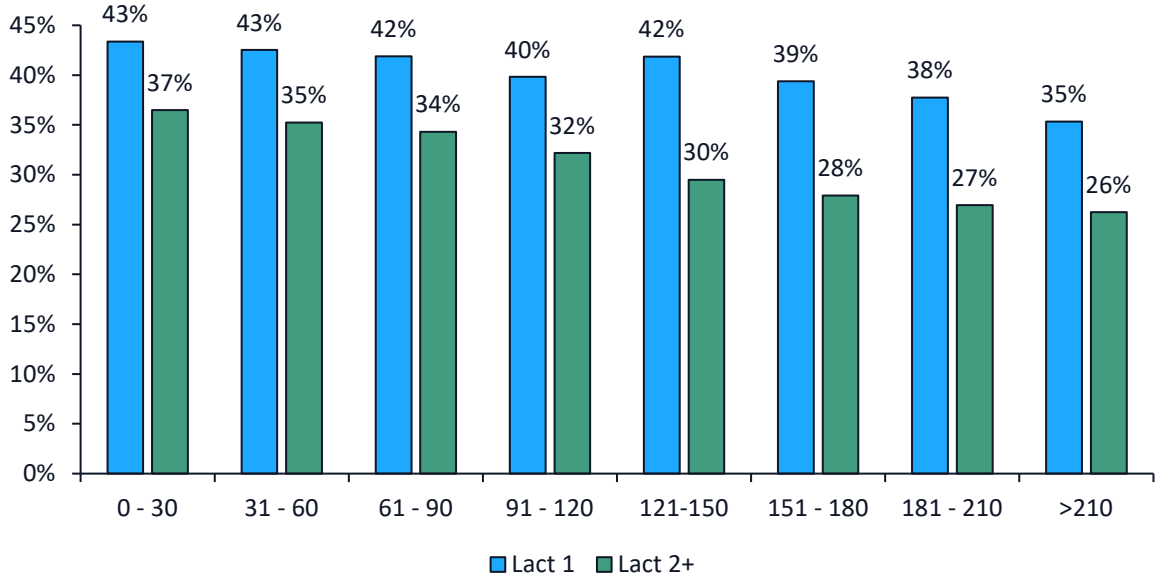
FS - Heat Cows - Sexed



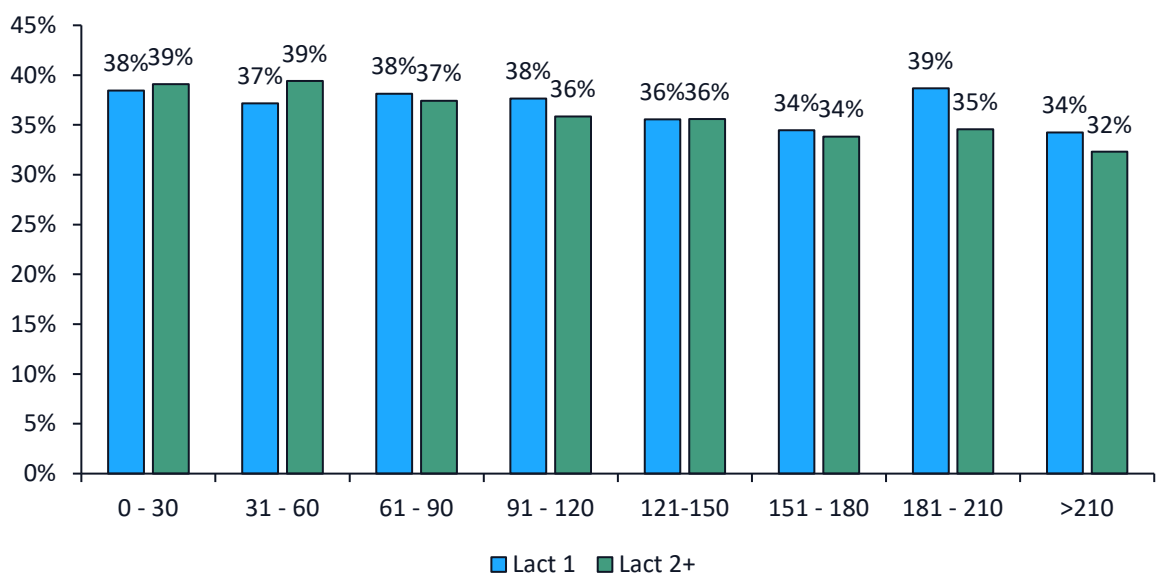
FS - Heat Cows - Beef



DL - Heat Cows - Sexed

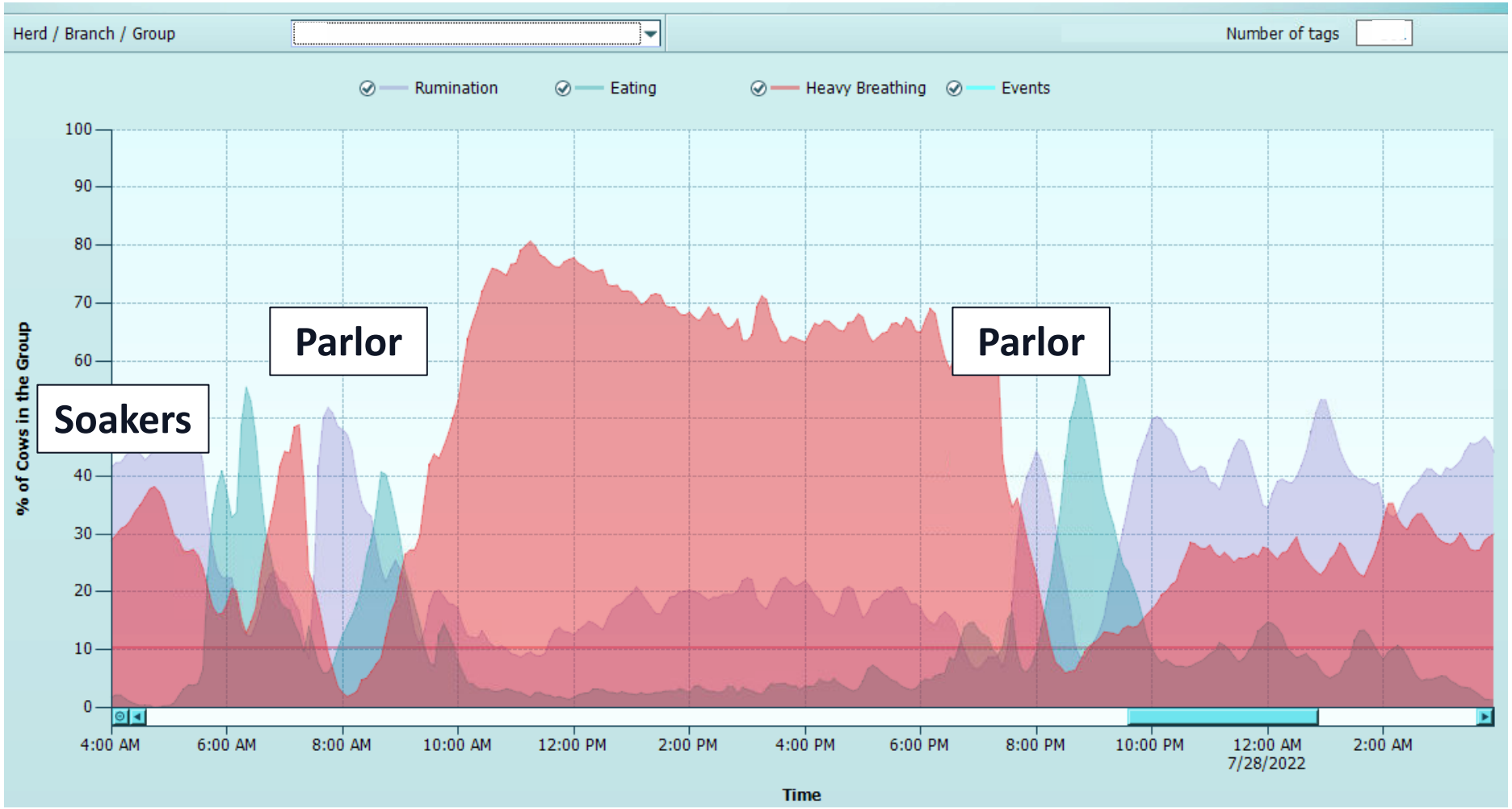


DL - Heat Cows - Beef



Confidential

Group Heat Stress

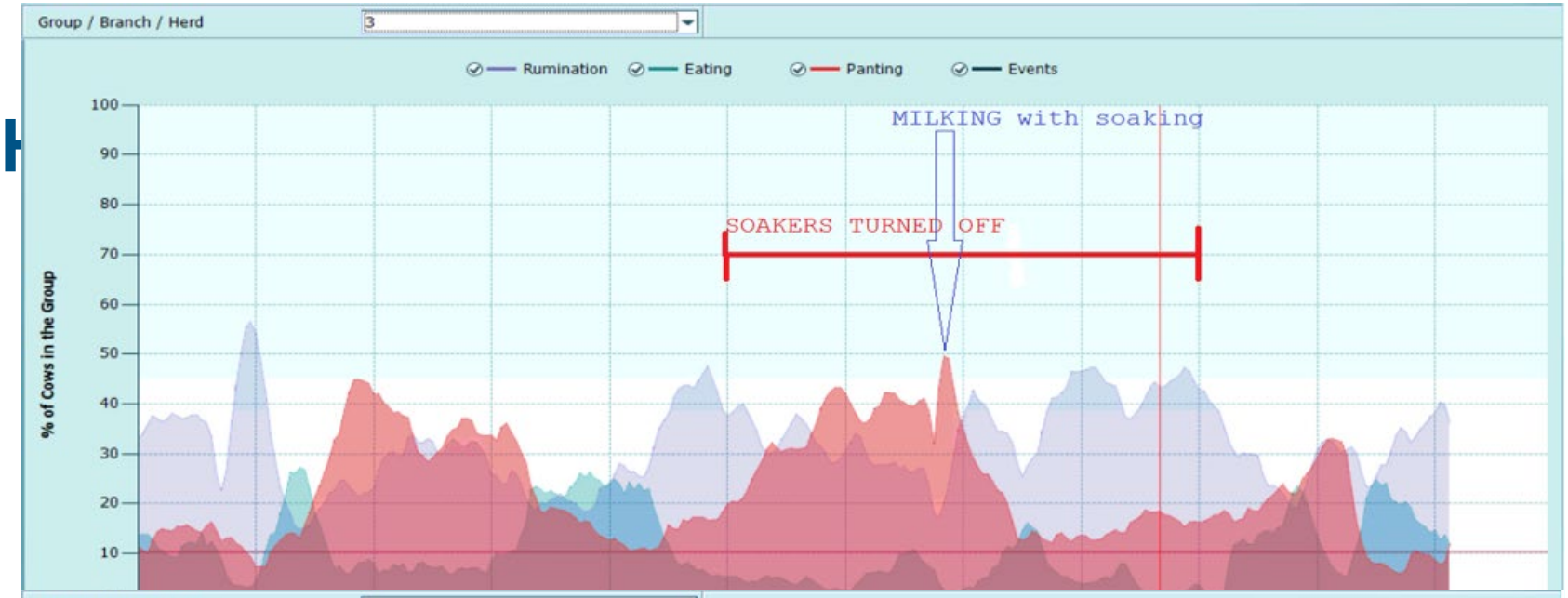


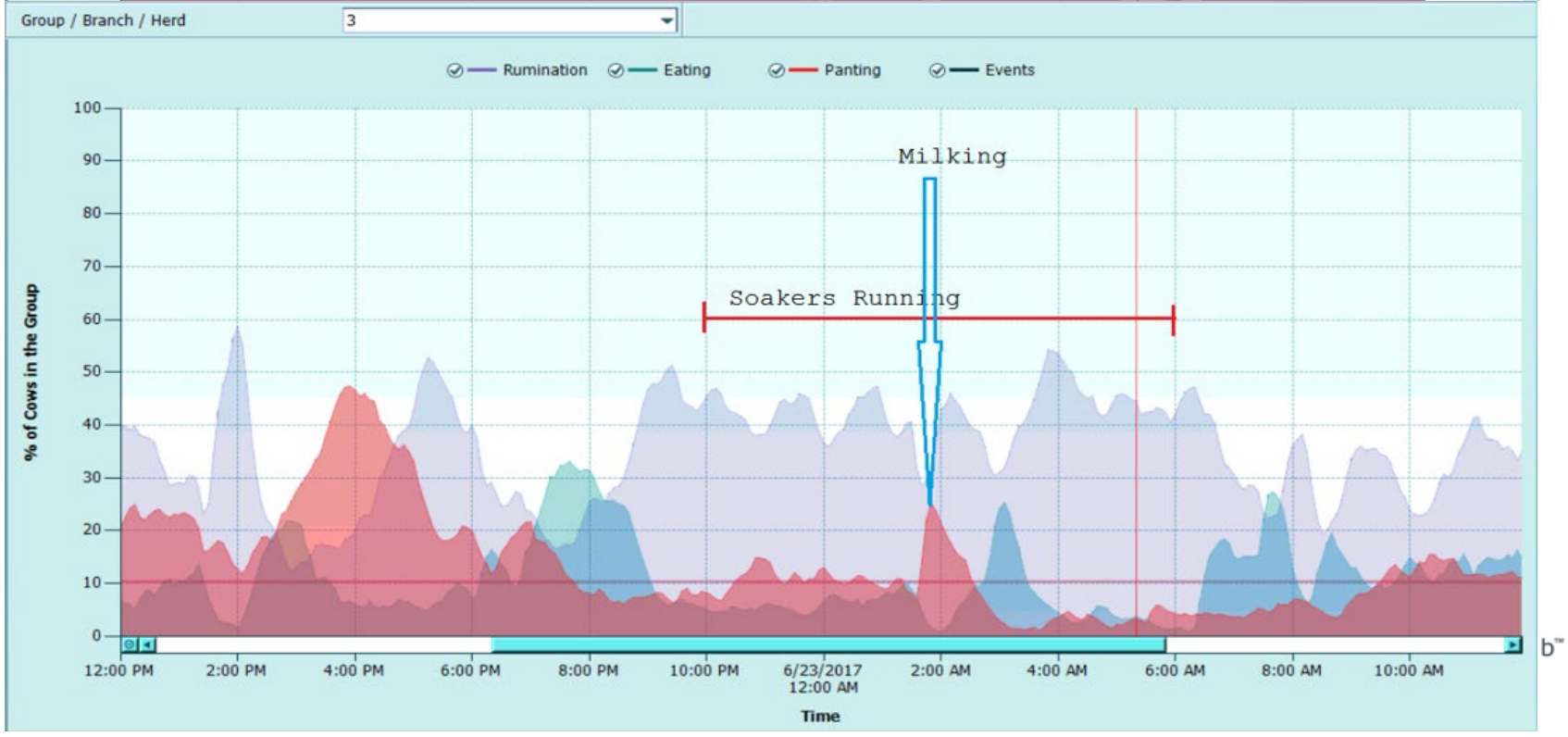
SenseHub™ DAIRY

MERCK Animal Health

Confidential

Group H





b™

MERCK
Animal Health

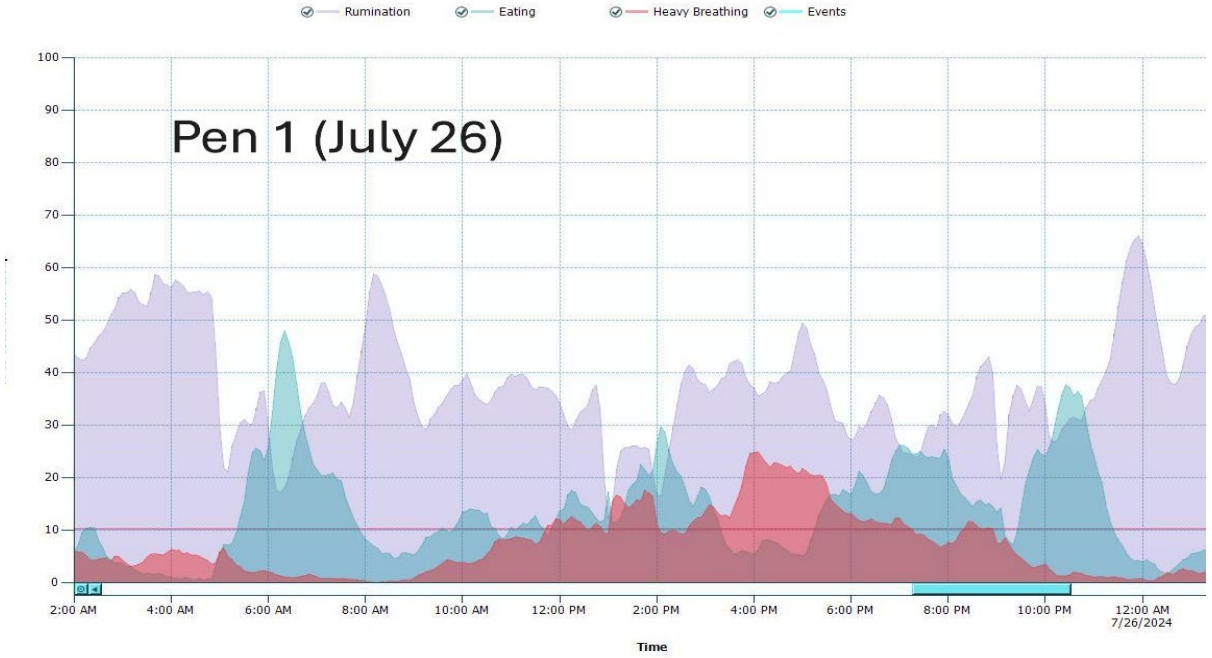
Confidential

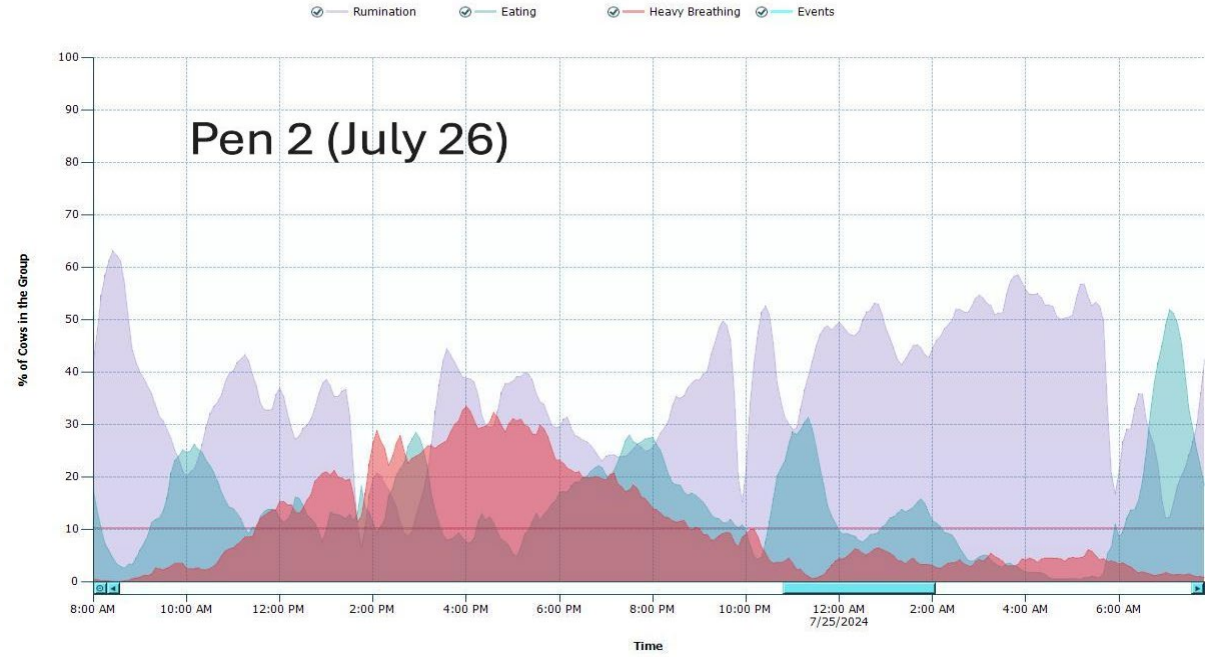
California Dairy

- Daily Heat Stress became a primary tracking metric immediately due to extreme heat waves that hit the area after install
- Fans turn on at 50% speed when temperature reaches 67 degrees; Full speed at 72 degrees
- Improvements in cooling systems were already planned for Winter 2024



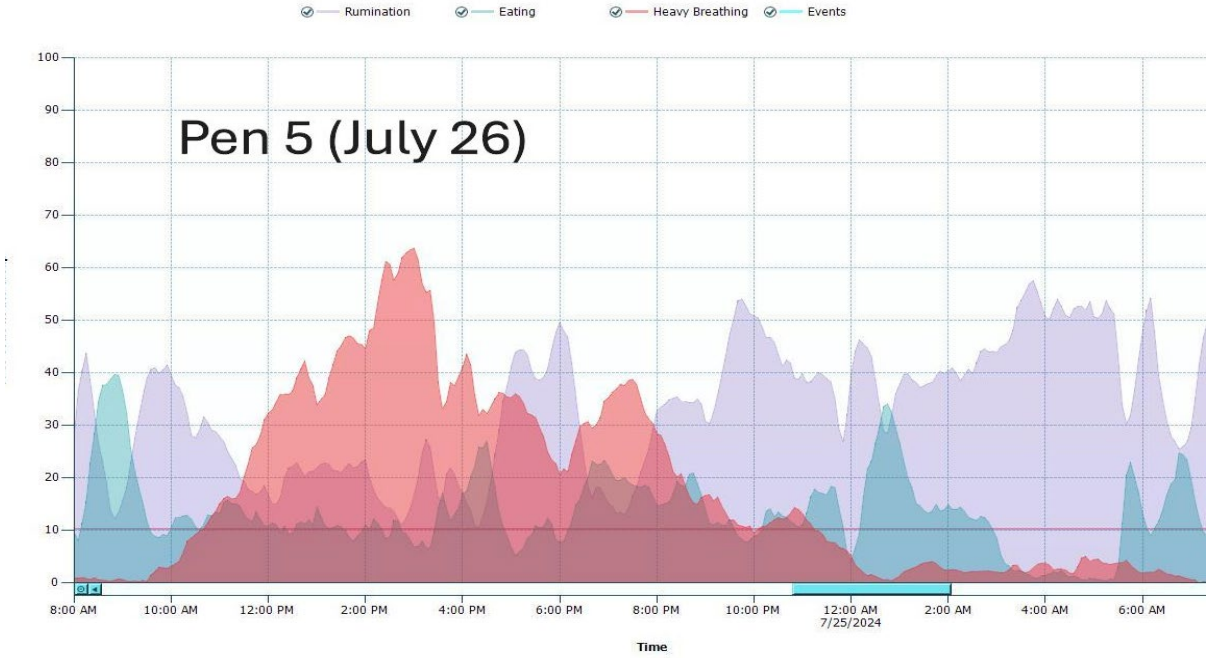
Confidential

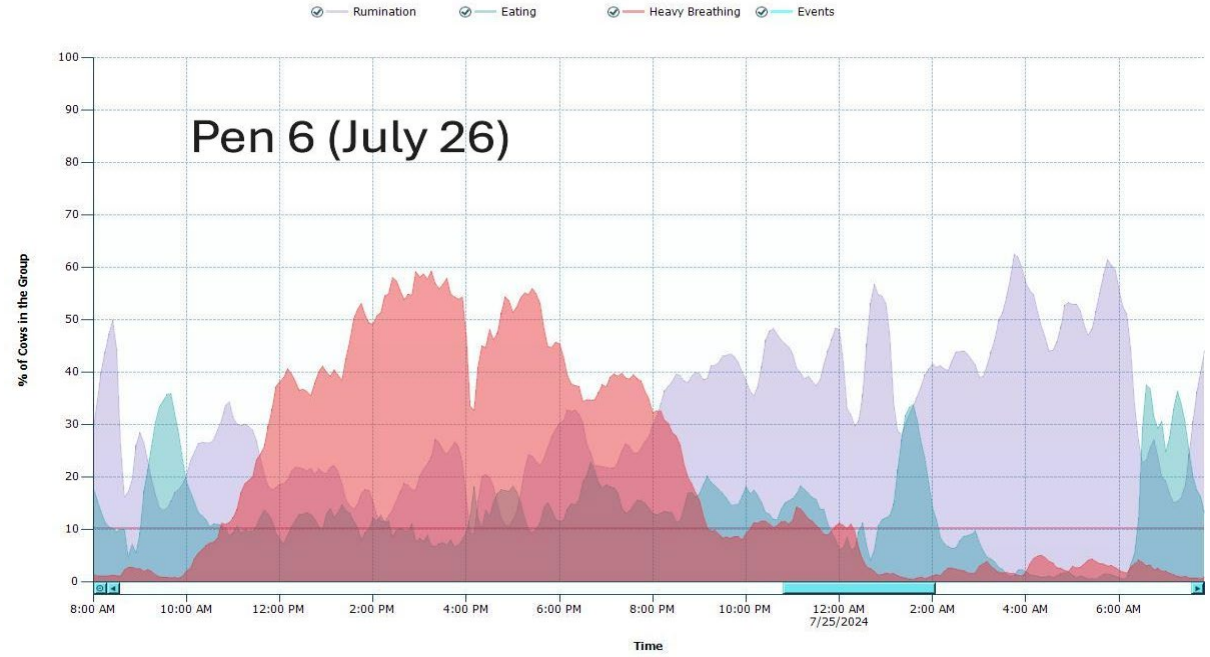






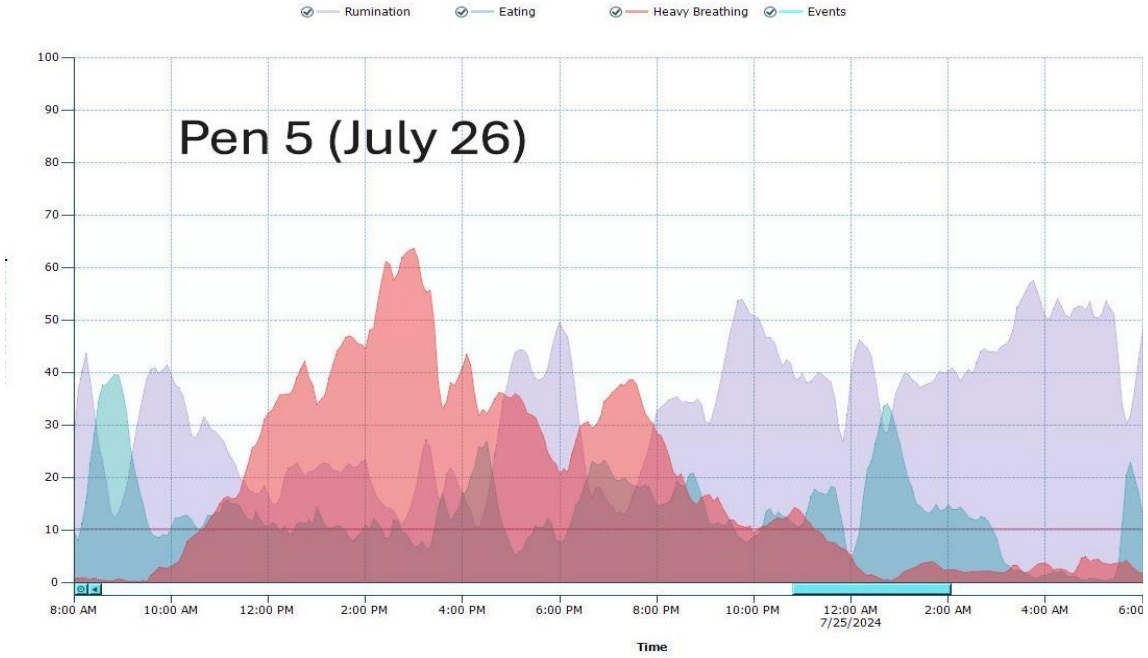
Confidential

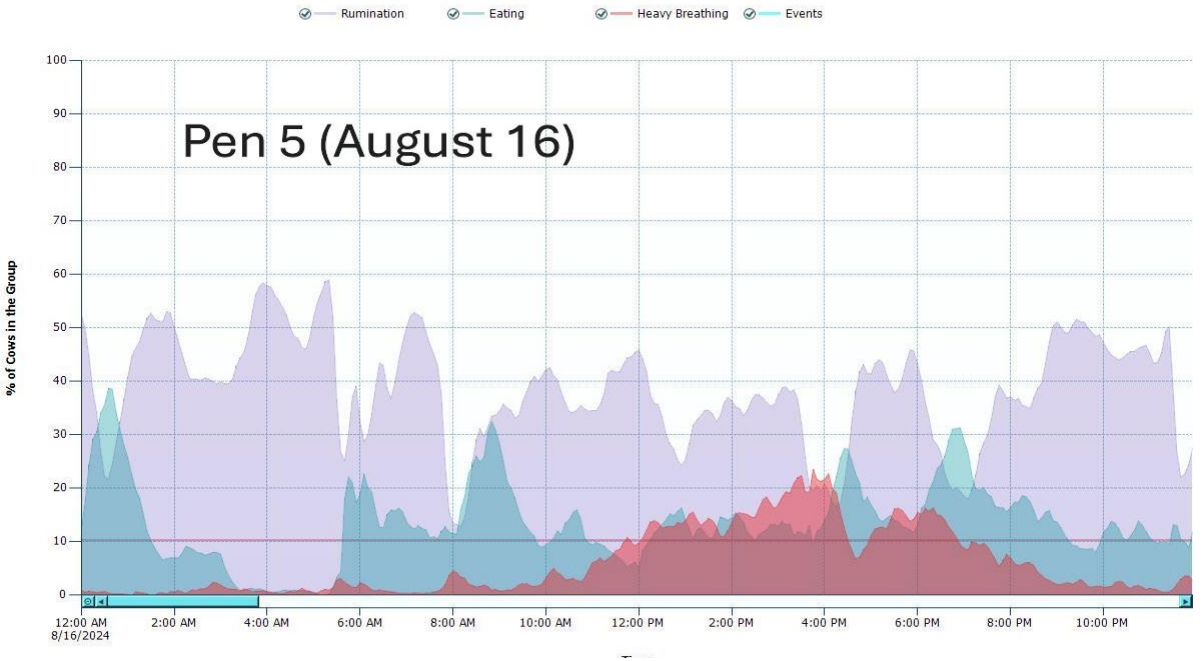


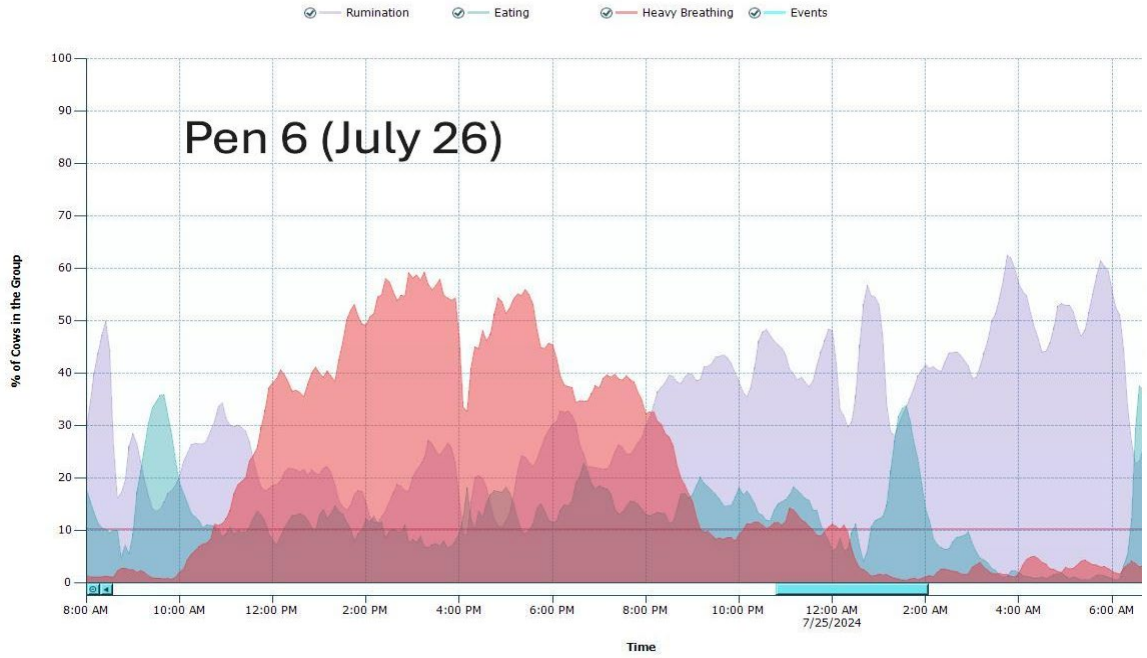


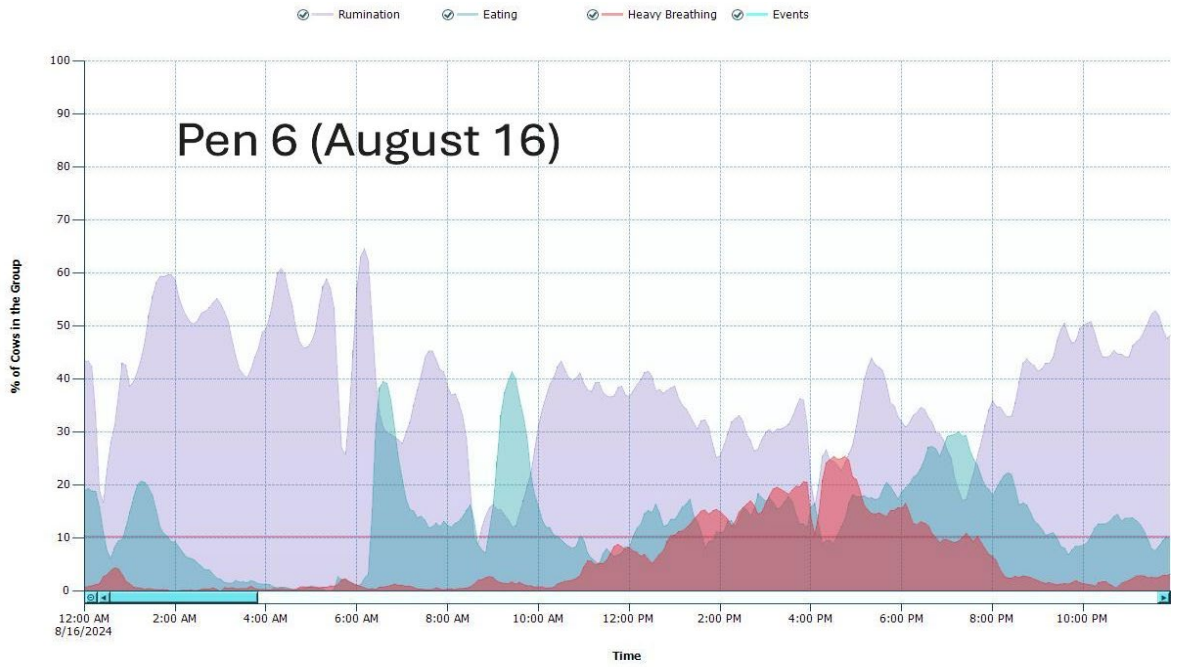


Confidential





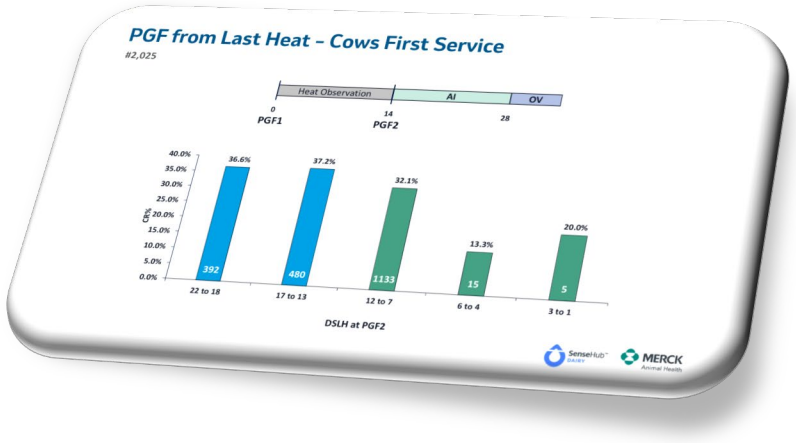




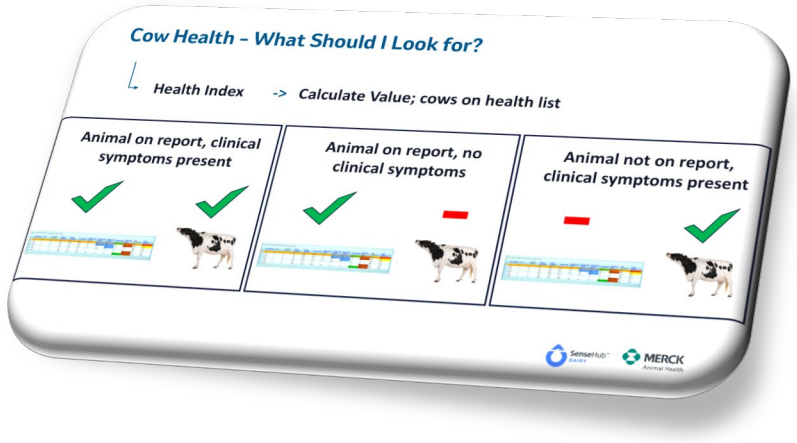
Confidential

Where We Go From Here

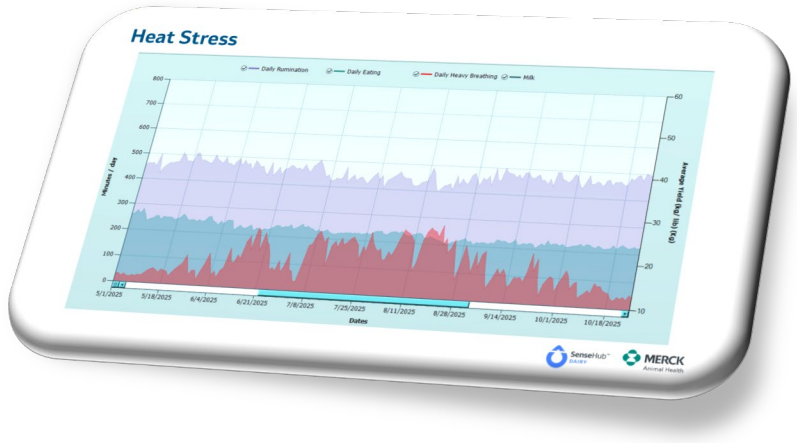
Reproduction



Cow Health



Heat Stress







SenseHub™ DAIRY

MERCK Animal Health

Caio Aranha Gamarra, DVM, MS

Customer Success Specialist – Key Accounts

608-628-6698

caio.aranha.gamarra@merck.com



This product is not intended to diagnose, treat, cure, or prevent any disease in animals. For the diagnosis, treatment, cure, or prevention of disease in animals, you should consult your veterinarian. The accuracy of the data collected and presented through this product is not intended to match that of medical devices or scientific measurement devices.

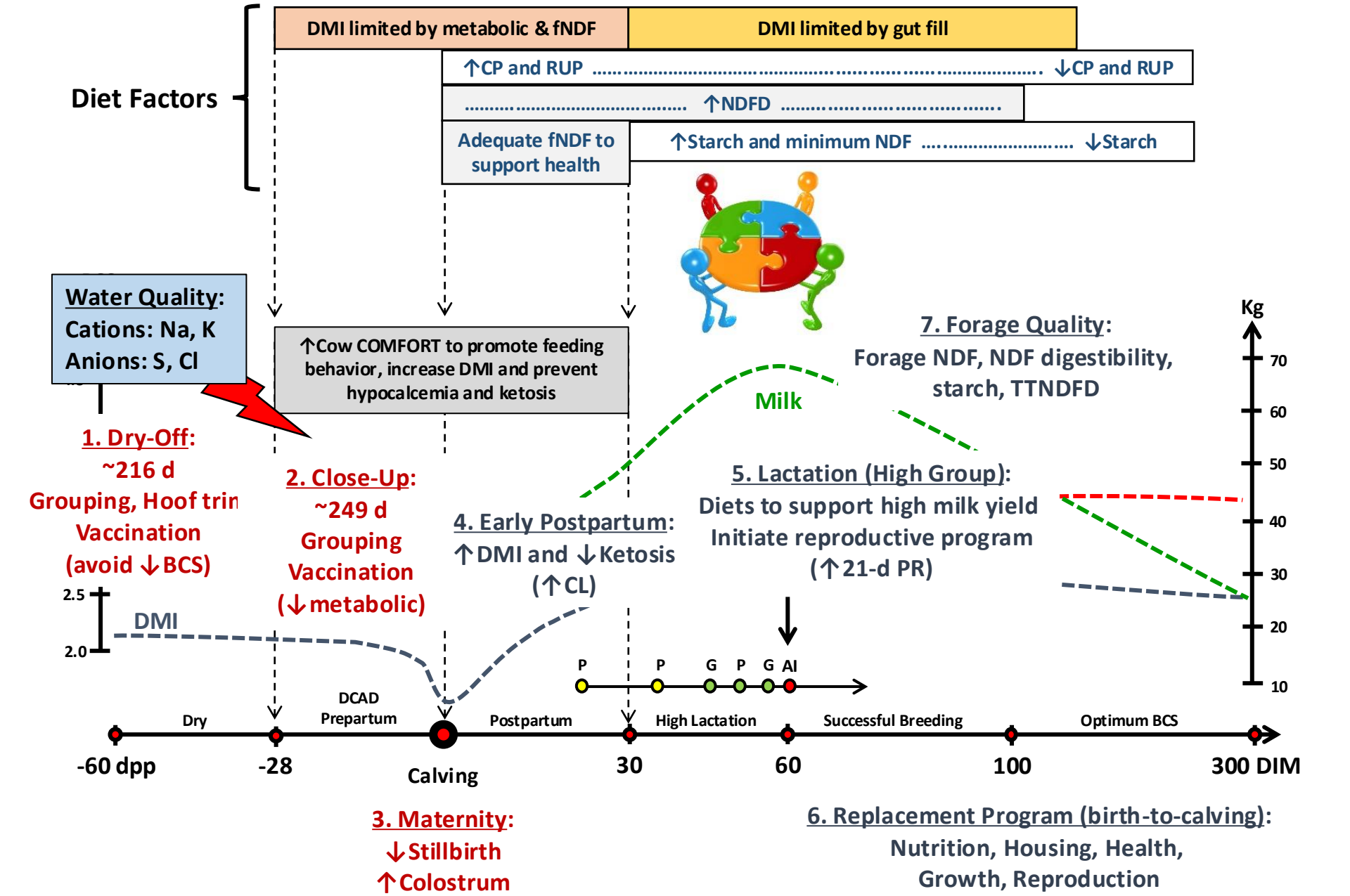
Copyright ©2023 Merck & Co., Inc., Rahway, NJ, USA and its affiliates. All rights reserved.

The Transition Cow: Where Health, Reproduction, Milk Peak, and Profit are Won or Lost

Gustavo M. Schuenemann, DVM, MS, PhD
Dairy Cattle Extension Specialist and Veterinarian
Department of Veterinary Preventive Medicine,
College of Veterinary Medicine

THE OHIO STATE UNIVERSITY

(©2026 G.M. Schuenemann)



(NDF = Neutral detergent fiber, fNDF = forage NDF, NDFD = NDF digestibility, CP = Crude protein, RUP = Rumen undegradable protein; adapted from VandeHaar et al., 2015 JDS 99:4941–4954)

(©2026 G.M. Schuenemann)

Where Are the Opportunities?



↓Intake
↑BCS loss
↑Metabolic disorders
↑Mastitis
↑Culling
↓Reproduction
↓Milk yield



↑Intake
↓Metabolic disorders
↓Culling & SCC
↑Reproduction
↑Milk yield and components

(©2026 G.M. Schuenemann)

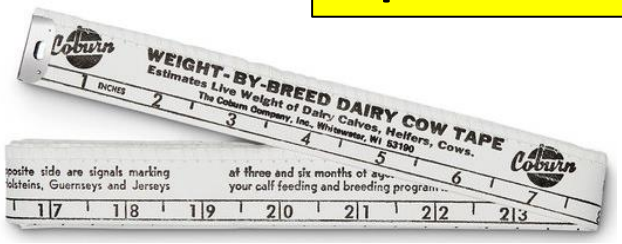
(Grant and Albright, 2001; Wiltbank et al., 2002; Theriogenology 57:21-52; Huzzey et al., 2006 JDS 90:3220–3233; Bach et al., 2008 JDS 91:3259–3267; Schuenemann et al. 2021 JDS 104:277(Suppl.1); Horst et al., 2021 JDS 104:8380–8410)

Opportunity #1: Effective Heifer Replacement Program

Objective: <2% mortality pre-weaning, ≥2x BW by weaning (60 d of age), >90% pregnant within first 2 services (13-15 mo) with ~55% mature BW and calving at 23-24 mo with ~80% mature BW (ADG ~1.8-2 lb/d or 0.8-0.9 kg/d)

Mature BW is determined in Lact 3-4 at 100-120 DIM

Tape or Scale = ↑Control & ↓Riesk





"You cannot manage what you do not measure!

(©2026 G.M. Schuenemann)

Opportunity #2: Effective Transition Cow Program

Objective: Achieve consistency in maternity (<2% stillbirth), reproductive performance ≥30% 21-d PR, milk yield ~45 kg/d ECM (4.2% F, 3.5% P), <150,000 SCC/mL, and longevity >3.2 lactations with positive financial outcomes



(©2026 G.M. Schuenemann)

Opportunity #3: Effective Forage Quality Program

Objective: Produce sufficient quantities of highly digestible forage (fiber and starch) with minimal soil, mycotoxins, and bacteria contamination

Forage Quality is Usually the Limiting Factor for DMI on Most Dairy Farms

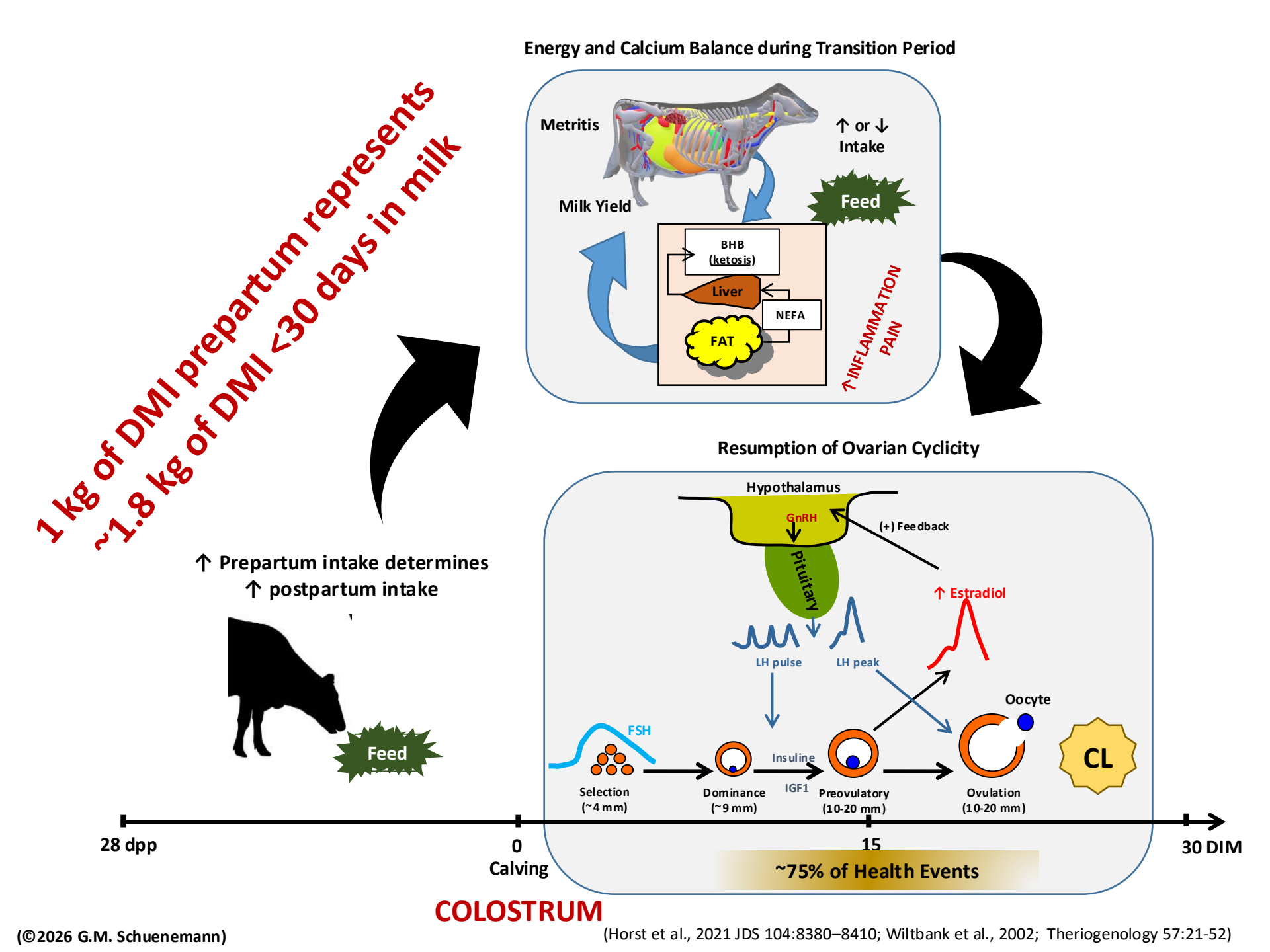
(©2026 G.M. Schuenemann)

Opportunity #4: Effective Training Program with Strong Emphasis on Prevention and a Process of Continuous Improvement

Objective: Have all protocols written down (simple but informative), implement a training schedule that is integrated and consistent with the protocols and facilities, and schedule regular meetings to review processes and goals



(©2026 G.M. Schuenemann)



(©2026 G.M. Schuenemann)

(Horst et al., 2021 JDS 104:8380–8410; Wiltbank et al., 2002; Theriogenology 57:21-52)

J. Dairy Sci. 102:3348–3361
https://doi.org/10.3168/jds.2018-15386
© American Dairy Science Association®, 2019.

Associations of pre- and postpartum lying time with metabolic, inflammation, and health status of lactating dairy cows

J. M. Piñeiro,[1]* B. T. Menichetti,[1] A. A. Barragan,[1]† A. E. Relling,[2] W. P. Weiss,[2] S. Bas,[1]‡ and G. M. Schuenemann[1]§
[1]Department of Veterinary Preventive Medicine, The Ohio State University, Columbus 43210
[2]Department of Animal Sciences, The Ohio State University, Wooster 44691

J. Dairy Sci. 103:11782–11794
https://doi.org/10.3168/jds.2020-18629
© 2020 American Dairy Science Association®. Published by Elsevier Inc. and Fass Inc. All rights reserved.

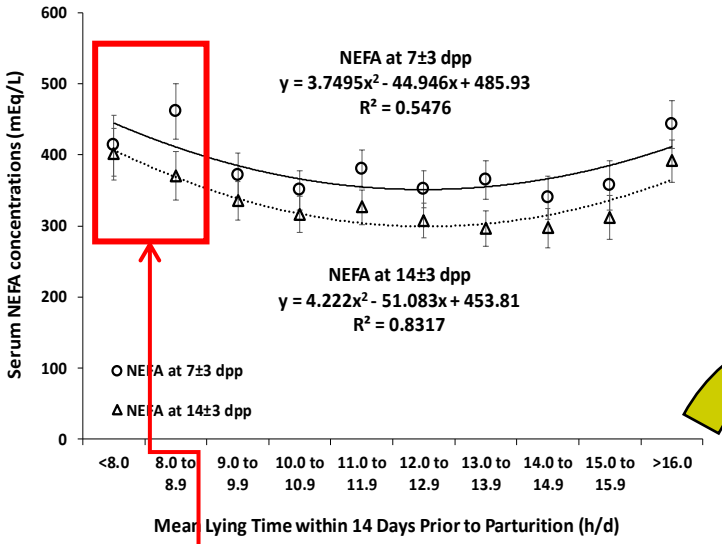
Association of prepartum lying time with nonesterified fatty acids and stillbirth in prepartum dairy heifers and cows

B. T. Menichetti,[1] J. M. Piñeiro,[1]* A. A. Barragan,[1]† A. E. Relling,[2] A. Garcia-Guerra,[3] and G. M. Schuenemann[1]‡
[1]Department of Veterinary Preventive Medicine, The Ohio State University, Columbus 43210
[2]Department of Animal Sciences, The Ohio State University, Wooster 44691
[3]Department of Animal Sciences, The Ohio State University, Columbus 43210

Prepartum

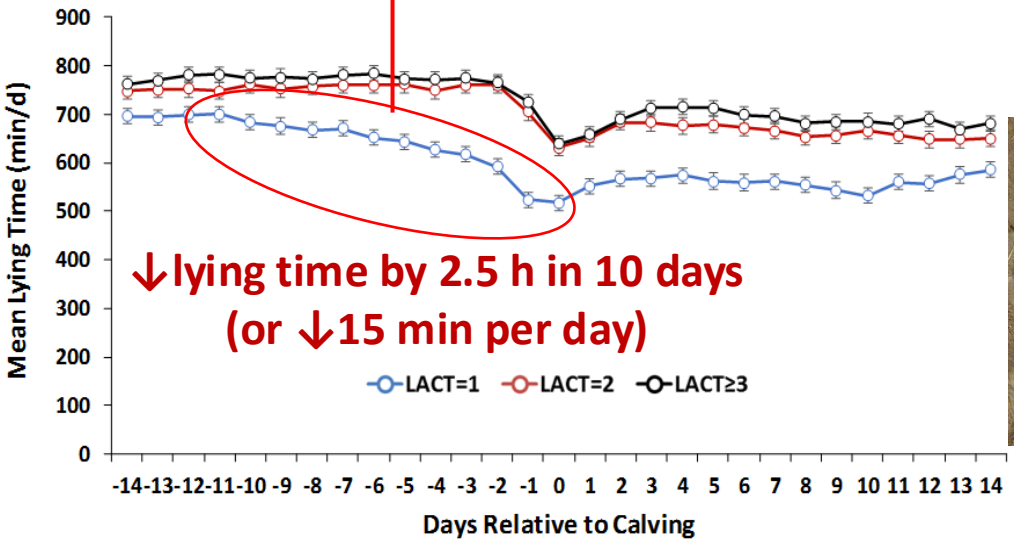






Sick Transition Cows:

- 2.5x ↑NEFA prepartum & ↓BCS loss
- 2x ↑Stillbirth
- 1.5x ↑Hypocalcemia
- 3.5x ↑Haptoglobin
- ↑Metritis, ↓Cyclicity/Reprod/Milk



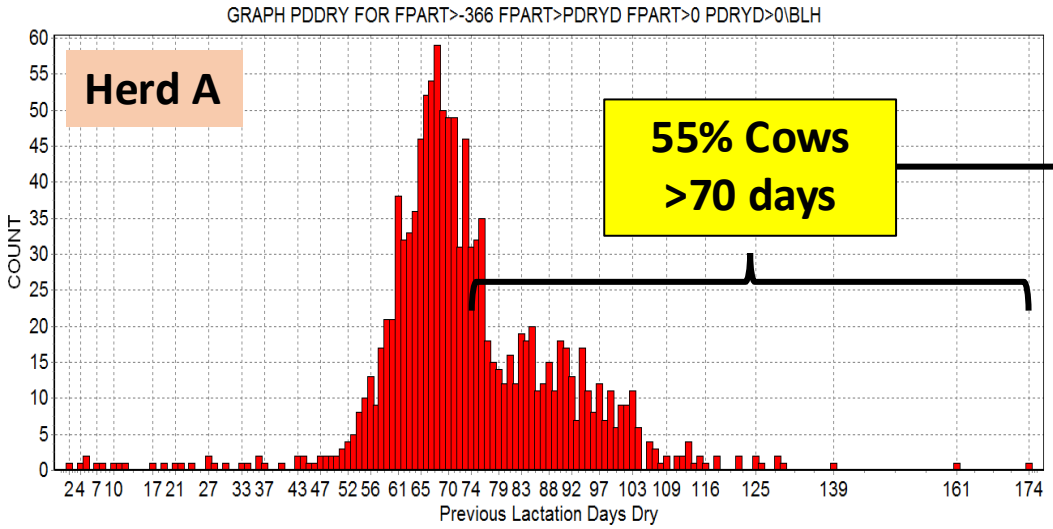
Maternity & Post-Partum

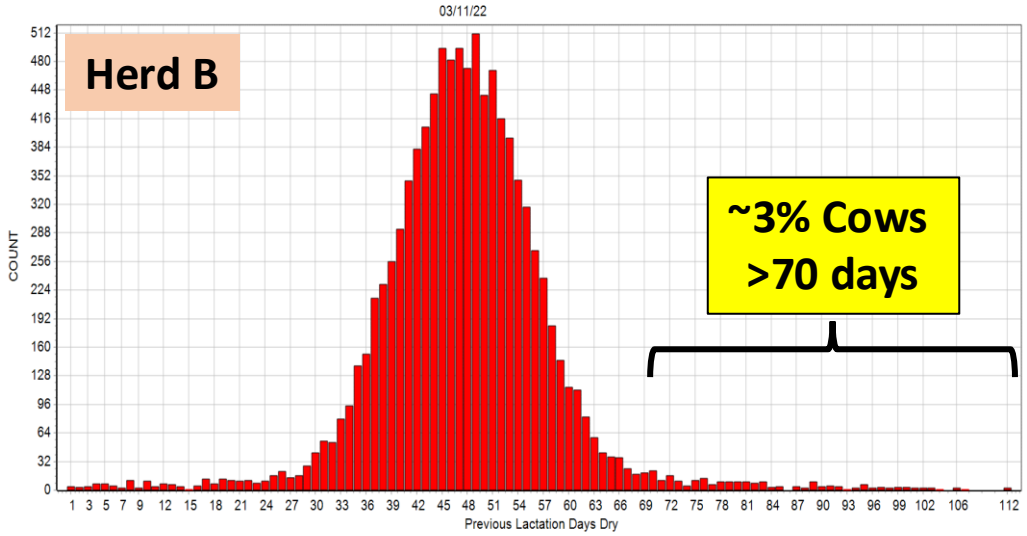




(©2026 G.M. Schuenemann)

Does the Pattern of Previous Dry Period Lengths Match the Management Plan?





↑NEFA Prepartum
↑Ketosis Post-partum



If feeding diet high in energy (1.55 Mcal/kg)

~5 Mcal/d x 70 d = 350 Mcal

= ↑0.75 BCS

(©2026 G.M. Schuenemann)

If anionic diet is fed, vaccinate cows at dry-off 56-60 dpp and at 28 dpp:

↑Energy, ↓hypocalcemia, ↑IgG

J. Dairy Sci. TBC:1–14
https://doi.org/10.3168/jds.2021-20242
JDS20242
© TBC American Dairy Science Association®. Published by Elsevier Inc. and Fass Inc. All rights reserved.

Effect of timing of prepartum vaccination relative to pen change with an acidogenic diet on lying time and metabolic profile in Holstein dairy cows

B. T. Menichetti,[1] A. Garcia-Guerra,[2] J. Lakritz,[3] W. P. Weiss,[4] J. S. Velez,[5] H. Bothe,[5] D. Merchan,[6] and G. M. Schuenemann[1]*
[1]Department of Veterinary Preventive Medicine, The Ohio State University, Columbus 43210
[2]Department of Animal Sciences, The Ohio State University, Columbus 43210
[3]Department of Veterinary Clinical Sciences, The Ohio State University, Columbus 43210
[4]Department of Animal Sciences, The Ohio State University, Wooster 44691
[5]Aurora Organic Farms, Boulder, CO 80302
[6]ABS Global Inc., DeForest, WI 53532

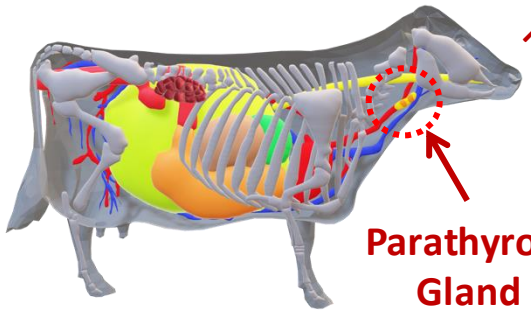
J. Dairy Sci. 104
https://doi.org/10.3168/jds.2021-20243
© 2021 American Dairy Science Association®. Published by Elsevier Inc. and Fass Inc. All rights reserved.

Effects of prepartum vaccination timing relative to pen change with an acidogenic diet on serum and colostrum immunoglobulins in Holstein dairy cows

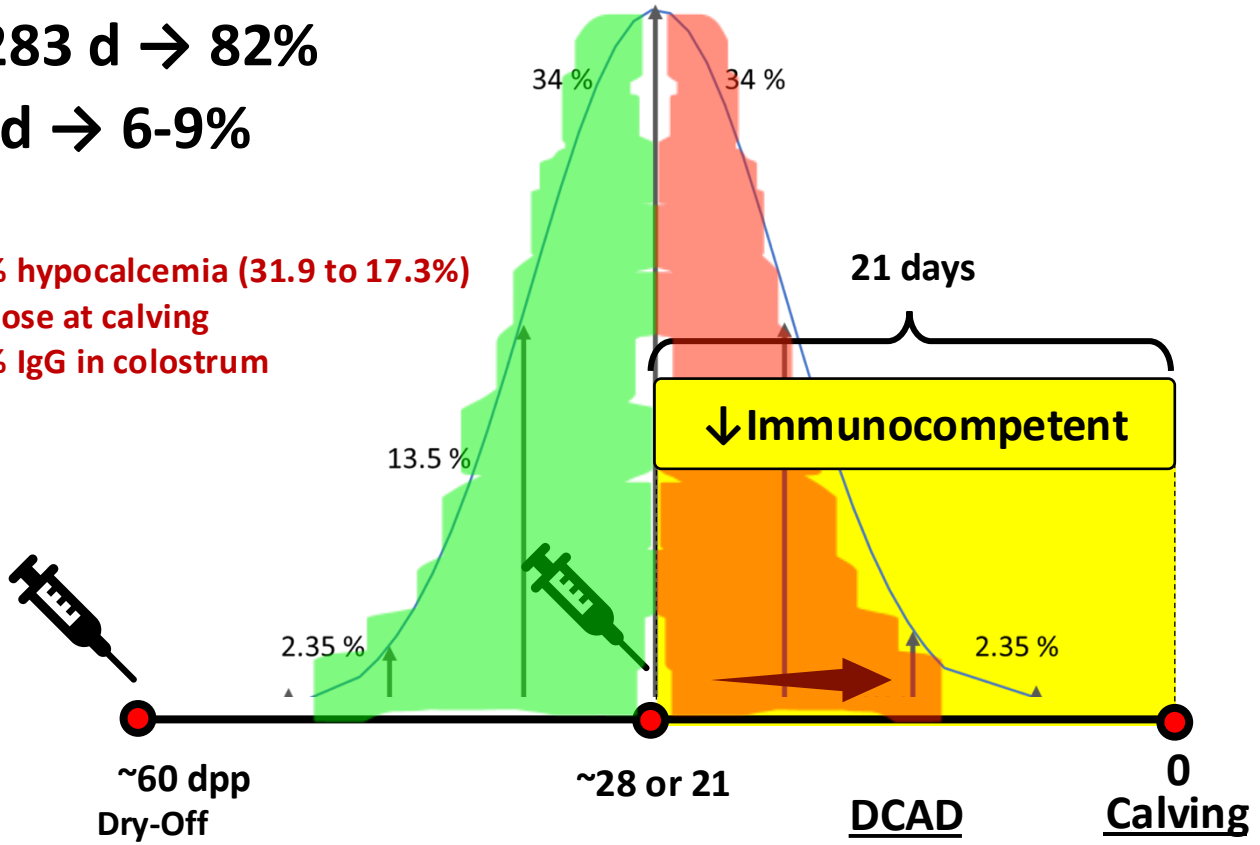
B. T. Menichetti,[1] A. Garcia-Guerra,[2] J. Lakritz,[3] W. P. Weiss,[4] J. S. Velez,[5] H. Bothe,[5] D. Merchan,[6] and G. M. Schuenemann[1]*
[1]Department of Veterinary Preventive Medicine, The Ohio State University, Columbus 43210
[2]Department of Animal Sciences, The Ohio State University, Columbus 43210
[3]Department of Veterinary Clinical Sciences, The Ohio State University, Columbus 43210
[4]Department of Animal Sciences, The Ohio State University, Wooster 44691
[5]Aurora Organic Farms, Boulder, CO 80302
[6]ABS Global Inc., DeForest, WI 53532

- **Gestation Length of 278 days**
  - Short: 254-269 d → ~9-12%
  - Average: 270-283 d → 82%
  - Long: 284-298 d → 6-9%

↓~46% hypocalcemia (31.9 to 17.3%)
↑ Glucose at calving
↑~20% IgG in colostrum



Parathyroid Gland



(©2026 G.M. Schuenemann)

>80% Wheat Straw Samples Contaminated with DON (50% >1000 ppb)

(Schuenemann et al. 2025 with 150 samples; Revealing the mycotoxin risk in straw, 2022. Source: https://www.allaboutfeed.net/all-about/mycotoxins/revealing-the-mycotoxin-risk-in-straw/?utm_source=chatgpt.com

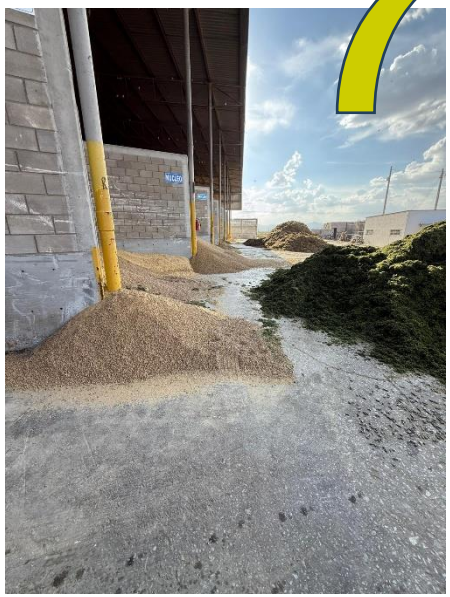




~30% Wheat Straw in Prepartum

(©2026 G.M. Schuenemann)

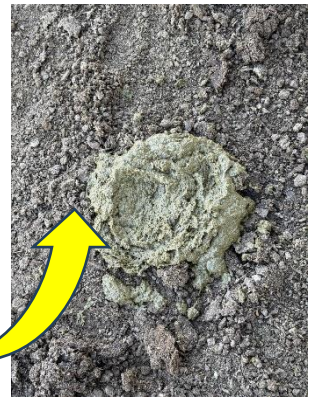
TMR AUDIT: Hygiene & Variation to ↑DMI >> ↑Health/Rumen >> ↑MILK (↑%F and ↓SCC) and ↑Reproduction (↓abortion)











Team

(©2026 G.M. Schuenemann)

The 4 Pillars of Feed Hygiene Assessment

Dirt/Mineral Contamination:

- Ash %, fermentation profile (butyric acid), heavy metals (Cd, As, and Pb)



Microbial Stability:

- Molds, yeasts, pathogenic bacteria

Mycotoxins:

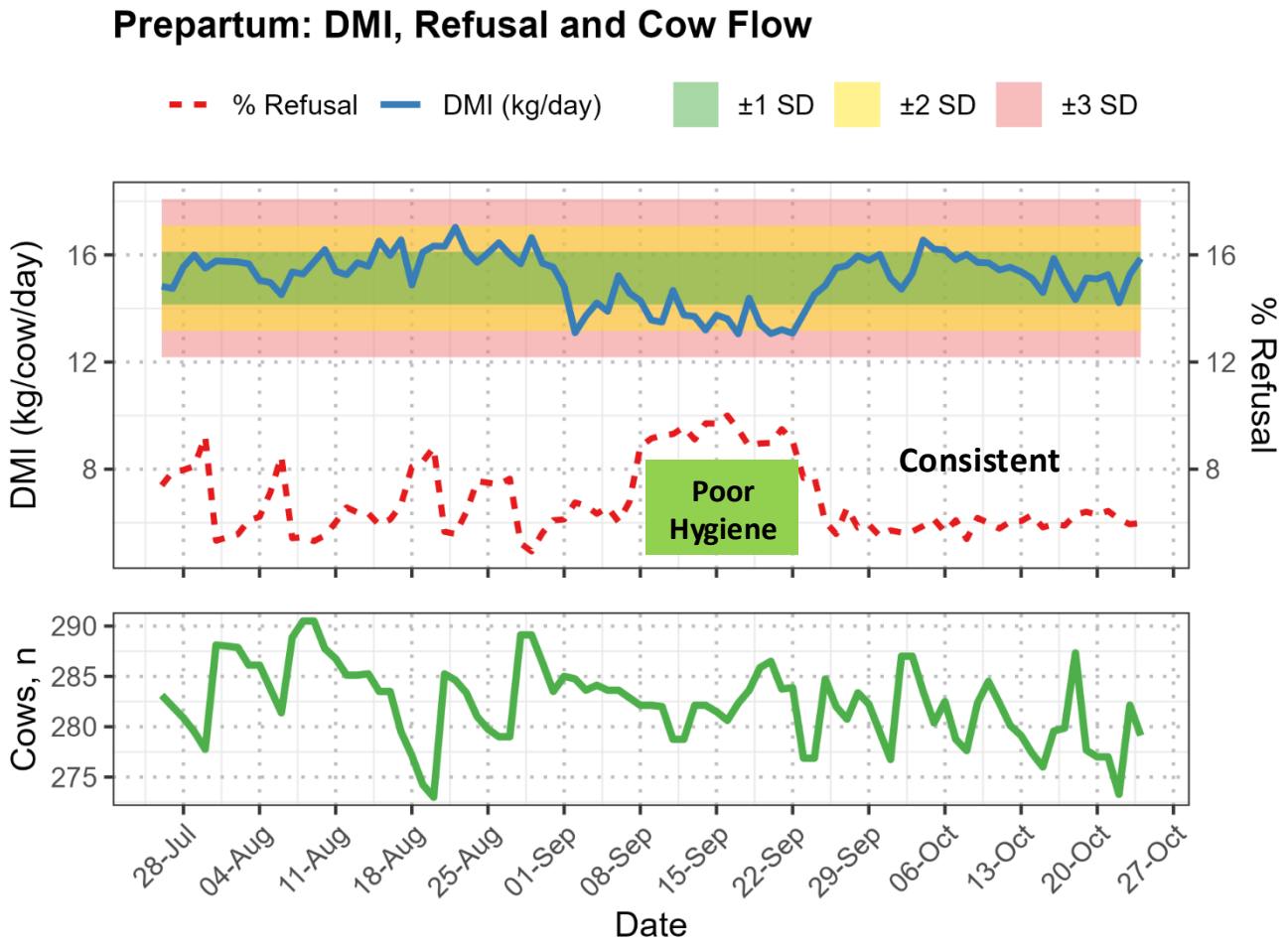
- Single + multi-toxin risk index

Cow-Level Indicators:

- Milk fat, DMI, gestation length, culling, stillbirth

(©2026 G.M. Schuenemann)

Effect of Poor Hygiene in Corn Silage and Wheat Straw



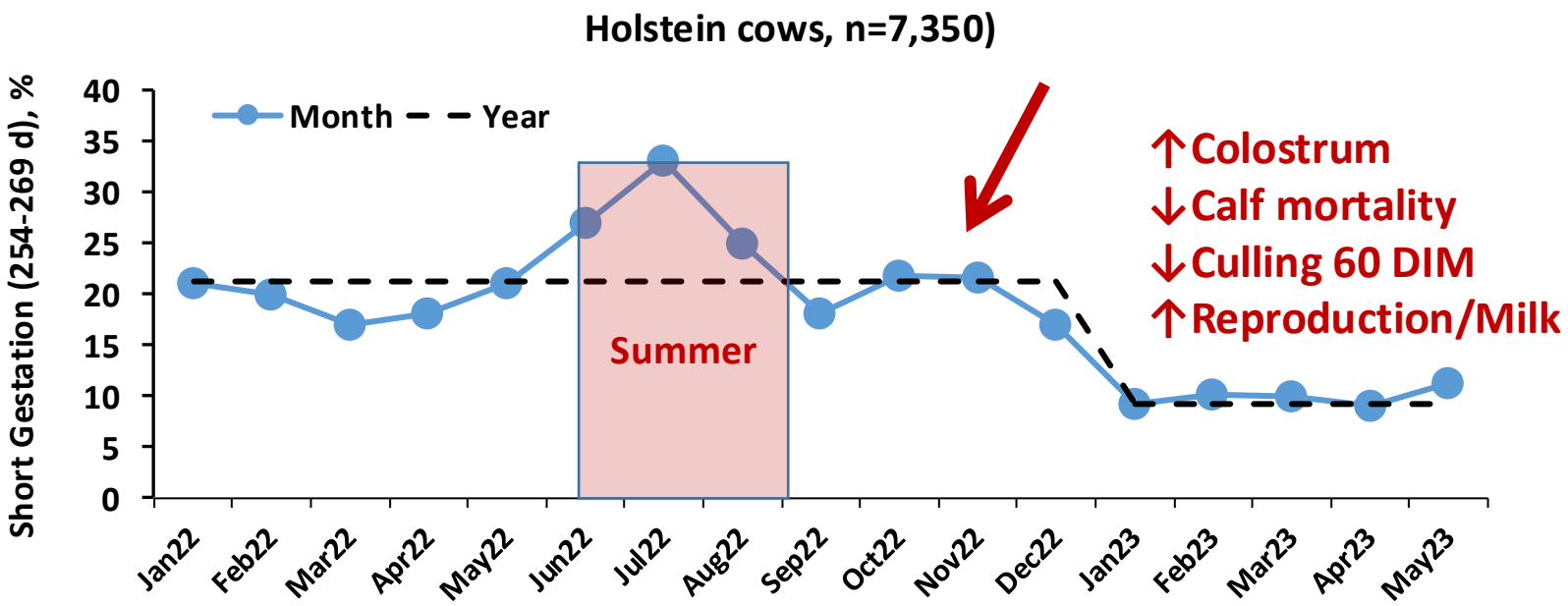
(©2026 G.M. Schuenemann)

SUM PDCC=269 PDCC=284 BY LCTGP FOR LACT>0 PDCC>254 PDCC<299

Short Gestation Reduced by 50%

DON (1090 ppb), ZEA (360 ppb), FUM (1600 ppb) & T-2 toxin (145 ppb)

(Schuenemann et al. 2026, on-going study)



"Ash" (% DM) in TMR ↓54% (from 11 to 5%)

Each % point over 5% represents ~10 kg (22 lb) of dirt per Tn feed

(60 kg dirt / 42 or 62 cows = ~1.4 or ~1 kg/d/cow)

(©2026 G.M. Schuenemann)

↓Inflammation = Precision Nutrition + Management/Environment

For transition cows, rumen-protected AA (e.g., meth, lys, cho) promotes metabolic resilience (↓inflammation, ↑liver function, and ↑immune response), ↑DMI, and ↑Milk (components)

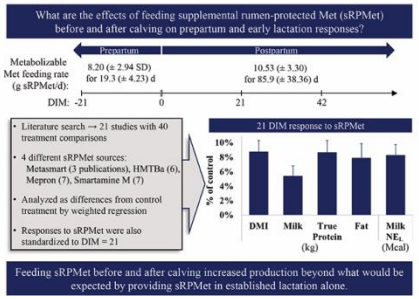
BUT if cows don't eat, nothing works!

JDS Communications®
2024; 5:293–298
https://doi.org/10.3168/jdsc.2023-0512
Short Communication
Animal Nutrition and Farm Systems

Systematic review and meta-analysis of dairy cow responses to rumen-protected methionine supplementation before and after calving

G. I. Zanton[1]* and M. Z. Toledo[2]†

Graphical Abstract



J. Dairy Sci. 103:282–300
https://doi.org/10.3168/jds.2019-16842
© 2020, The Authors. Published by FASS Inc. and Elsevier Inc. on behalf of the American Dairy Science Association®.
This is an open access article under the CC BY-NC-ND license (http://creativecommons.org/licenses/by-nc-nd/4.0/).

Meta-analysis of the effects of supplemental rumen-protected choline during the transition period on performance and health of parous dairy cows

U. Arshad, M. G. Zenobi, C. R. Staples, and J. E. P. Santos*
Department of Animal Sciences, DH Barron Reproductive and Perinatal Biology Research Program, University of Florida, Gainesville 32611

(©2026 G.M. Schuenemann)

Why Cows Stop Eating?

1. Gut fill
2. Metabolic
3. Non-dietary factors

Feeding:
Environment
Facilities
Management

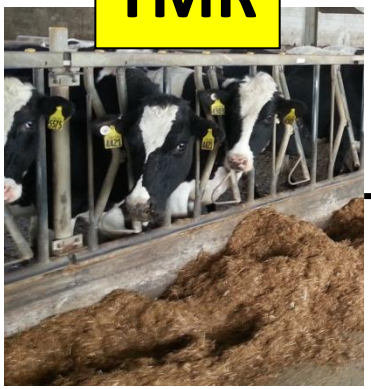
Maintenance
Growth
Milk
Reproduction

LIVER
Energy

Absorbed Nutrients

3
2
1

TMR



RUMEN FILL

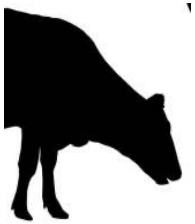
INTESTINE



Feces

(©2026 G.M. Schuenemann)

Feeding Behavior Drives DM Intake



BW = 1730 lb
(786 kg)

Prepartum

Meals per d = 5.9

Meal size = 2.6 kg/d (2.3 to 2.9 kg/d)

Time per meal = 50 min

Interval between meals = 4 h

2.6 kg =
3.7 Mcal NE_L per d

Meal Meal Meal Meal Meal Meal

0 Noon 24:00

DMI
14.2 kg/d
31.2 lb/d

Water 11.4 G
(43 kg/d)



BW = 1540 lb
(700 kg)

Fresh

Milk 73 lb (33 kg/d)

Meals per d = 8.7

Meal size = 2.5 kg/d (2.2 to 2.8 kg/d)

Time per meal = 30 min

Interval between meals = 2.9 h

2.5 kg =
4.2 Mcal NE_L per d

Meal Meal Meal Meal Meal Meal Meal Meal Mea

0 Noon 24:00

DMI
19.5 kg/d
43 lb/d

Water 26.9 G
(102 kg/d)

(©2026 G.M. Schuenemann)

(Adapted from Beauchemin, 2018; Havekes, 2019; and Jensen and Vestergaard, 2021)

What are the Top 3 Non-Dietary Factors Reducing DMI Potential?

- **Cow COMFORT:**
  - **Defined by 5 principles of animal welfare**: 1) access to water, 2) access to TMR, 3) thermo-neutral, 4) be able to express natural behavior (eat, walk, resting), 5) free of pain and not fearful of people. Largely determined by people (management), facilities, and environment (e.g., heat stress)
  - ***People can overcome facility limitations, but great facility design cannot replace poor management***
- **Linear feed bunk and water space per animal:**
  - 80 cm per cow (30 in) with feed available within reach of animals for at least 22 h/d
  - Provide 10 cm (4 inches) of linear water space per cow with a at least 38 L (10 gallons) of water flow per min
- **Frequency of feed push-ups:**
  - Feed transition cows 2x per day with push-ups every 1-hour interval (~12x per day)

(Grant and Albright, 2001; Huzzey et al., 2006 JDS 90:3220–3233.Bach et al., 2008 JDS 91:3259–3267)

(©2026 G.M. Schuenemann)

Changes in Eating Time by Management and Facilities

Items[1]	Changes in Eating Time, min/d
Limiting feed bunk space:	
50 vs 80 cm/cow (Goal)	↓30
20 vs 80 cm/cow	↓60
Feed bunk design:	
Headlock vs Neck rail	↑18
↑Frequency of feed delivery per day:	
From 1x to 2x	↑10
From 3x to 4x	↑14

[1]On average, the feeding time of a Holstein cow is ~280 min/d. Adapted from Grant and Albright, 2001; DeVries et al., 2005; Huzzey et al., 2006)

↓2 kg DMI (cow/d) with overcrowded transition pens (<50 cm/cow & bedding). Solution: ↑TMR (8% residual) with full feed bunk 22 of 24 h

Agressive Fresh Cow Program: ↓DMI and ↑Ketosis



(©2026 G.M. Schuenemann)

Why is Cow "COMFORT" Important?





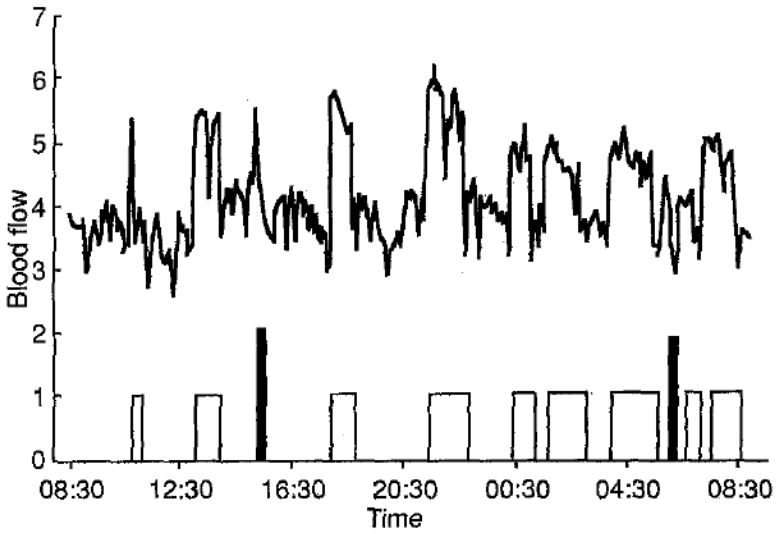


FIG 2: Blood flow through the external pudic artery in a dairy cow over a 24 hour period (continuous line) using a TT flow probe. Time spent lying (□) and the occurrence of milking (■) are also shown

(Metcalf et al., 1992 RVS 53:59-63)

When lying down, a cow has ~30% more blood flow to the mammary gland compared when standing …

lying down with full rumen ↑MILK

(©2026 G.M. Schuenemann)

Cow COMFORT ↑Milk

(Field response observation; Schuenemann et al. 2018-2024)







(©2026 G.M. Schuenemann)

Cow COMFORT ↑Stall Usage

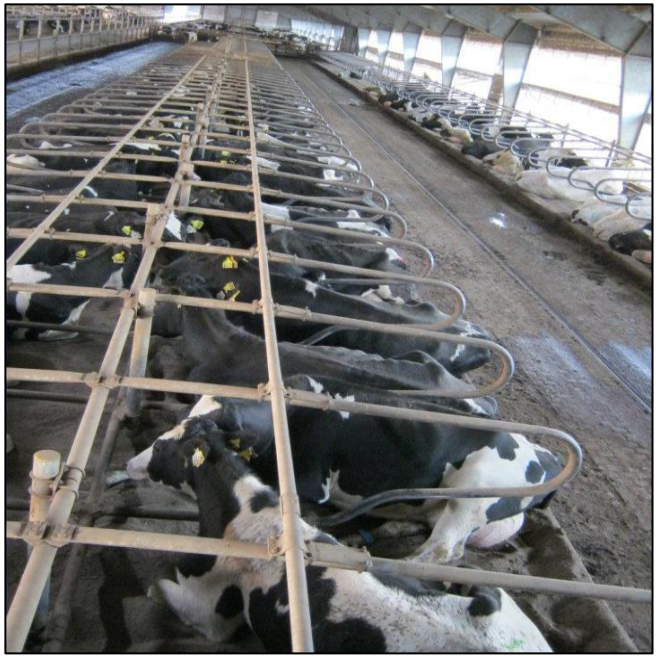
(Field observation: Fontana and Schuenemann, 2019; Schuenemann, 2020-2026)

Compacted Sand Bedding with <50% Stall Usage





<u>Stall Usage Index</u>: >85%
2 h before morning milking



(©2026 G.M. Schuenemann)

Strong Negative Correlation (r = –0.82) between THI and DMI

(↓0.45 kg/d for every 1-unit ↑ above the threshold of 68 THI)



Fans and Sprinklers with intermittent water at 1.3 L/min (3 min "ON" followed by 9 min "OFF") ↓heat stress: DMI ↑ >1 kg/d

(Chen et al., 2016 JSD 99:4607-4618)



Transition and high milk-yield cows: 30 min session (Wind + 1 min shower every 3 min), 3x per day ↓heat stress: ↑DMI >2 kg/d

(adapted from Honig et al., 2012 JSD 95 :3736–3742)

(©2026 G.M. Schuenemann)

Forage NDF and Starch are Key for Optimum DM Intake, BUT …

	Dry		Lact=1	Lact ≥2
			Days in Milk	
Item	Far-off 60-21d	Prepartum <21d	15	20
BW, kg	740	740	570	700
DMI, kg/d	13.9 (11)	12.3 (11)	20.8	25.8
DMI, % BW	1.87	1.66	3.6	3.7
NE_L, Mcal/kg	1.28	1.49	1.58	1.70
CP, %	12	14.3	18.5	17.5
NDF, min %	39-41	35-39	30-32	30-32
fNDF, min %	19-25	19-25	19-25	19-25
Starch, max %	15-20	15-20	22-30	22-30

(NASEM, 2021)

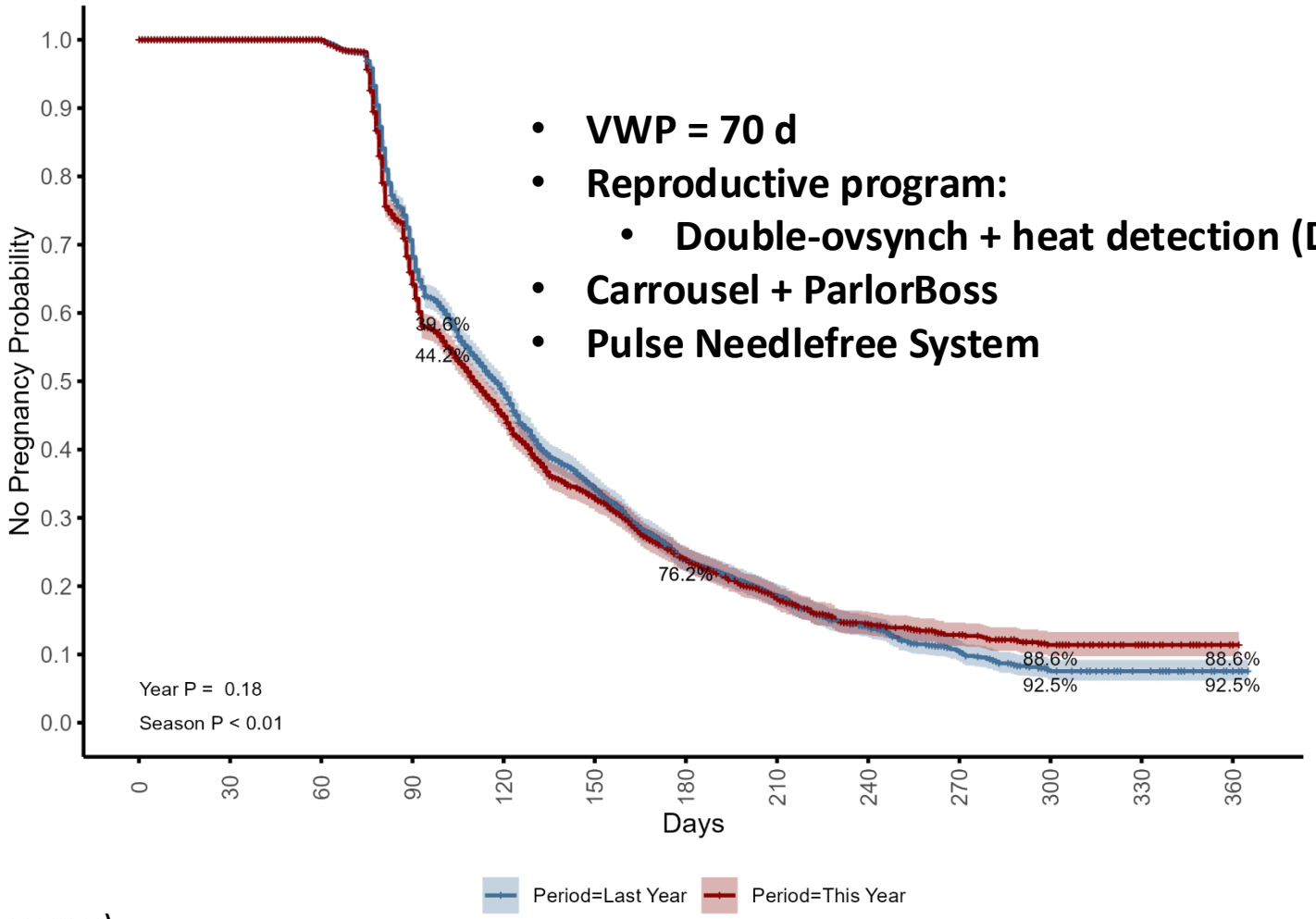
If feeding 19% fNDF and 25% starch, the minimum total NDF is 19+(60-19-25) = <u>35% NDF</u>



(©2026 G.M. Schuenemann)

Effective Transition Program Drives Reproductive Success

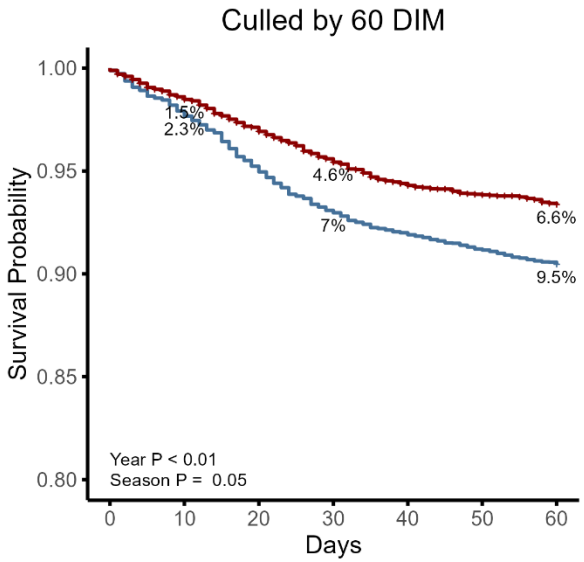
4500 Holstien cows (BW ~780 kg), cross-vented barns, 52 kg/d ECM (4.2%F, 3.4%P, 147000 SCC), ~6.6% culling 60 DIM, ~31% PR (~7% abortion), and 100% beef x dairy bulls (~2% stillbirth)



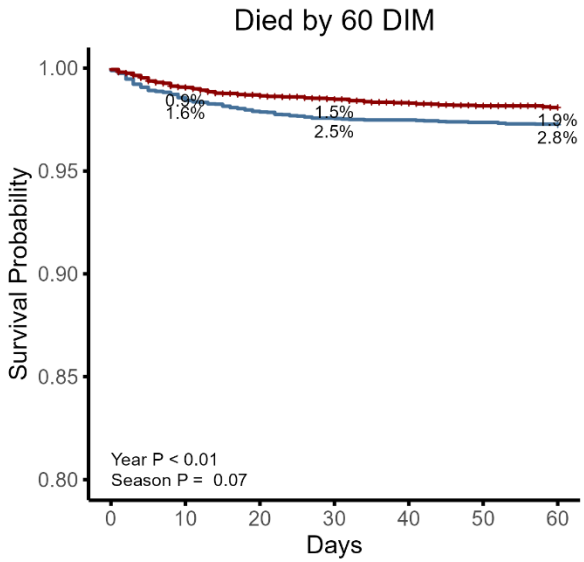
- **VWP = 70 d**
- **Reproductive program:**
  - **Double-ovsynch + heat detection (DelPro)**
- **Carrousel + ParlorBoss**
- **Pulse Needlefree System**

(©2026 G.M. Schuenemann)

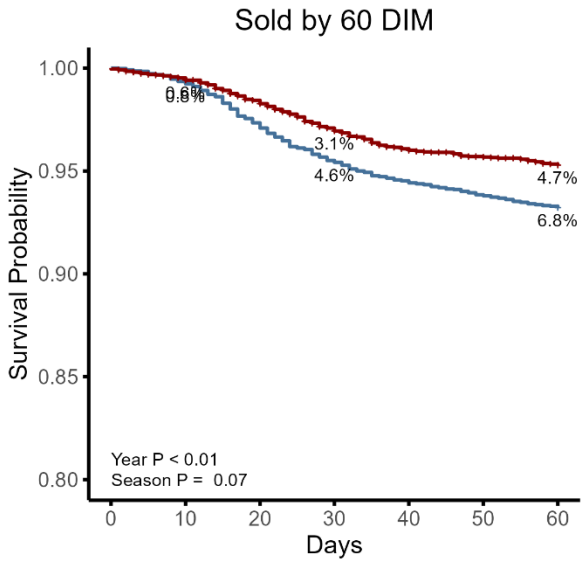
Early Cow Removal Costs You CASH!



YearGroup	LCTGP 1	LCTGP 2	LCTGP 3
Last Year	5.8%	4.9%	14.4%
This Year	2.9%	4%	9.9%



YearGroup	LCTGP 1	LCTGP 2	LCTGP 3
Last Year	0.8%	1.4%	4.6%
This Year	0.2%	1.1%	3.4%



YearGroup	LCTGP 1	LCTGP 2	LCTGP 3
Last Year	5%	3.4%	9.8%
This Year	2.7%	2.9%	6.5%

<u>GOAL for first 60 DIM</u>:

- **Overall: <6%**
- **Lact=1: <35% of overall culling (~2%)**

Your heifer replacement program will determine quality of first-calf heifers at calving

(©2026 G.M. Schuenemann)

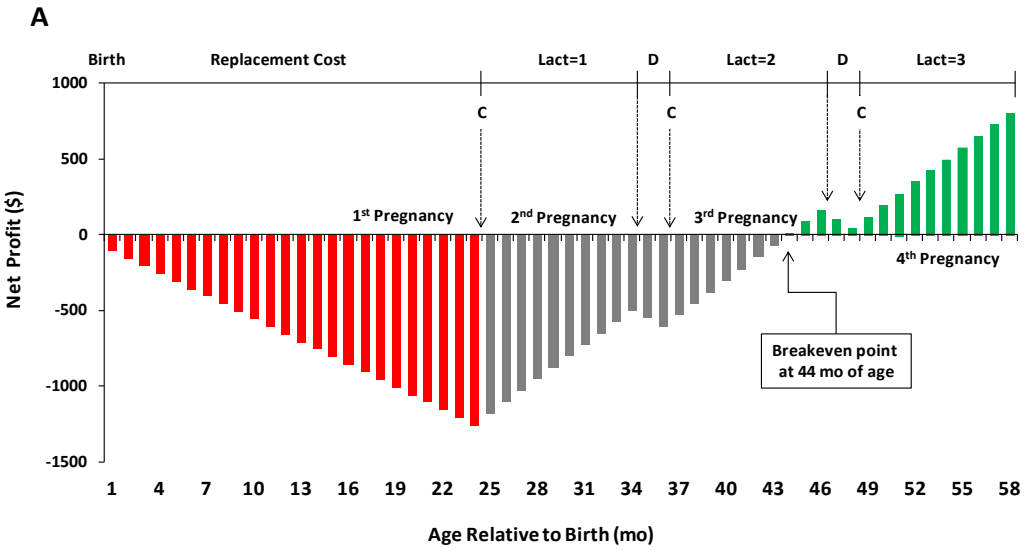
How Many Lactations Does It Take to Pay Back a Replacement Heifer?

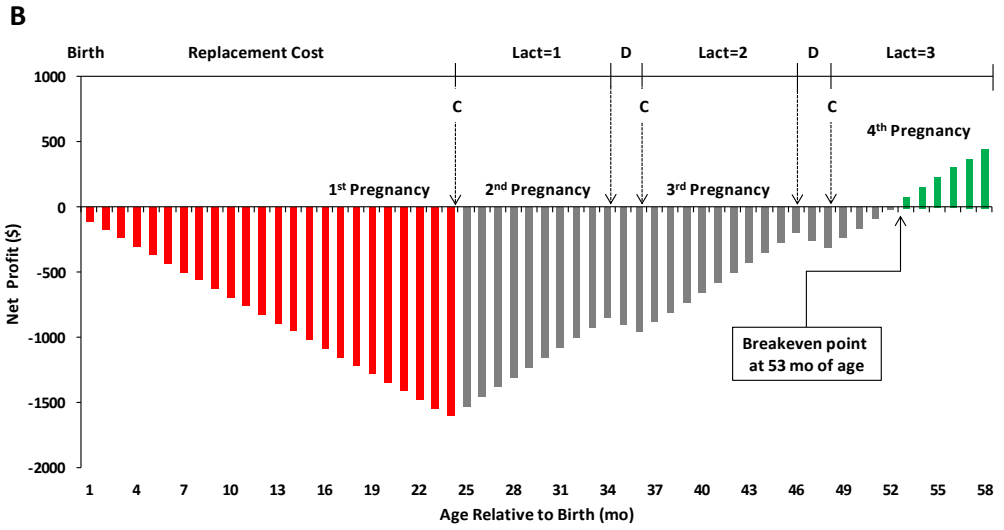
(Schuenemann et al., 2017 ADSA; Schuenemann et al., 2026 on-going study)

$2680

- Milk price
- Feed price
- Culling cow price
- Replacement costs

$2900





(©2026 G.M. Schuenemann)

What Problem Needs to be Addressed to Improve Your Work?

(feedback from 2,900 workers, 450 dairy herds, and 11 US states)

(Schuenemann et al., 2017 ADSA)



(©2026 G.M. Schuenemann)

Teamwork is "KEY" for Success



Performance

$$P = (K + S) * A$$

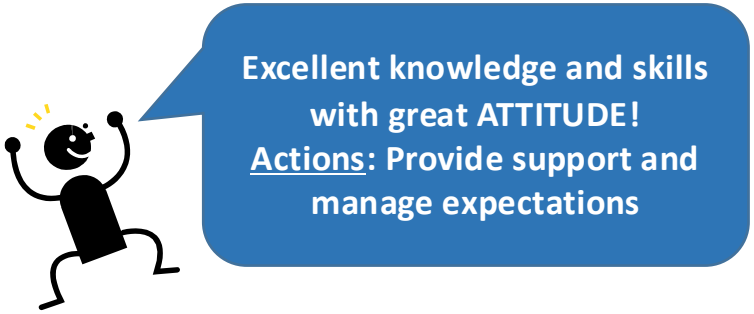
Knowledge

Skills

Attitude

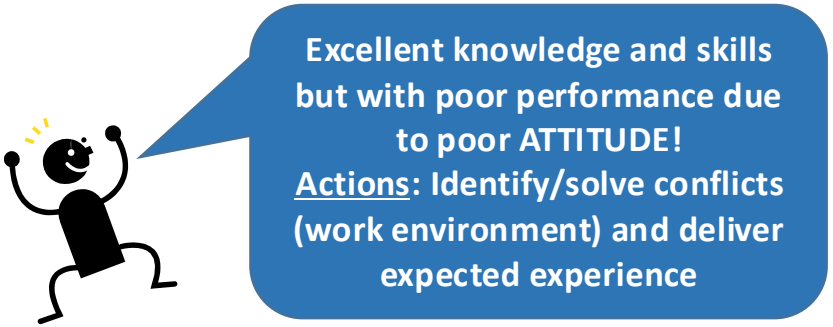
(©2026 G.M. Schuenemann)

Knowledge and Skills are Important, BUT ATTITUDE Defines Performance!



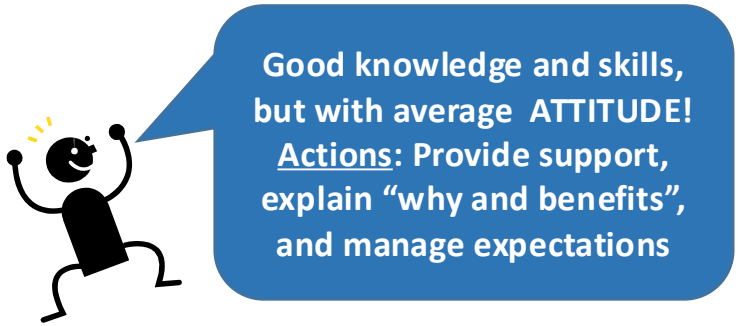
P=(0.95+0.95)*0.90 = 1.71

↑Performance



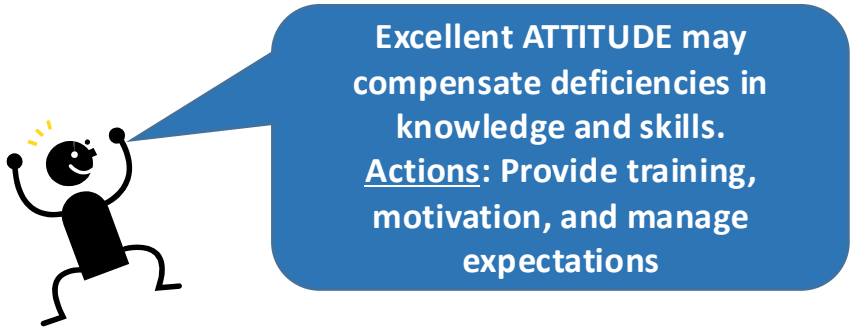
P=(0.90+0.90)*0.30 = 0.57

↓Attitude



P=(0.80+0.80)*0.65 = 1.04

Average



P=(0.70+0.70)*0.95 = 1.33

↑Attitude

(©2026 G.M. Schuenemann)

4 Points that Characterize the Best US Dairy Herds

Holstein Cows: Maternity (~1% stillbirth with beef bulls), reproductive efficiency (≥30% 21-d PR & <5% abortions), milk quality (≥90 lbs/d with 4% F, 3.4% P & <150,000 SCC/mL) and longevity ≥3.2 lact with positive financial results

(Schuenemann et al., 2026; on-going study)

1) Committed and well-organized herd managers
2) Management program designed for transition cows
3) Record-keeping designed to monitor "processes"
4) Training program integrated and consistent with established protocols

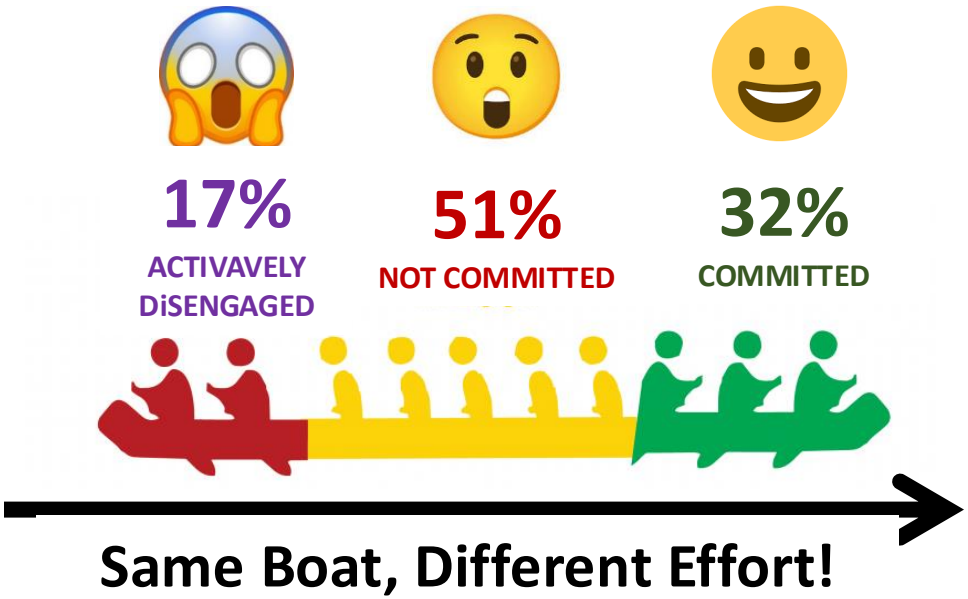
Promote feeding behavior (COMFORT):

1. Access to quality water, adequate linear feed bunk/bedding space
2. Adequate maternity management & control of THI
3. Feed 2x or 3x times per day & monitoring %DM content (5x or 3x/week)
4. Feed push-ups every 1 h and separate feed delivery from milking
5. Adequate effective fiber in diet (peNDF $_{>8mm}$ = 14-18%)
6. Separate lact=1 from multiparous cows (rubber floor for Lact≥4 cows)

(©2026 G.M. Schuenemann)

Achieving Farm Consistency is Not Accidental, It is the Product of Strong Teamwork

Hire for ATTITUDE, Mentor for Excellence!



(Source: US Workplace Engagement, 2025 Gallup Report)

(©2026 G.M. Schuenemann)

Gustavo M. Schuenemann
Email: schuenemann.5@osu.edu; Ph: +1-614-625-0680

THANK YOU!

Short and Long-Distance Transport of Dairy and Dairy-Beef Cross Calves

Gustavo M. Schuenemann, DVM, MS, PhD
Dairy Cattle Health and Management
Department of Veterinary Preventive Medicine,
College of Veterinary Medicine
The Ohio State University Extension

(©2025 G.M. Schuenemann)

1

Journal of Animal Science, 2025, **103**, skaf341
https://doi.org/10.1093/jas/skaf341
Advance access publication 29 September 2025
Animal Health and Well Being

Short- and long-distance transport: health, survival and growth of preweaned dairy and dairy-beef cross calves

Gustavo M. Schuenemann,[1,]† and Juan M. Piñeiro[1]
[1]Department of Veterinary Preventive Medicine, The Ohio State University, Columbus, OH 43210
[2]Department of Animal Sciences, Texas A&M University, College Station, TX 77843
†Corresponding author: schuenemann.5@osu.edu

- Prepartum diets
- Maternity and neonatal care
- Fit-for-transport criteria and logistics
- Calf pre-weaning diet and management

(©2026 G.M. Schuenemann)

2



Rationale for the Study

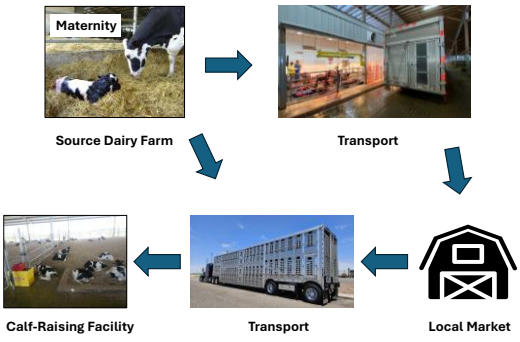


- Over 64% of calves are raised-off farms
- Most studies assessing calf transport involve veal calves
- Long-distance transport has been associated with poor calf health (diarrhea and pneumonia), and reduced growth or increased morality
- Management, housing and nutrition are key for calf survival and growth

(Uetake et al. 2011 ASJ 82:587–590; USDA, 2016; Renaud et al. 2018 JDS 101:2659–2668; Scott et al. 2019 JDS 102:9224923S; Cramer et al. 2024 JDS 107:2454–2464; Fernandes et al. 2024 J. Dairy Sci. 108:3980–3990)

(©2026 G.M. Schuenemann)

3



(©2026 G.M. Schuenemann)

4

Objective

To assess the association of transport duration (0.5, 8, 17 or 24 h) with calf survival, diseases (diarrhea and pneumonia), and preweaning average daily gain (ADG)

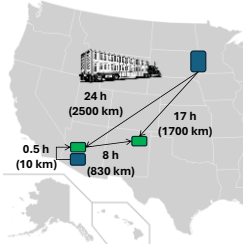
Hypothesis

We hypothesized that calves exposed to transport longer than 8 h will have increased incidence of diarrhea and pneumonia, decreased survival, and reduced preweaning ADG

(©2026 G.M. Schuenemann)

5

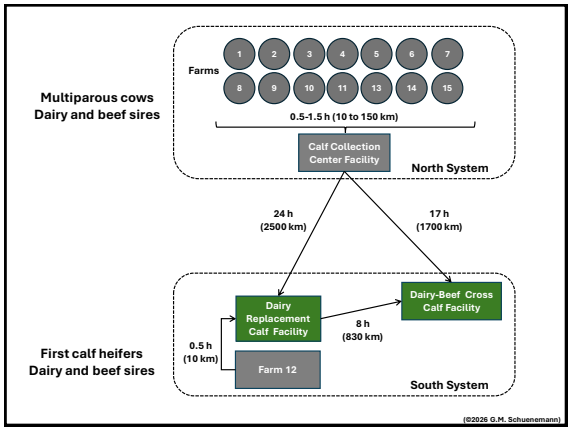
- **Retrospective observational study:**
  - **One integrated production system with same genetic base for all cows, under the same operational management and logistics (e.g., transportation)**
- **From January 2022 to March 2024:**
  - **15 dairy farms, 2 calf raising-facility with 392,064 cales**
  - **Transport duration: 0.5, 8, 17 and 24 hours**



- **Parity, Dystocia, Calf Sex, Calf Breed**
- **Gestation length:**
  - **Short: 254-269 d**
  - **Average: 270-283 d**
  - **Extended: 284-298 d**
- **Failure of passive transfer:**
  - FPT was assessed in a subset of calves (n=46,377)
  - Total calf serum protein <5.1 mg/dL at 2-3 d of age
- **Calf Survival:**
  - Calf mortality upon arrival and calf mortality at weaning
- **Health Status:**
  - Calf diarrhea and calf pneumonia
- **Calf Growth:**
  - Calf birthweights were recorded at calving for all calves
  - Weaning BW were recorded in a subset of calves (n=84,449)
  - Individual ADG = [(calf birthweights - weaning BW)/ calf age at weaning]

(©2026 G.M. Schuenemann)

6



7

Fit-for-Transport Criteria

Criteria	Description
1) Calving pen and maternity	• Clean and dry environment • Sanitation: Hygiene, Hygiene, Hygiene • All newborn calves were washed with warm water
2) Navel (Umbilicus)	• Disinfected, completely dry, no signs of swelling
3) Colostrum intake	• Quantity + quality + timing to ensure proper IgG transfer
4) Handling calves with care	• Gentle loading and unloading with emphasis on safety for both calves and people
5) General health status	• Alert, responsive, normal posture and without signs of illness • Conditioning protocol consisting of 4 consecutive meals + free choice water
5) Mobility	• Able to stand and walk without fractures or joint swelling
6) Transport trailers	• Clean and dry bedding (deep sawdust or wheat straw) • Adequate space per calf (~0.36 m^2 per calf) • Periodic checks • Thoroughly washed and disinfected once per day

(©2026 G.M. Schuenemann)

8

Hygiene, Hygiene, and Hygiene

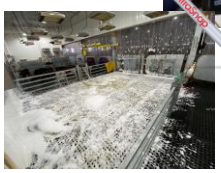
Pasteurizer (valve): <5 RLU
Tube or bottle: <5 RLU

ATP Swabs



If reading is ≥30 Reading Light Units (RLU) on SystemSURE Plus, surface is considered dirty. Reading <10 is considered clean





Maternity Box (20-24 m^2)

(©2026 G.M. Schuenemann)

9



Neonatal care:

- Birthweight
- Washed with warm water
- ID with an ear tag
- Colostrum (≥22% Brix):
  - 1st meal of 3.8 L within 2 h of birth (n=142,892)
  - 2nd meal of 2 L 6 h later (n=249,172)
- Umbilical cord disinfection
- …

(©2026 G.M. Schuenemann)

10

Schematic Representation Loading and Unloading Calves



(©2026 G.M. Schuenemann)

11

What was the Conditioning Protocol Prior to Transport?

- At least 4 consecutive feedings:
  - 2 L per calf (4 L per d with 14% solids)
  - Fourth milk feeding + 1.9 L electrolyte
- All calves who drank 4 consecutive meals and without any signs of illness were considered fit to transport starting at 3 d of age
- Calves were loaded onto the trailers between 30 min and 1 h after their last feeding

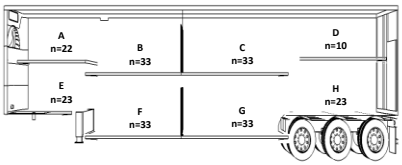
(©2026 G.M. Schuenemann)

12

Team drivers



2,973 loads
~0.36 m² of space



(©2026 G.M. Schuenemann)

13

Calf Age (d) at Transport

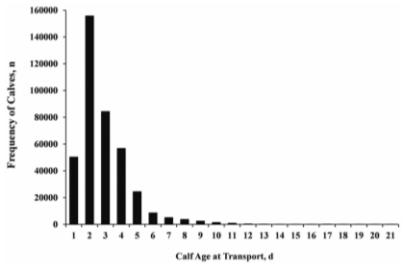


Figure 4. Frequency distribution of calf age (d) at the time of transport. All live calves were transported to calf-raising facilities for a duration of 0.5, 8, 12 or 24 h (10, 830, 1700 or 2500 km, respectively). Bars represent the frequency (n) of calves according to their age (d) relative to calving at the time of transportation.

(©2026 G.M. Schuenemann)

14

Overall Calf Outcomes

- **392,064 calves transported in 2973 loads**

Calf Mortality:

- **Upon arrival: 0.015%**
- **At weaning: 2.49%**

(©2026 G.M. Schuenemann)

15

Calf Mortality upon Arrival was 0.015%, did not differ by Transport Duration

Table 4. Distribution of calves regarding the effect of birthweight, calving assistance, FPT, age at transport, calf mortality upon arrival at calf-raising facility, pre-weaning diarrhea and pneumonia, and calf mortality at weaning, and ADG by transport duration

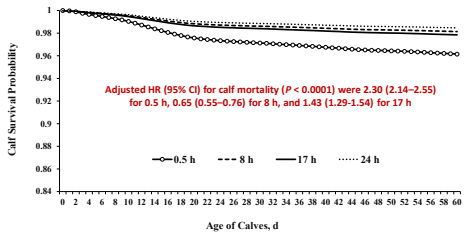
Items	Calf transport duration[1], h				
	South system		North system		
	0.5	8	17	24	*P*-value
Calf birthweight[1], kg	28.50 ± 0.95[d]	32.09 ± 0.95[c]	37.41 ± 0.28[a]	33.84 ± 0.69[b]	<0.0001
Calving assistance[1], %	3.48 ± 0.91[bc]	4.21 ± 0.92[ab]	3.61 ± 0.26[c-d]	4.79 ± 0.28[a]	<0.0001
FPT <5.1 g/dL[1], %	1.23 ± 0.12[c]	1.22 ± 0.23[c]	0.41 ± 0.12[d]	0.21 ± 0.10[d]	<0.0001
Calf age at transport, d	1.63 ± 0.17[d]	6.93 ± 0.17[b]	3.08 ± 0.04[c]	3.47 ± 0.04[b]	<0.0001
Calf survival and health					
Mortality upon arrival[1], %	0.015 ± 0.010	0.005 ± 0.011	0.027 ± 0.006	0.009 ± 0.008	0.32
Diarrhea preweaning[1], %	17.15 ± 0.77[b]	3.75 ± 0.77[d]	5.41 ± 0.24[d]	16.40 ± 0.27[b]	<0.0001
Pneumonia preweaning[1], %	7.21 ± 1.49[ab]	1.75 ± 1.49[c]	9.48 ± 0.42[a]	7.64 ± 0.44[ab]	<0.0001
Mortality at weaning[1], %	3.65 ± 0.25[c]	1.05 ± 0.26[d]	2.53 ± 0.10[b]	2.08 ± 0.12[c]	<0.0001
Pre-weaned calf performance[1]					
BW at weaning, kg	67.39 ± 0.96[d]	83.69 ± 0.82[b]	86.34 ± 0.65[a]	80.54 ± 1.12[c]	<0.0001
Birth to weaning ADG, kg/d	0.65 ± 0.02[d]	0.86 ± 0.04[c]	0.82 ± 0.02[c]	0.76 ± 0.01[c]	<0.0001

Calf Mortality at Weaning Differed, Mostly Due to FPT, Calf Diarrhea, Short Gestation, Etc.

(©2026 G.M. Schuenemann)

16

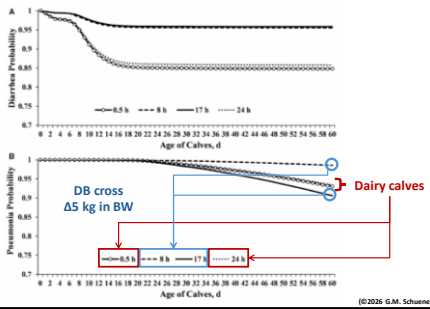
Cumulative Calf Survival Curves for Time to Mortality (n = 392,064) by Transport Duration



(©2026 G.M. Schuenemann)

17

Cumulative Survival Curves for Time to Calf Diarrhea (A) or Pneumonia (B)

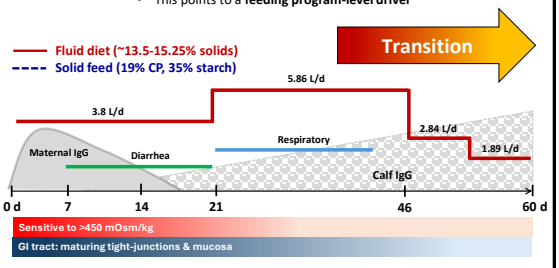


(©2026 G.M. Schuenemann)

18

Given the shared timing (~22 d) of disease onset across all groups, transport duration alone is unlikely to account for the pneumonia cases observed

- Heavier calves had ~10% less ME
- This points to a **feeding program-level driver**



(Meale et al., 2017 JDS 100:5984–5995; Mellors et al., JDS 106:2408–2427; Steele et al., 2016 JDS 99:4955–4966; Wood et al., 2015 JDS 98:7226–7237)

(©2026 G.M. Schuenemann)

19

Calf Diarrhea Was the Single Most Important Factor Explaining Calf Mortality at Weaning

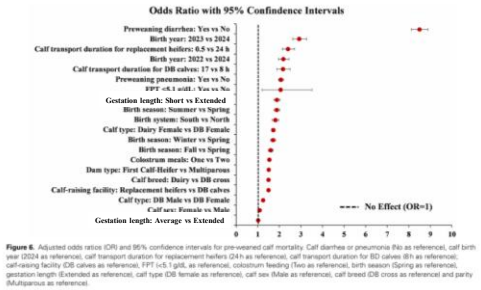


Figure 6. Adjusted odds ratios (OR) and 95% confidence intervals for pre-weaned calf mortality. Calf diarrhea or pneumonia (No as reference), calf birth year (2024 as reference), calf transport duration for replacement heifers (24 h as reference), calf transport duration for BD calves (8 h as reference), calf-raising facility (DB calves as reference), FPT (<5.1 g/dL as reference), colostrum feeding (Two as reference), birth season (Spring as reference), gestation length (Extended as reference), calf type (DB female as reference), calf sex (Male as reference), calf breed (DB cross as reference) and parity (Multiparous as reference).

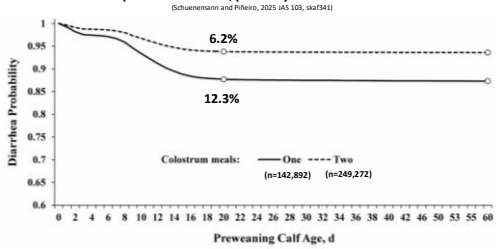
(©2025 G.M. Schuenemann)

20

What Is the Effect of Two Colostrum Feedings on Calf Diarrhea?

Calves fed two colostrum meals were ~50% less likely to develop diarrhea compared to one meal, primarily within the first 20 d

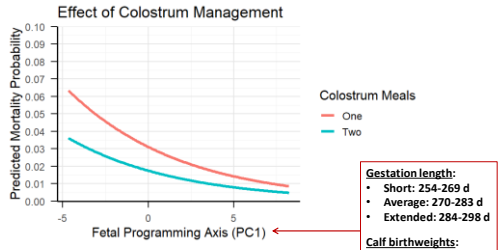
(Schuenemann and Piñeiro, 2025 JAS 103, skaf341)



(©2026 G.M. Schuenemann)

21

Two Colostrum Feedings Mitigates Compromised Fetal Programming



Gestation length:
- **Short: 254-269 d**
- **Average: 270-283 d**
- **Extended: 284-298 d**

Calf birthweights:
- **<30 kg**
- **30-38 kg**
- **>38 kg**

(©2026 G.M. Schuenemann)

22

Calves are born without antibodies (IgG, IgM, IgA), but not immunologically naïve

Why Does this Matter?

COLOSTRUM intake is necessary but not sufficient

If fetal programming is compromised before birth:
IgG may absorb normally, yet fail to respond effectively to pathogens

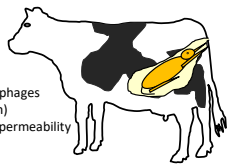
👉 This explains **"high colostrum Brix >> high IgG in blood >> sick calves"**

(Hulbert and Moisá, 2016 J. Dairy Sci. 99:3199–3216; Saun and Sniffen, 2014 Clin North Am Food Anim Pract 30:689-719)
(©2026 G.M. Schuenemann)

23

Why the Last 60 d of Gestation Matters for Calf Immunity?

- **~50% of fetal growth**
- **Rapid development of calf immunity:**
  - **Lymph nodes, thymus & spleen**
  - **Innate immune cells:** Neutrophils, macrophages
  - **Barrier tissues:** GI tract & lung epithelium)
- **Hypothalamus:** Stress, thermoregulation & GI permeability



Prepartum Nutrition & ↓Inflammation >> Fetal Programming:
- **Energy status: ↑cortisol, ↓fetal immune development, ↓IgG**
- **Protein & AA: Lymphocyte proliferation and antibody synthesis**
- **Trace minerals: Zn** (epithelium integrity, innate immunity)**,**
  Se (antioxidant defense, neutrophil function)**, Cu** (phagocytosis, cytokine signaling)
- **Vitamins: A** (mucosal immunity in gut and lung)**, E** (antioxidant protection, immune cell stability)

(Hulbert and Moisá, 2016 J. Dairy Sci. 99:3199-3216; NASEM 2021
Saun and Sniffen, 2014 Clin North Am Food Anim Pract 30:689-719)
(©2026 G.M. Schuenemann)

24

Key Health-Related Factors Early in Life Play a Much Larger Role in Calf Mortality at Weaning than Transport Duration

👉 **Calf immunity is largely set before or at calving**

Prepartum nutrition
Management
Environment
Housing
…

(©2026 G.M. Schuenemann)

25

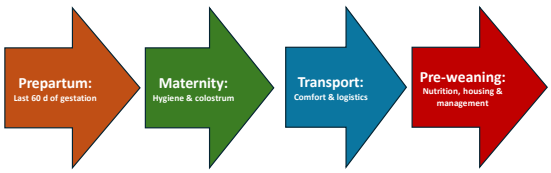
Calves that Are NOT Fit-for-Transport

- **Have not received colostrum**
- **Unable to thermoregulate**
- **Dehydrated**
- **Showing signs of illness (diarrhea, pneumonia)**
- **Navel swelling or infection**
- **Fracture, lameness or other injuries**
- **Unable to stand or walk unassisted**
- **Recent surgical procedure (e.g., hernia)**
- **…**

(©2026 G.M. Schuenemann)

26

What are the Opportunities?



- 5 Principles of teamwork:
1) Shared goals
2) Clear roles
3) Mutual trust
4) Effective communication
5) Assessing results & continuous improvement

- Appropriate training

(©2026 G.M. Schuenemann)

27

Gustavo M. Schuenemann
Email: schuenemann.5@osu.edu; Ph: +1-614-625-0680

THANK YOU!

(©2026 G.M. Schuenemann)

28

Rethinking colostrum feeding: spoiler alert, it's all about total IgG's

Dr. Liz Cox

Calf Milk Calculator

High Plains Dairy Conference, March 2026

Goal is to provide 300g IgG in the first 24 hours

What we need to Rethink

1. Calf serum benchmarks
2. Colostrum Brix benchmark for first feeding
3. Volume given in the first feeding
4. Always offer a second feeding



Our Beef Cow Cousins

- Beef cows make 500-1,000g IgG in first 12-24 hours of life
- After nursing colostrum from the cow, beef calf serum IgG is **50g/L**
- In beef calves, serum <24 g/L IgG associated with negative health outcomes



- What is the cutoff we traditionally use for failure of passive transfer?

<10 g/L IgG

Do we want to pass with a D+ or pass with an A?

E Abdelfattah et al. 2025, Review

Lombard Scale for Calf Total Serum Protein

Passive Transfer Category	Serum IgG g/L	Total Serum Protein g/dL	Goal for your calf population
Excellent	≥ 25	≥ 6.2	≥ 40%
Good	18-24.9	5.8-6.1	30%
Fair	10.0-17.9	5.1-5.7	20%
Poor	<10	<5.1	10%
	Measured in a lab	Measure on farm	

J Lombard et al. 2020

Let's Strive for an A, not just a pass

- The traditional calf serum IgG <10g/L failure of passive transfer benchmark associated with mortality
- Higher serum IgG levels have additional benefits
  - Decreased morbidity
    - Ex. Calves with >15 g/L lower incidence of pneumonia
  - ADG preweaning and postweaning
    - Ex. Calves with ≥25 g/L gained 0.8 pound/day more preweaning



- **Excellent (A) is ≥ 25g/L**

Higher Serum IgG's → Better Lung Health

Total Serum Protein g/dL	# calves with this TP	# calves in this group with Lung Score ≥3
≥ 6.2	236 (44.8%)	88 (37.3%)
5.8-6.1	145 (27.5%)	67 (46.2%)
5.1-5.7	125 (23.8%)	74 (59.2%)
<5.1	21 (4%)	16 (76.2%)

- Dairy in WI
- 527 calves
- Lung ultrasound preweaning
  - Only the Excellent category showed statistical reduction in pneumonia
- Other observation – 33% calves had evidence of pneumonia on lung ultrasound preweaning

D Sockett, 2026 webinar

Rethinking Calf Serum Benchmark:

Goal of ≥ 5.8 TSP for 70% or more of your calves

What does a 22% Brix mean?

Colostrum

- 22% Brix → approximately 50 g/L IgG
  - 4 L would deliver 200g IgG

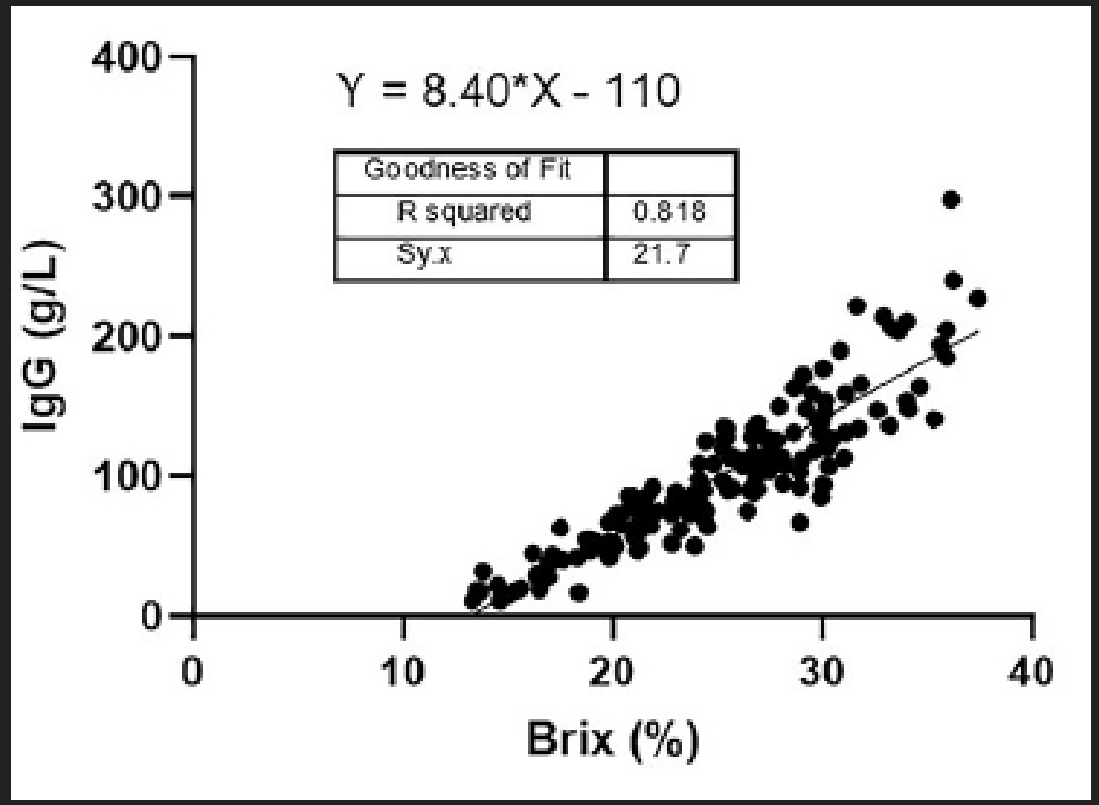
- We want to deliver 300g IgG in the first 24 hours



% Brix Provides an Estimation of IgG

- 182 colostrum samples
- 4 different dairies

Brix	Minimum IgG g/L
30%	100
25%	75
22%	50
19%	25



D Sockett et al. 2023

Dairy Cows Can Make Good Colostrum

- 5,200 cow dairy
- Colostrum harvested twice a day
- July – October
- Avg 55 day dry period

IgG concentration in the colostrum

Parity	Avg IgG g/L	Number of cows
1	84.3	201
2	84.2	148
3	117.9	113
≥4	139.1	174

S Mann et al. 2024

Dairy Cows Can Make Good Colostrum

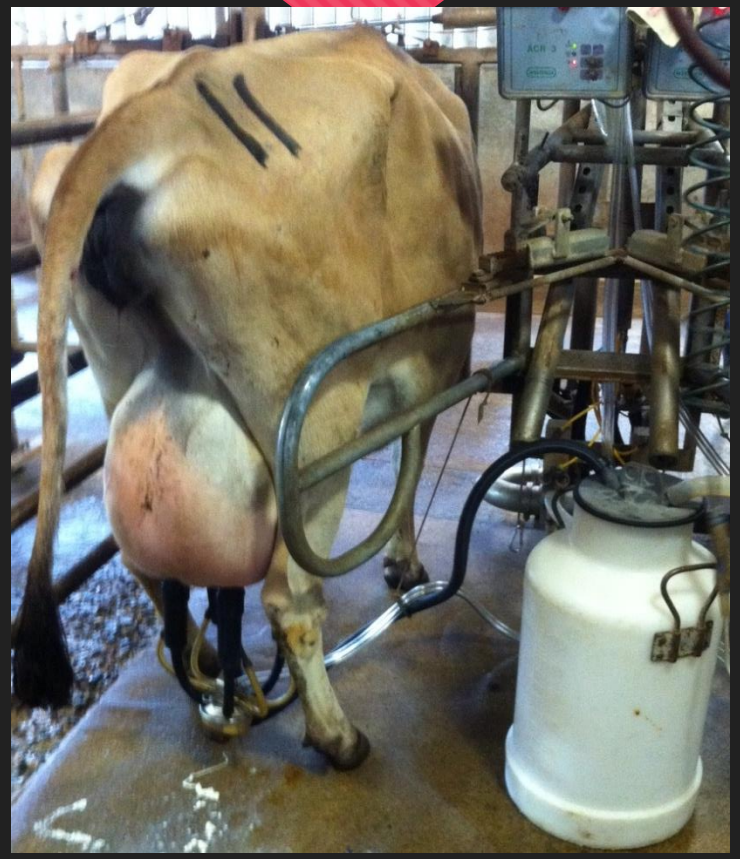
- 5,200 cow dairy
- Colostrum harvested twice a day
- July – October
- Avg 55 day dry period

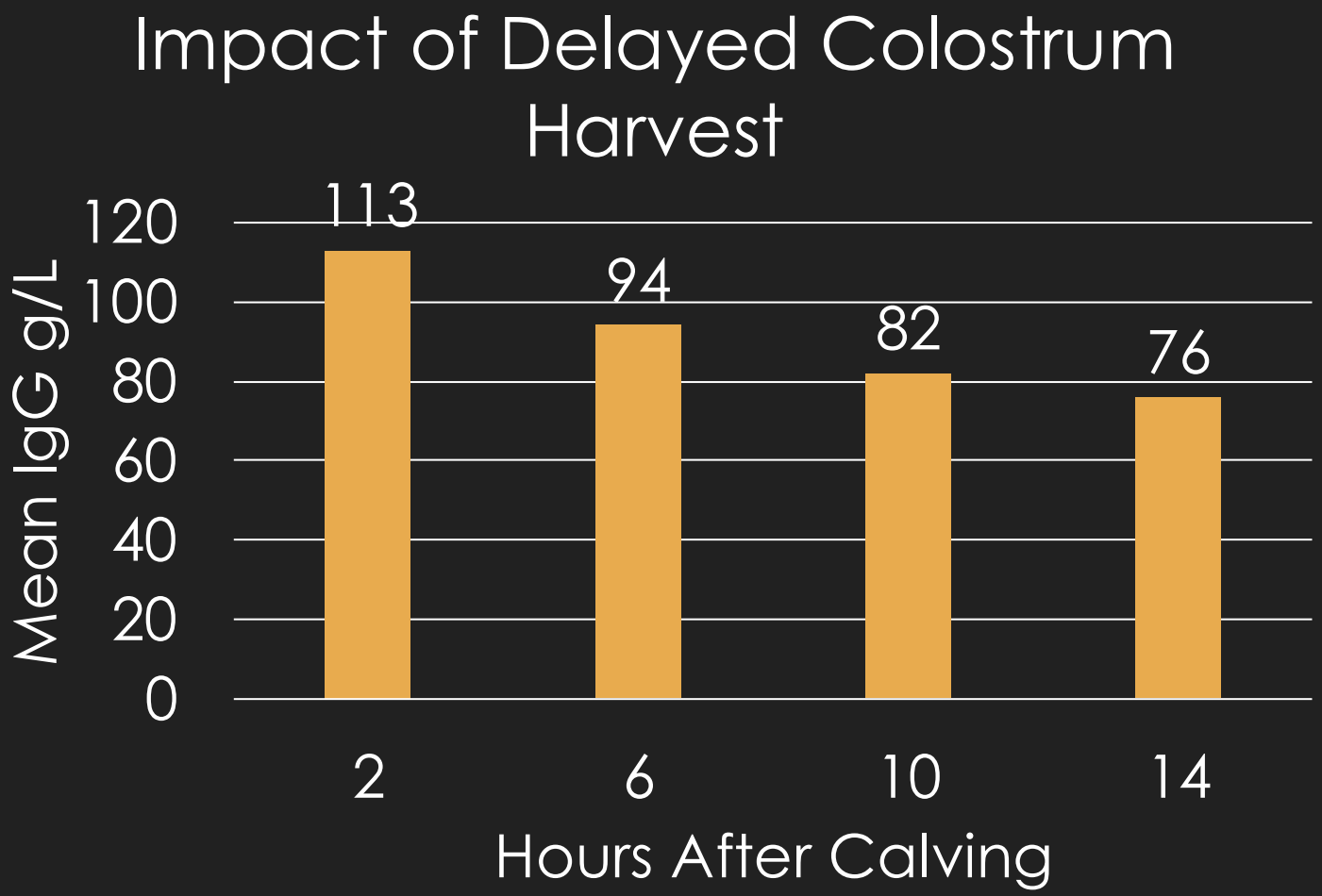
Relationship between Brix and IgG

Brix	IgG g/L
21%	<50
24%	≥100

S Mann et al. 2024

Colostrum Quality Impacted by When it is Harvested





More et al. 2005

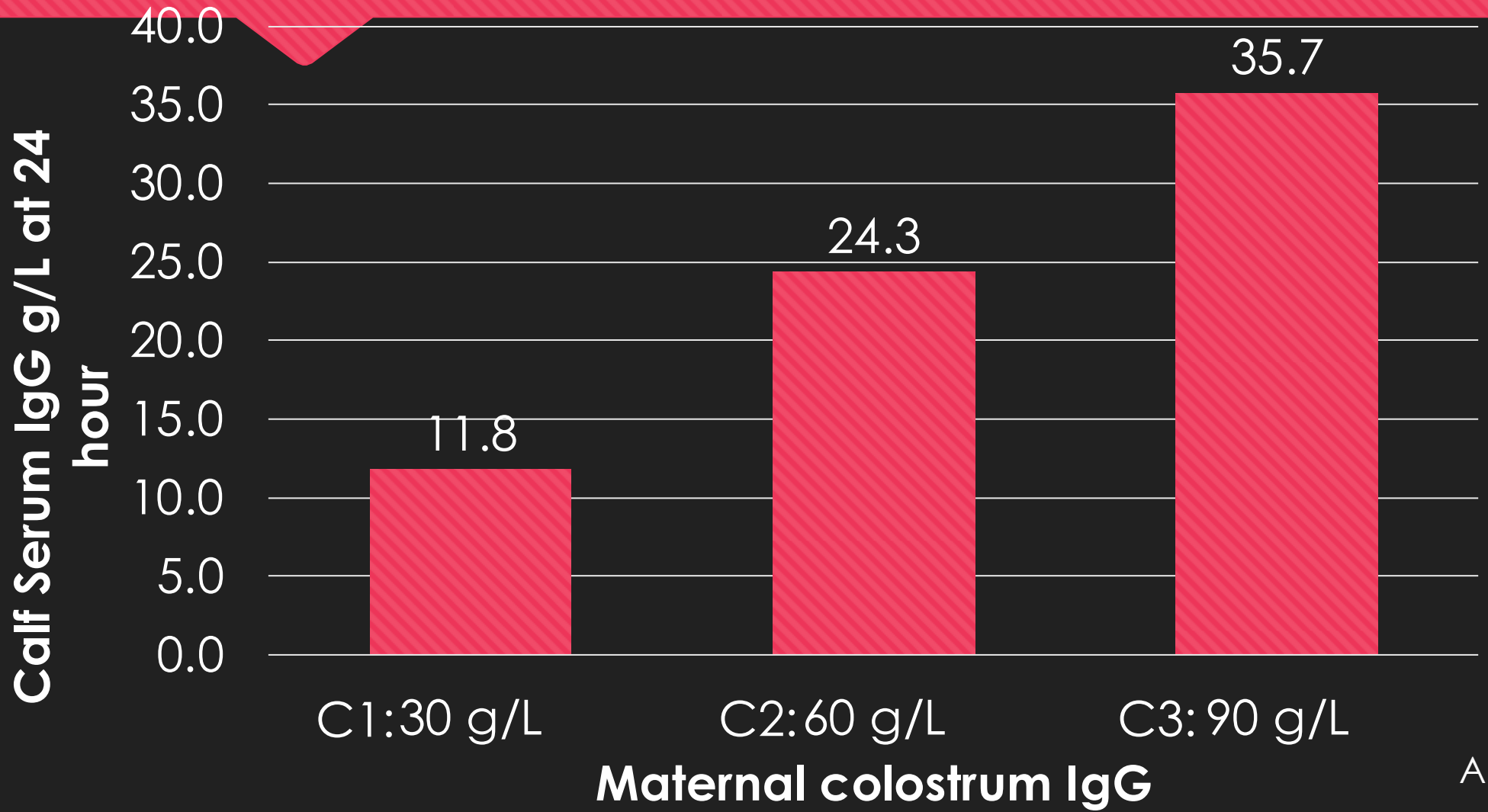
As We Feed More IgG, Calves Absorb More

- 80 male Holstein calves
- Fed 3.8L of colostrum with different IgG concentrations

Group	Colostrum [IgG]	Total IgG fed
C1	30 g/L	114 g
C2	60 g/L	228 g
C3	90 g/L	342 g

AJ Lopez et al. 2022

As We Feed More IgG, Calves Absorb More



AJ Lopez et al. 2022

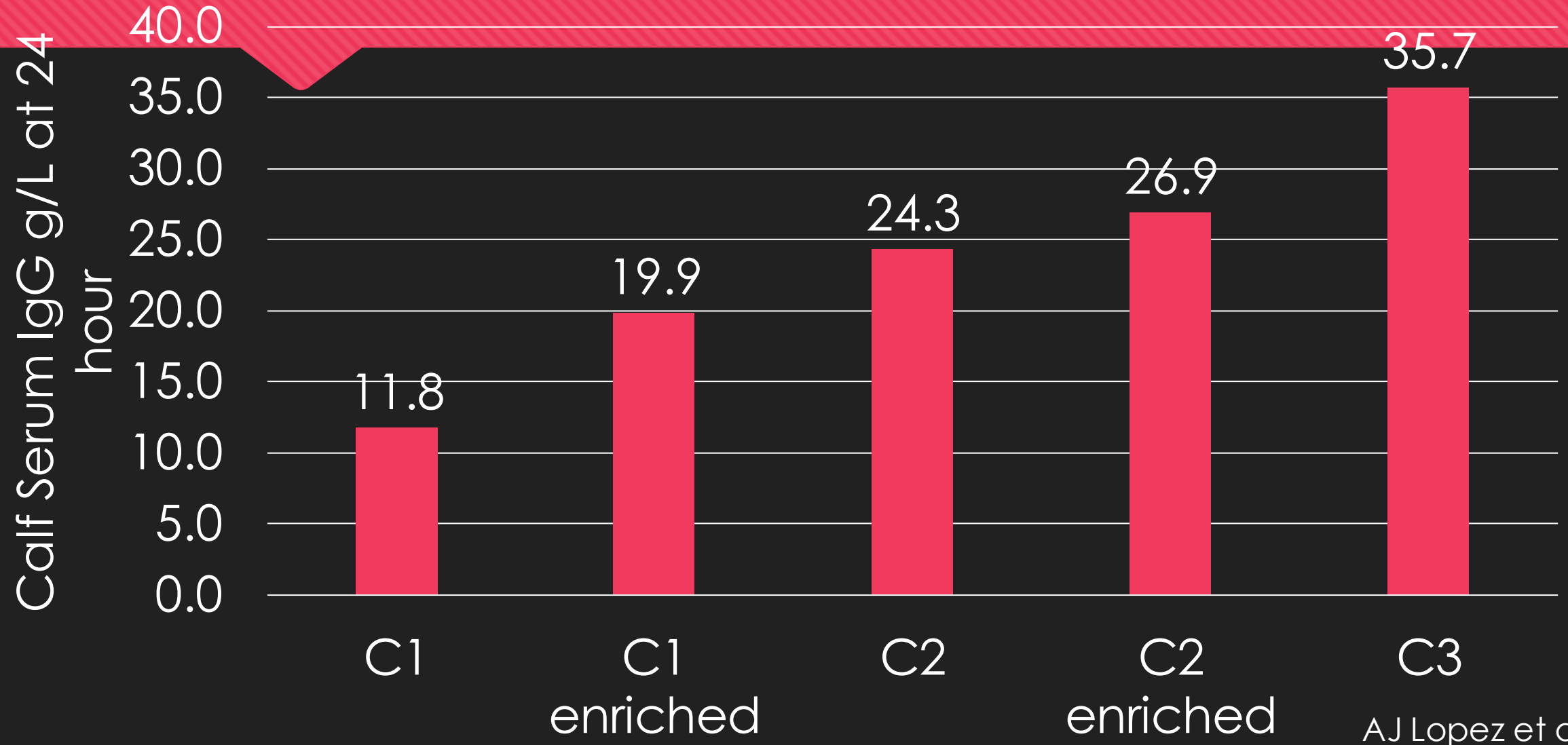
As We Feed More IgG, Calves Absorb More

- Also had 2 enriched colostrum groups
- Added colostrum replacer to enrich the low quality to medium quality and the medium quality to high quality

Group	Colostrum [IgG]	Total IgG fed
C1	30 g/L	114 g
C1 enriched	60 g/L	228 g
C2	60 g/L	228 g
C2 enriched	90 g/L	342 g
C3	90 g/L	342 g

AJ Lopez et al. 2022

As We Feed More IgG, Calves Absorb More



AJ Lopez et al. 2022

Consideration when Enriching Colostrum

- Enrichment will increase osmolality
- High osmolality fluid in the abomasum **delays** abomasal emptying
  → Inflammation of abomasal mucosa
- IgG absorption happens in the small intestine

Group	Osmolality mOsm/kg
C1	302
C1 enriched	**518**
C2	331
C2 enriched	**613**
C3	339

AJ Lopez et al. 2022

Abomasal Inflammation





Rethinking colostrum Brix benchmark for first feeding:

Brix ≥25% for the first feeding

Background on Volume of Feeding

- Why 1 gallon of 22% Brix?

  Historical Goals

  - 10% BW
  - 200g IgG
    - 22% Brix is ≈ 50 g/L IgG

- New goal is 300g IgG in first 24 hr



Volume Given in the First Feeding

We need to reduce volume for 2 big reasons

1. Efficiency of absorption

2. Calves too full → colic, acidosis, abomasal ulcers, regurgitation, aspiration, pneumonia, refusal to drink next meals…



Efficiency of IgG Absorption

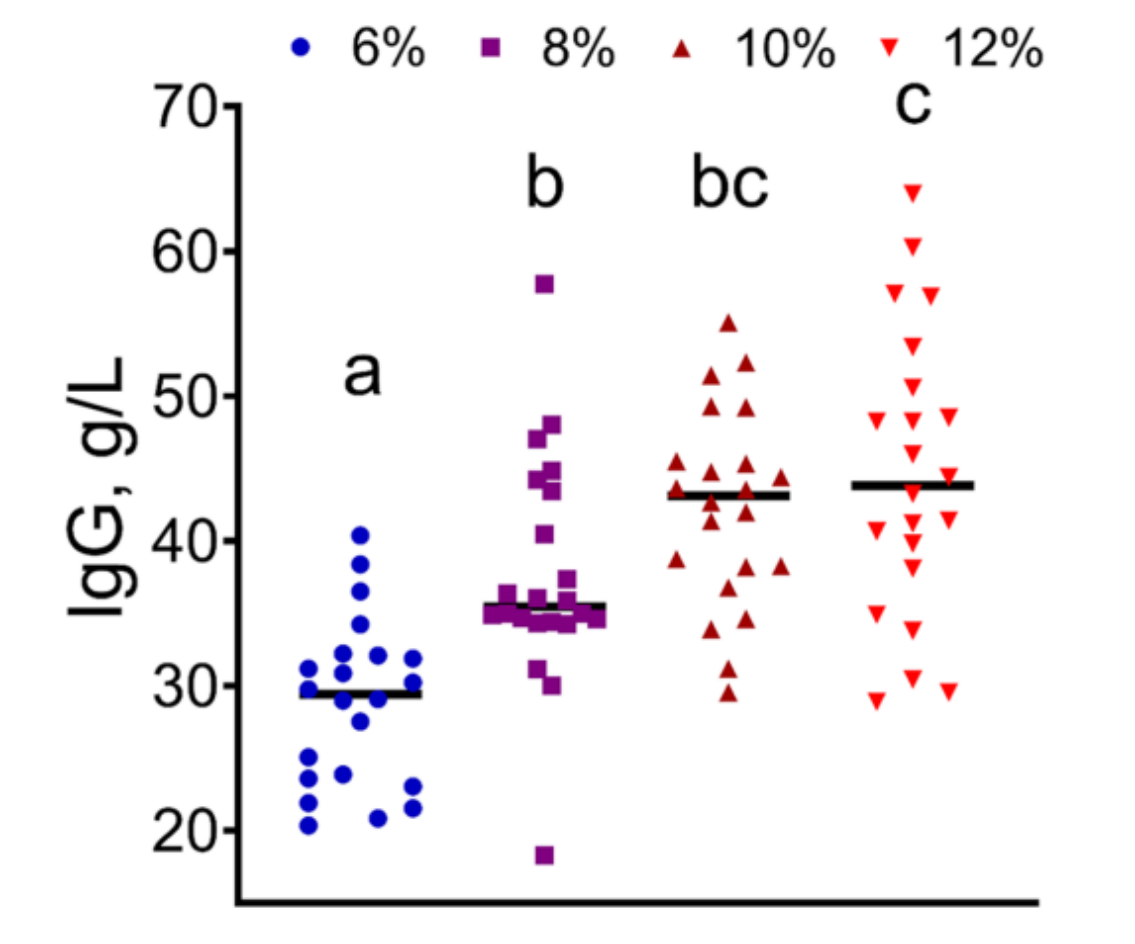
- 88 female Holstein calves in 4 groups
- Fed colostrum via tube at different percentages of BW
- Pooled colostrum → Brix 24.2%, IgG 86.7 g/L

BW %	Avg L of colostrum fed	Avg Total g IgG fed
6%	2.3 L	215
8%	3.1 L	286
10%	4.0 L	354
12%	4.8 L	429

G. Frederick et al. 2025

Efficiency of IgG absorption

Calf serum sample taken 24 hours after colostrum feeding



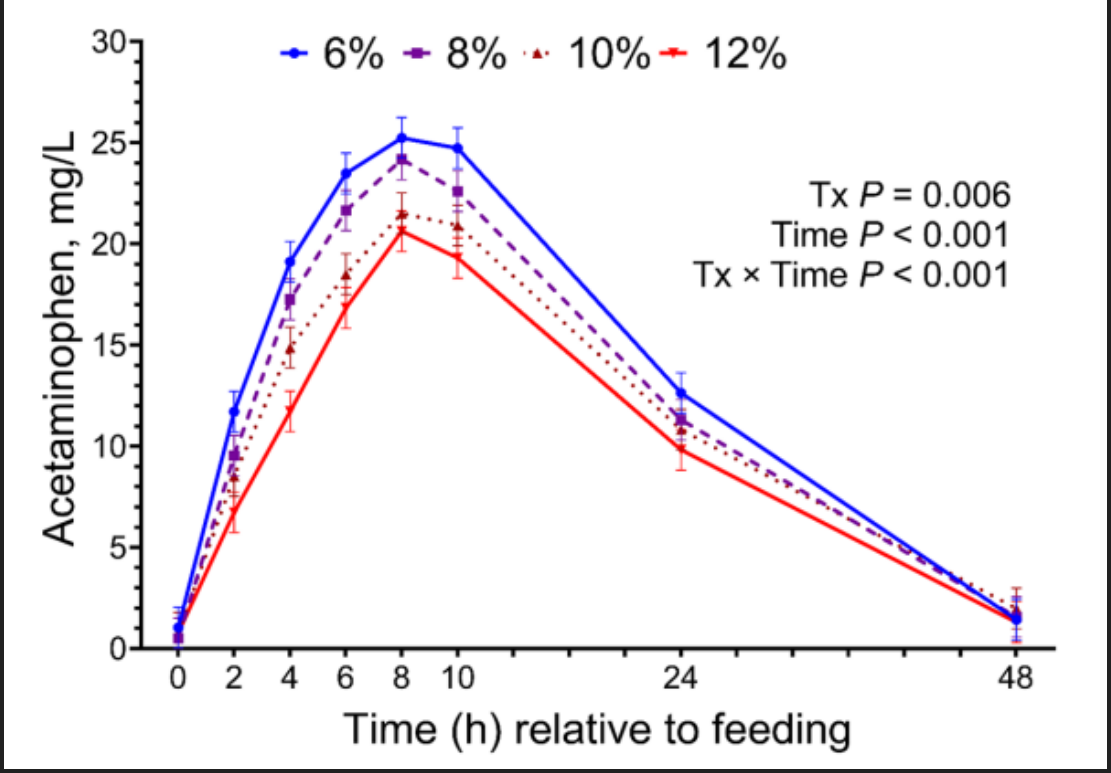
BW %	Avg Serum IgG g/L
6%	28.8
8%	37.4
10%	41.1
12%	43.4

No statistical difference in serum IgG in calves fed 8% and 10% of BW

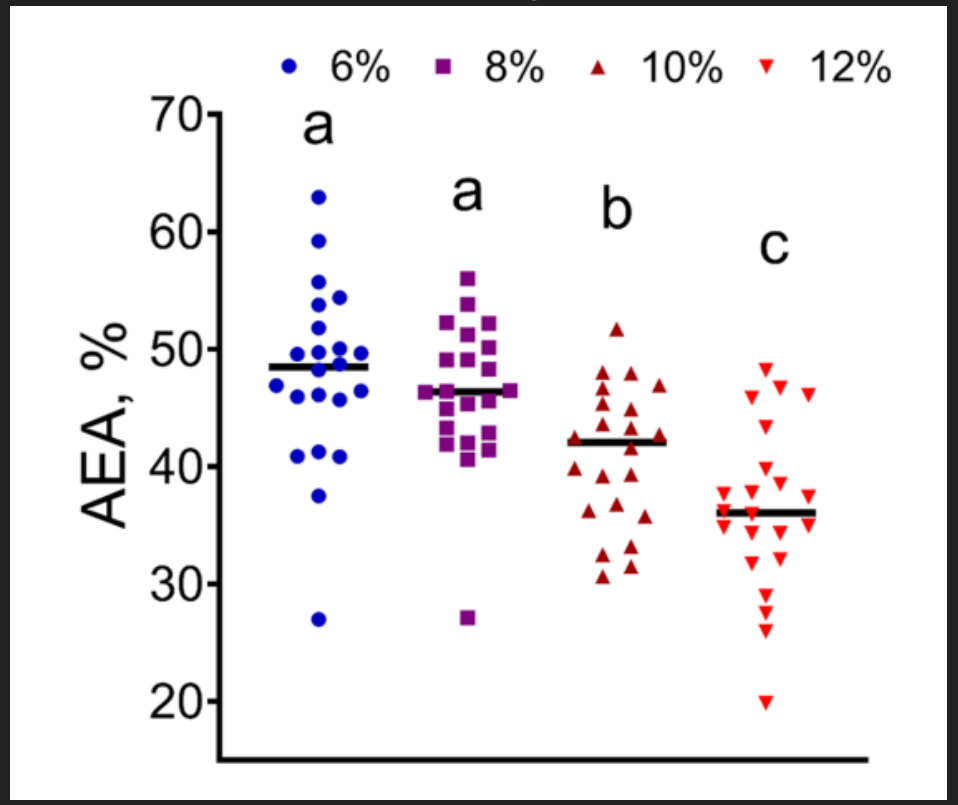
G. Frederick et al. 2025

Efficiency of IgG absorption

This study also evaluated abomasal emptying to help understand the efficiency of IgG absorption



AEA: apparent efficiency of absorption



G. Frederick et al. 2025

Efficiency of IgG Absorption

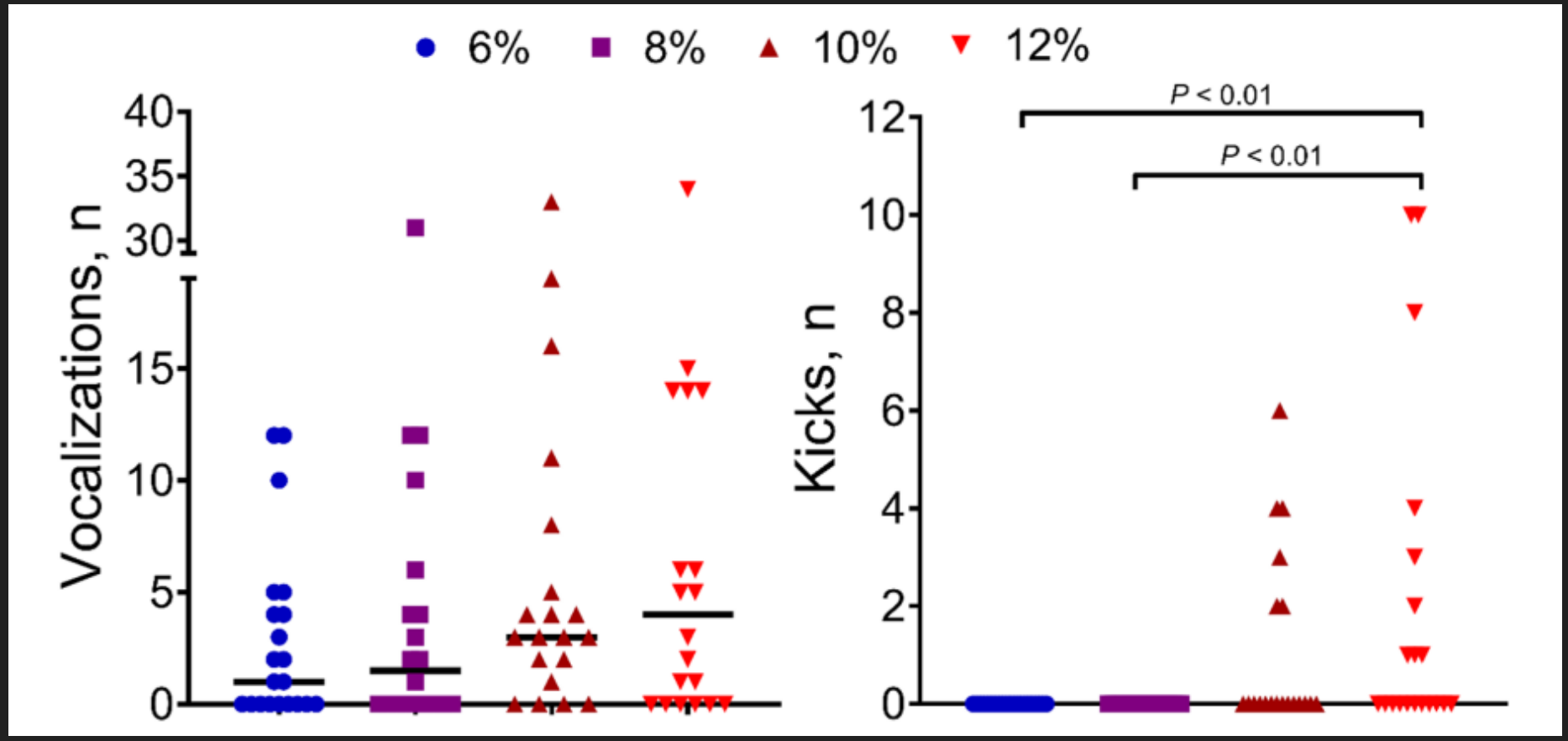
- Calves fed 10% and 12% of BW had significant decrease in efficiency of absorption
- As volume of colostrum meal increased, **gastric emptying rate slowed**
- They also observed calves' behavior after colostrum feeding
  - Lying position, walking, standing, kicking, vocalizing



G. Frederick et al. 2025

Impact of Feeding Large Volume of Colostrum

- Calves fed 12% BW spent more time lying lateral compared to other groups
- 2 calves in 12% group and 1 in 10% group regurgitated



G. Frederick et al. 2025

Let's do the Math on BW%

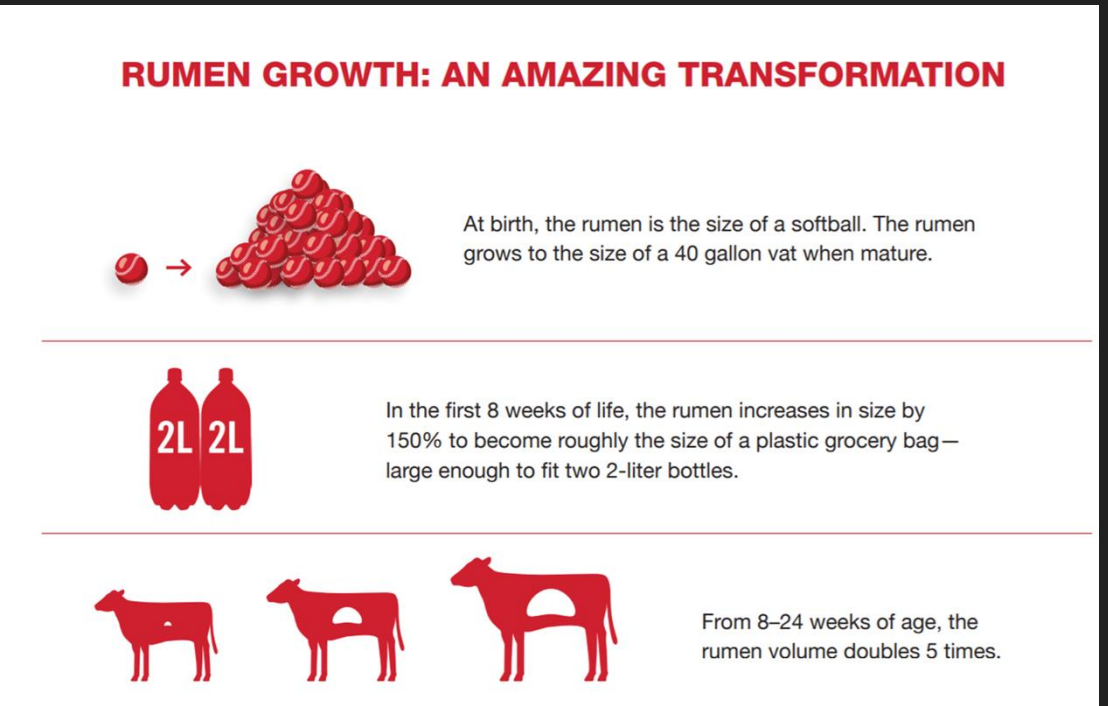


9 pounds/gallon colostrum			
Calf Weight	2L	3L	4L
60 pounds	**7.5% BW**	11% BW	15% BW
90 pounds	5% BW	**7.5% BW**	10% BW

Weight of colostrum can range from 8.5-9.4 pounds per gallon (4L)

Volume Given in the First Feeding

- Size of GI organs at birth
  - Rumen: 0.8 – 1.6 L
  - Abomasum: 2 – 4 L





Where does the colostrum go?

When We Tube Feed Colostrum

- Tubed into the rumen, but the rumen can't hold >1.6L
  1. Flows into the abomasum
  2. Regurgitation → aspiration
- Colostrum/milk in the rumen ferments → acidosis, bloating, GI stasis



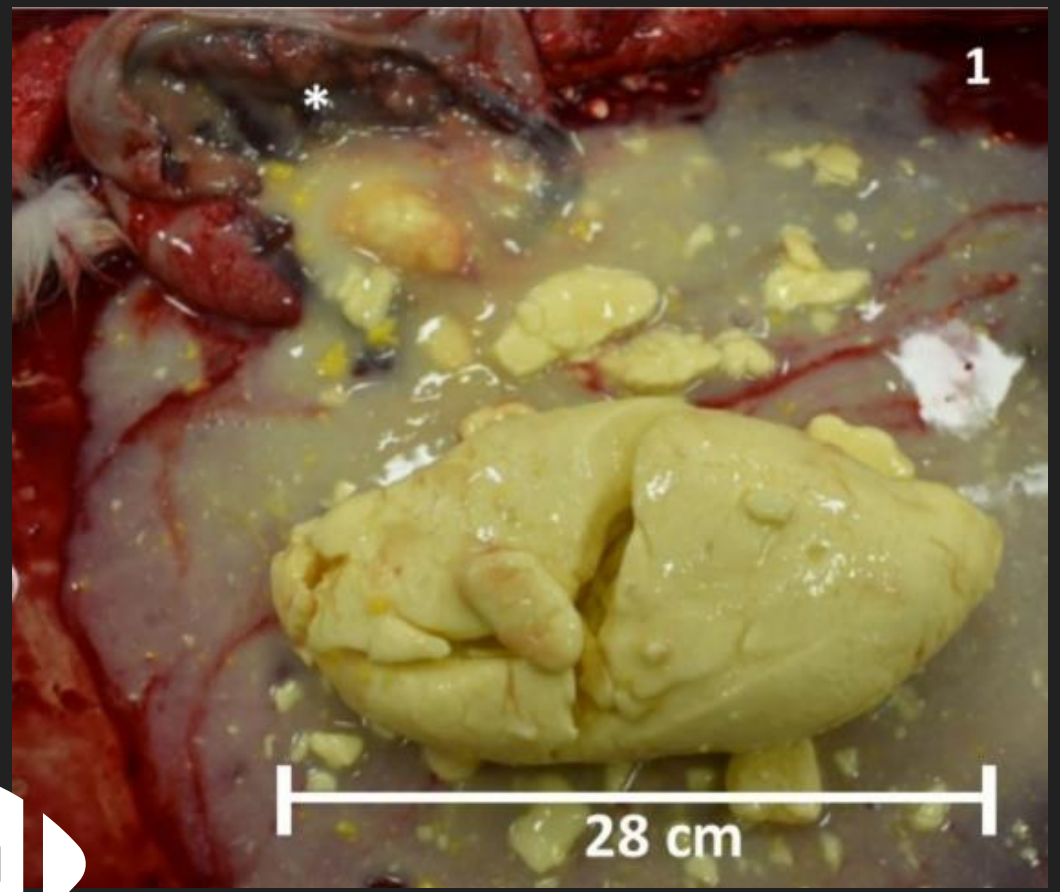
When a Calf Nurses Colostrum



- 1L meals
- Goes directly into the abomasum
- Moves to small intestine where IgG absorption takes place

Rethinking Volume of First Feeding

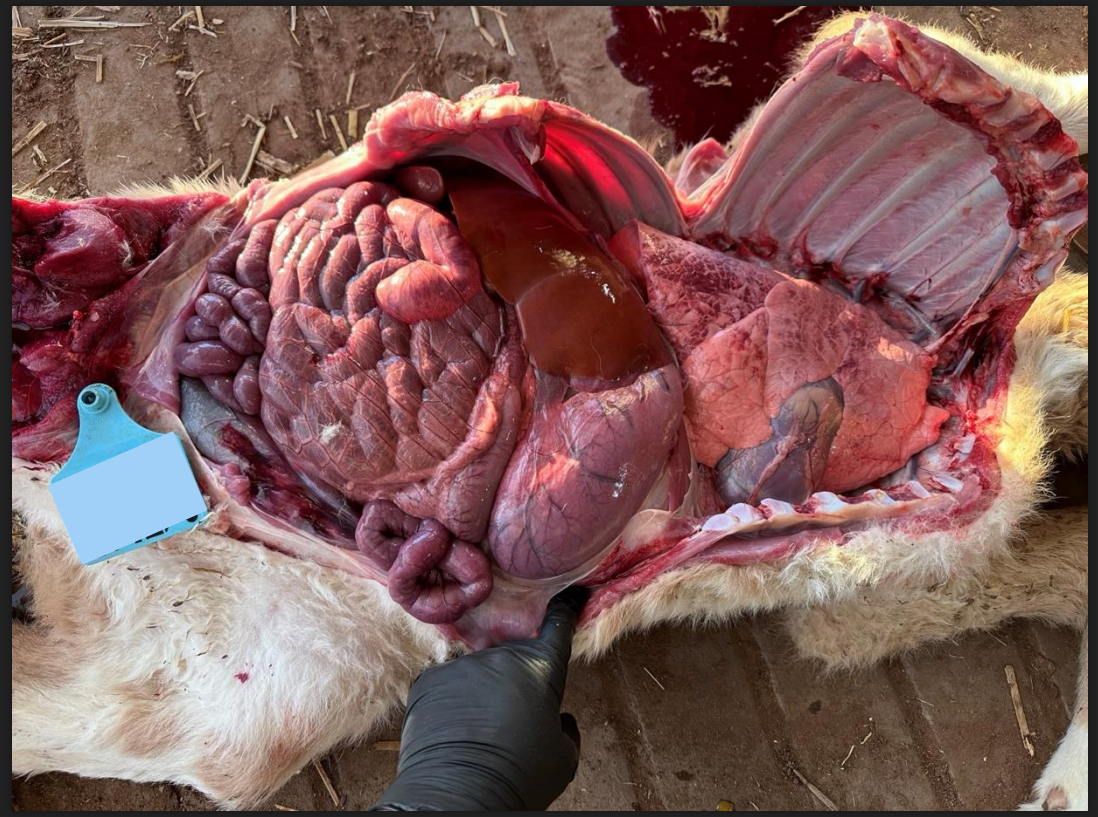
- Holstein heifer, 85 pounds
- First feeding 4L colostrum via tube
- 6 hours later 2L via tube
- Calf presented with signs of colic, distress, pain and do not want to eat



DC Sockett et al. 2024

< 24 Hour Old Calf Found Dead

Tubed 4L colostrum at birth, tubed 2L colostrum 12 hours later





Colostrum clot

Overtubed Calves Don't Want to Drink



Leads to employee frustration and increased risk of aspiration when training to drink

Risks of Tube Feeding Large Meal of Colostrum



- Regurgitation, aspiration, pneumonia
- Colic, rumenitis, abomasitis, ulcers, acidosis
- Large colostrum clots
  - Pain, discomfort, not digested, increased risk for ulcers
  - IgG's not absorbed because colostrum needs to get to the small intestine for IgG absorption
- Decreased efficiency of IgG absorption – wasting IgG's
- Calves do not want to drink
- Further exacerbated when multiple colostrum meals tubed

Volume given in the first feeding:

4L is too much

3L for Holsteins and 2L for Jerseys

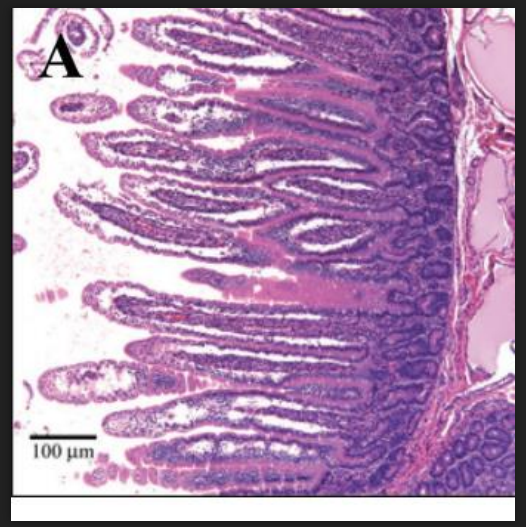
Continued Feeding of Colostrum Promotes GI Development



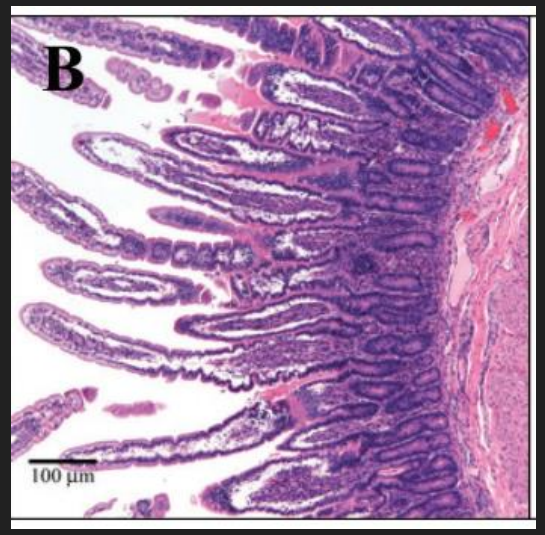
- Holstein bull calves, 3 groups
- All fed 1 meal of colostrum **(7.5% BW)**
- At 12 hours, second meal went into one of the three groups fed at **5% BW 2X day**
  1. Colostrum
  2. 50/50 Colostrum/Milk
  3. Whole Milk
- Killed on day 3 of life

J Pyo et al. 2020

Continued Feeding of Colostrum Promotes GI Development



Colostrum



50/50
Colostrum/Milk



Milk

Calves continued to be fed colostrum or the 50% milk/50% colostrum meals had **increased intestinal villi development** surface area for absorption compared to milk only group

J Pyo et al. 2020

IgG's in this Study

	IgG's in first 2 feedings	Additional IgG's given	Max Serum IgG	Time to Max serum IgG
Colostrum	314g	251g	30.4 g/L	29.5 hours*
50/50 Mix	247g	124g	27.2 g/L	27.0 hours*
Whole Milk	195g	N/A	23.9 g/L	13.4 hours

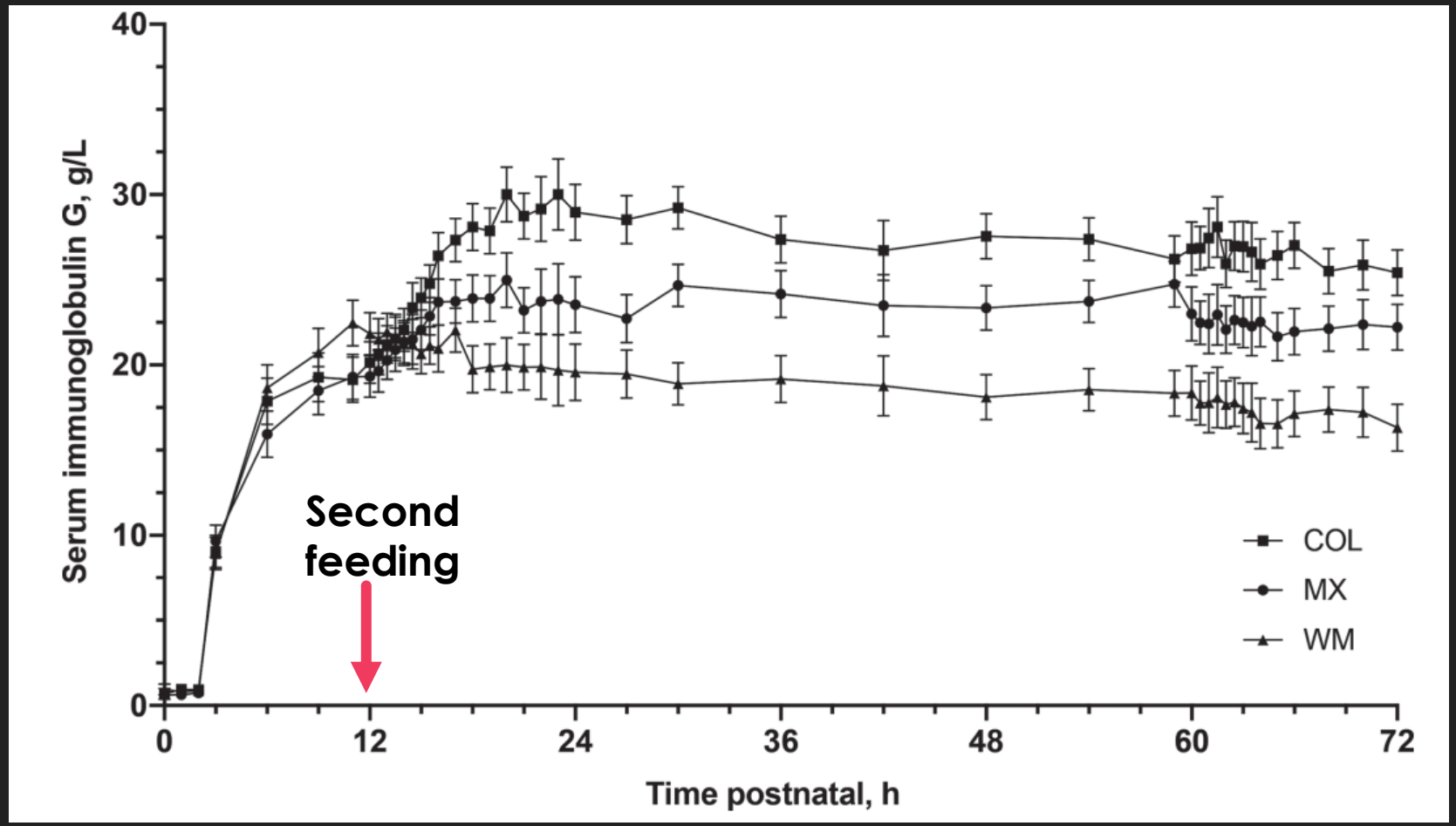
* No statistical difference

- Feedings started at 12 hours of life was 5% BW (approx. 2L)
  - Calves fed every 12 hours until end of study at 3 days old

KS Hare et al. 2020

Benefit to Additional IgG Feeding at 12 hours

- Providing another feeding of IgG's at 12 hours increased serum IgG
- Persistence of IgG's in serum
- IgG's provided after 12 hours did not continue to increase serum IgG



KS Hare et al. 2020

Best Practices for Second Feeding

- 12 hours after first feeding
- Use your 22-24% Brix colostrum
- 2L (Holstein and Jersey)
- If possible, offer via a nipple instead of a tube



Offer a Second Colostrum Feeding:

2L, 12 hours later

Summary

- 300g IgG in the first 24 hours of life
- Accomplished by feeding multiple smaller meals of higher quality colostrum



		Holstein	Jersey
1st feeding	≥25% Brix	3L	2L
2nd feeding	22-24% Brix	2L	2L
2nd feeding is 12 hours after the first feeding, preference is to be offered via nipple			

- 70% of your calves' serum total protein at 48 hours old is ≥ 5.8

QUESTIONS

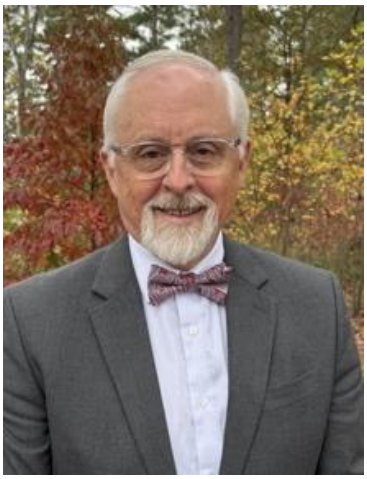


elizms@gmail.com

A new perspective on right sizing your heifer inventory

Dr. Michael Overton, DVM, MPVM | Zoetis

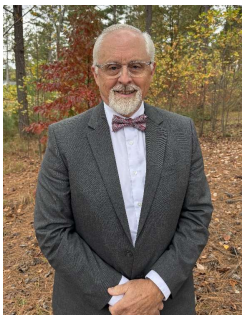
Description of presentation: This presentation explores the economic and biological factors behind right-sizing dairy heifer inventories, challenging the conventional wisdom that lowering replacement rates always improves profitability. It demonstrates how replacement rate is fundamentally driven by available heifer supply, with insufficient replacements forcing herds to keep lower-performing cows longer—ultimately reducing productivity and profits. Practical data-driven strategies are offered to help producers accurately estimate future heifer needs and optimize herd replacement decisions for sustainability and success.



Bio: Dr. Michael Overton is a veterinarian with a diverse background, holding degrees from North Carolina State University and UC Davis. He spent 8 years in private practice and 14 years teaching at UC Davis and the University of Georgia, followed by 13 years in industry with Elanco and Zoetis. Currently, at Zoetis, he leads the development of a global cloud-based analytics platform focused on delivering data-driven solutions to enhance animal health and customer value. His expertise includes reproduction and transition management, record analysis, heifer management, and economic decision-making, with a consistent focus on improving productivity and profitability through advanced analytics.

A New Perspective on Right-Sizing Your Heifer Inventory

Michael Overton
Zoetis, Blairsville, Georgia



Take-home Points

1. **Heifer Availability Drives Replacement Strategies.** Herd-level replacement rates are fundamentally constrained by the number and quality of available replacement heifers.
2. **Prioritize Profitability Over Cost Reduction.** Keeping inferior cows longer to reduce replacement costs may hurt overall profitability.
3. **Data-Driven Planning Reduces Risk.** A clear understanding of actual performance aids in preparing for the future.



2026 High Plains Dairy Conference, March 3-4, 2026

1

zoetis

1

Replacement Rate:

$$\frac{\text{\# Sold + \# Died (Lact>0)}}{\text{Average \# Milking and Dry}}$$



\# Lact=0 that Calve = \# Sold + \# Died (Lact>0)

In a stable herd, these are equal

2

zoetis

2

I Asked an AI Chatbot to Describe the Prevailing Wisdom Around Dairy Cattle Replacement Rates

Typical Range:

Most commercial dairy herds have replacement rates between 25% and 40% annually.

Prevailing Target:

A replacement rate of about 30% is often cited as ideal. Rates above 35-40% are generally viewed as symptomatic of herd problems (e.g., high culling due to disease, injuries, or reproductive failure).

Current Trends:

In some regions, tightening economics and improvements in herd health have pushed rates lower (closer to 25-30%).

Others still see high rates due to factors like lameness, mastitis, fertility challenges, or aggressive expansion.

Advice: Remove animals with poor health, low productivity, or genetic problems

3

zoetis

3

I Asked an AI Chatbot to Describe the Prevailing Wisdom Around Dairy Cattle Replacement Rates

Typical Range:

Most c ally.

Prevailin

A repla enerally
viewed or
reprodu

Current

In some ed rates
lower (

Others still see high rates due to factors like lameness, mastitis, fertility challenges, or aggressive expansion.

Do you agree with these statements???

What is the real driver (and limiter) of replacement rate?

Heifer availability

What happens when the availability (and quality) of incoming replacement heifers decreases?

Advice: Remove animals with poor health, low productivity, or genetic problems

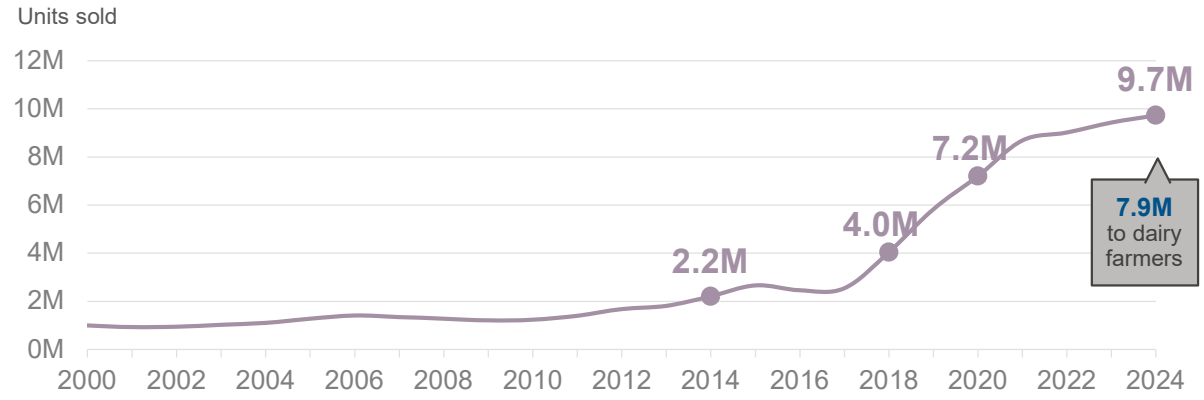
4

zoetis

4

Beef-on-dairy Continues to Transform the Industry

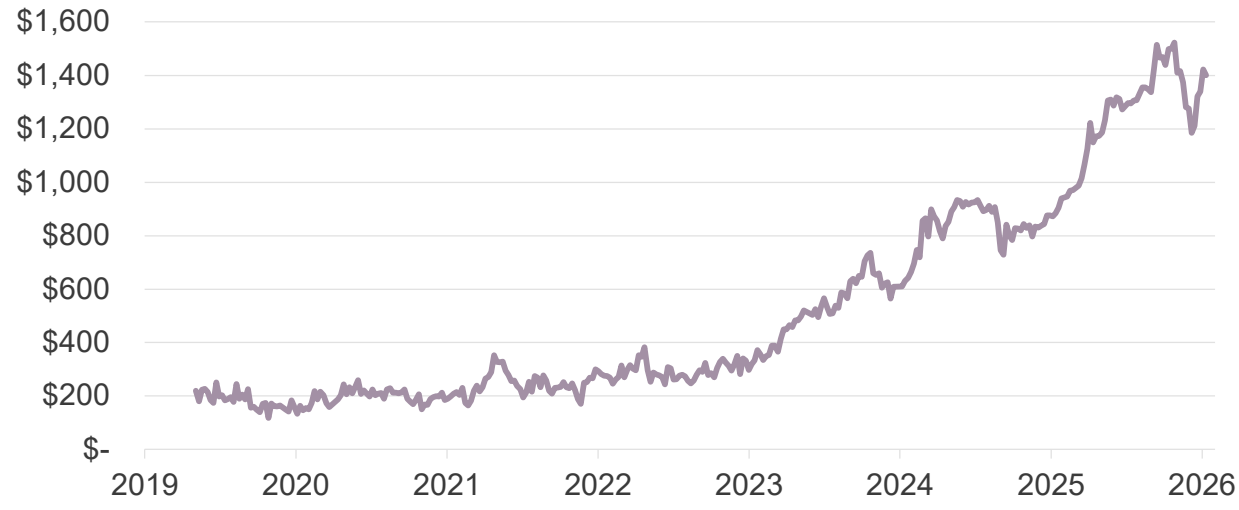
Domestic beef semen sales climbed substantially[1]



[1]Corey Geiger, CoBank, Georgia Dairy Conference, January 20, 2026

5

Pennsylvania Beef-on-dairy Calf Pricing ($ Per Calf)



[1]Corey Geiger, CoBank, Georgia Dairy Conference, January 20, 2026

6

Where are These Values Heading???

Who knows for sure. The following comments/thoughts are just my personal reflections and are not meant to represent official projections or predictions:

Market conditions remain favorable. Record prices may pull back a little, but fundamentals are still supportive

Futures do not suggest an impending crash

Based on current consumer demand for beef and low cow-calf inventories, will probably continue to see above-average calf values

Watchouts:

- Some event(s) that cause consumer demand to weaken
- Beef herd rebuild that is faster than expected
- Political action to change market for imported beef

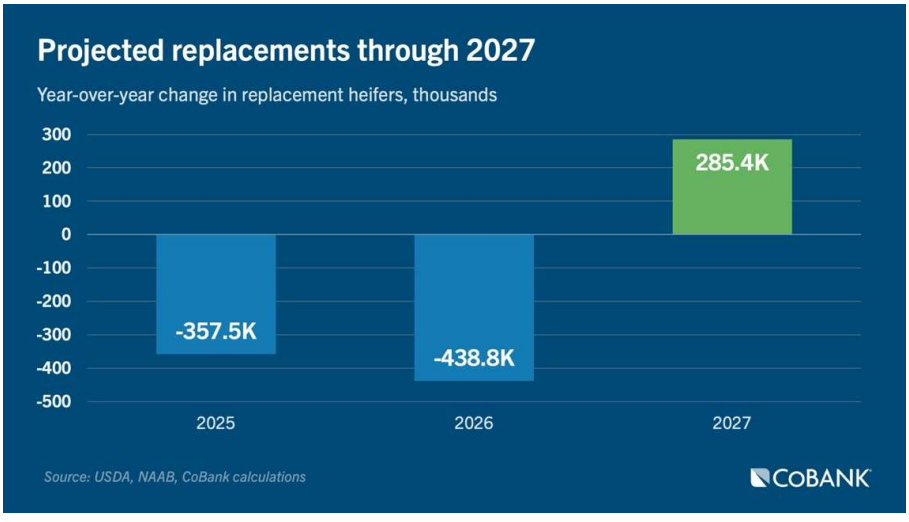
7 7

zoetis

7

Dairy Replacements Will Shrink Further Until 2027[1]

Dairy replacements available to enter the milking string on U.S. dairy farm (year over year)

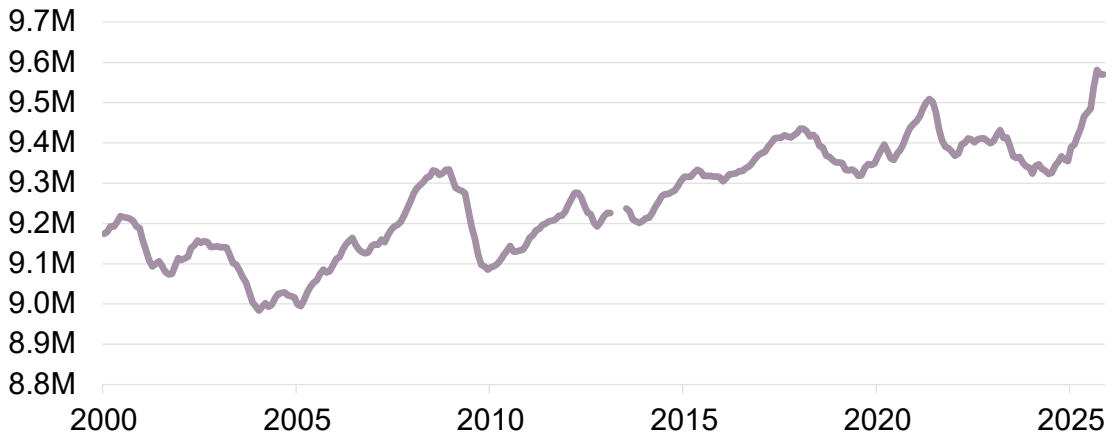


8 [1]Model and calculations by Corey Geiger, CoBank, Georgia Dairy Conference, January 20, 2026

8

Yet, We Have the Largest Dairy Cow Herd In 30 Years[1]

Monthly dairy cow inventory



~90,000 fewer cows culled in 2025 than in 2024; culling pullback extends back to 2023[1]

9 [1]Corey Geiger, CoBank, Georgia Dairy Conference, January 20, 2026

9

Recent Comments from Veterinarians

- "I can't really put my finger on why, but milk/cow is down and we can't seem to get it back up. Forages are good, cow comfort is good… but the cows just aren't responding" (veterinarian in mid-Atlantic region)
- "Dry-off milk is down… cows aren't producing as well as they have been…" (California veterinarian)
- Why???
- Herds are milking more "stale" cows (that should have been replaced sooner)

10 zoetis

10

Replacement Rate:

$$\frac{\text{\# Sold + \# Died (Lact>0)}}{\text{Average \# Milking and Dry}}$$



\# Lact=0 that Calve = \# Sold + \# Died (Lact>0)

In a stable herd, these are equal

e.g. In a stable 1,000-cow herd over a 12-month period, *by definition*, if 350 first-calf heifers enter the herd, 350 existing cows found a new home

Availability (and quality) of incoming heifers drives replacement rate

11

zoetis

11

Herd-level Replacement Rate is Driven by Heifer Availability (and Quality)

Herds that grow their own replacements "plan" for a "maximum" level of turnover based on how many heifers are raised*

Type of Cows for Replacement

Dead cows
Incurable or chronic disease issues
Cows that fail to become pregnant
Health-related poor producers
Poor producers but otherwise healthy
Genetics (heifers)

Failure to produce enough heifers results in constrained replacement opportunities

12

zoetis

12

Focus on Replacing the Right Cows at the Right Time and NOT Just on Lowering Replacement Cost

*Focus management efforts to reduce the risk of cows losing sufficient value to **warrant** replacement!*

Reduce disease risk, improve repro, reduce lameness, etc.

Genetics, nutritional management, improve cow comfort, etc. are all important

But continue focusing on making good economic decisions to improve profitability

Remember, the question that we need to continuously ask ourselves…

"Is the immediate and long-term value of *THIS* **slot** improved by keeping the current cow or by replacing her with a fresh heifer?"

***Increasing* replacement rate can improve profitability if done carefully…**

13

zoetis

13

Overview of an Economic Model[1] Used in This Presentation

Spreadsheet-based model that mimics the flows of cows from first calving through each successive lactation up to a maximum of 10

Each lactation has its own unique production curve, removal risk (sold, condemned, died), lactation length, dry period length, dry period cost, transition management cost, and transition disease cost

Each future lactation is adjusted back to the day of first calving using a net present value approach with an interest rate of 8%

Key economic assumptions:

Milk $/lb ECM =		$0.22
Replacement =		$3,200
Calf values:	HO Heifer:	$750
	HO Bull:	$800
	BeefXCalf:	$1,200
Market cow (liveweight):		$1.5/lb
Feed (lactating)/lb:		$0.13
Dry cow cost/d:		$3.25

Economic result = **Income over Cost (IOC)**

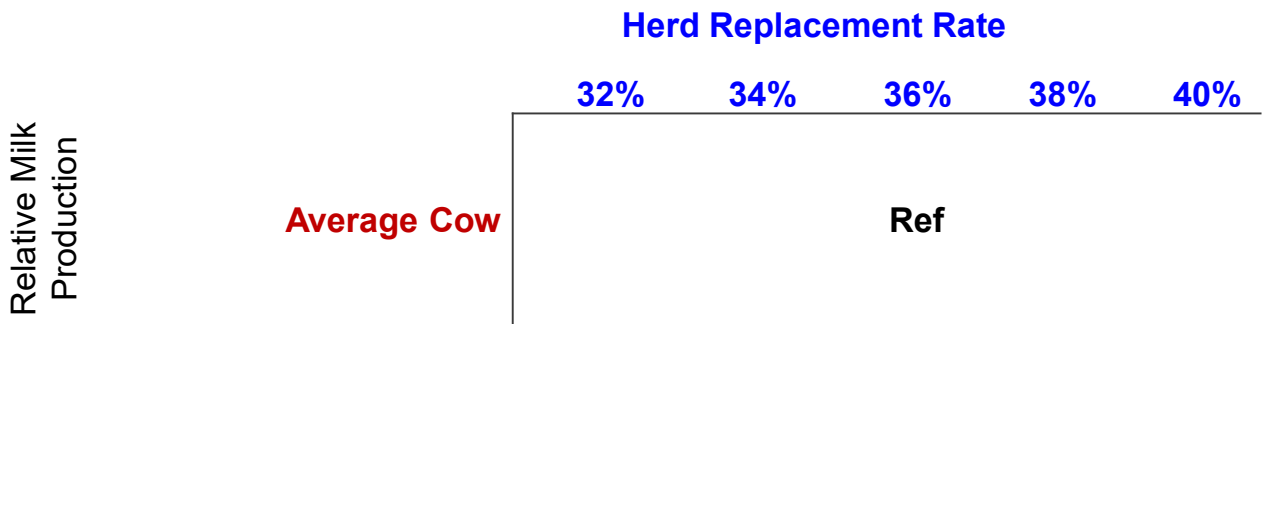
(Milk + Calf Value + Market Cow Revenue) – (Feed + Dry Cow + Transition + Replacement Cost)

14 [1]Overton, M. and S. Eicker. 2022. Use of an NPV model to estimate the value of additional selective replacement of dairy cattle during first lactation. J. Dairy Sci. Vol. 105, Suppl. 1:140.

zoetis

14

Examining the Relationship Between Replacement Rate and Milk Production on IOC*



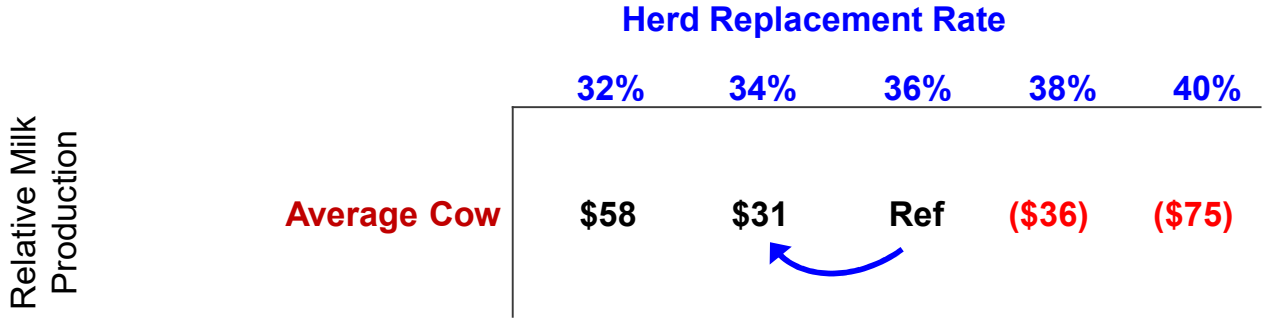
*IOC = (Milk + Calf + Market Cow Revenue) – (Lactating Feed + Dry Cow Feed + Transition Management + Transition Disease + Replacement Costs)

15

zoetis

15

Examining the Relationship Between Replacement Rate and Milk Production on IOC*



Many assume that if they constrain (lower) replacement rate, it will save money. If, average production per cow did not change due to keeping potential market cows longer, this would be true. However…

*IOC = (Milk + Calf + Market Cow Revenue) – (Lactating Feed + Dry Cow Feed + Transition Management + Transition Disease + Replacement Costs)

16

zoetis

16

Examining the Relationship Between Replacement Rate and Milk Production on IOC*

Herd Replacement Rate

Relative Milk Production	32%	34%	36%	38%	40%
Average Cow	$58	$31	Ref	($36)	($75)
2% Decrease in Milk	($26)	($53)	($84)	($120)	($159)

Restricting replacement production actually results in a diagonal move in this grid and a reduction in profitability since cows *that should be replaced* are retained longer due to insufficient replacement heifers being available

*IOC = (Milk + Calf + Market Cow Revenue) – (Lactating Feed + Dry Cow Feed + Transition Management + Transition Disease + Replacement Costs)

17

zoetis

17

Examining the Relationship Between Replacement Rate and Milk Production on IOC*

Herd Replacement Rate

Relative Milk Production	32%	34%	36%	38%	40%
2% Increase in Milk	$141	$115	$84	$49	$10
Average Cow	$58	$31	Ref	($36)	($75)
2% Decrease in Milk	($26)	($53)	($84)	($120)	($159)

Careful and appropriate *selective* replacement can increase profitability if it results in an increase in production

A higher replacement rate is costly IF production does not change but it can be more profitable if replacement yields a higher level of production

*IOC = (Milk + Calf + Market Cow Revenue) – (Lactating Feed + Dry Cow Feed + Transition Management + Transition Disease + Replacement Costs)

18

zoetis

18

So, What Happens if Replacement Heifer Production is Inadequate?

Some replacements can be purchased (unlikely for many herds due to cost and quality issues).

Therefore:

- Cows that should be replaced will be retained longer
- Fewer replacement heifers reduces or eliminates the option for selective replacement based on productivity

If a herd lowers their replacement rate from 38% to 34% (without significant management improvements), the worst cows in the herd are required to be retained about 113 days longer!

19

zoetis

19

An Actual Dairy Example

For the past year, the average milk for cows that left the herd as “SOLD” after 120 DIM = 68 lb

What if these cows were retained an extra 113 days as a consequence of delayed replacement?

- With a 0.18 lb drop/day → 20 lb less milk at time of replacement (48 lb)
- That is nearly 1200 lb of cumulative milk production opportunity lost
- At $0.13/lb TMR and $0.22/lb milk → $0.16 loss/lb of milk (marginal milk value)
- Approaching $200 net loss/delayed replacement
- At the new 34% replacement rate → about $62/cow slot/year

OK – but what about the savings from fewer replacements needed?

20

zoetis

20

Consequences of Delayed Replacement

(Decreasing Replacement Rate from 38% to 34% by Constraining Heifer Supply)

Key Assumptions Used:

- Market value = $1.50/lb
- Whole herd annual mortality risk = 6%
- Condemnation risk at market = 7%
- Interest rate = 9%

Average Replacement Cost/d at Varying Replacement Rates[1]

Heifer Cost	34%	36%	38%
$2,800	$1.13	$1.17	$1.21
$3,100	**$1.41**	$1.46	**$1.53**
$3,400	$1.68	$1.76	$1.84

$1.53 - $1.41 = $0.12; $0.12 * 365 = $43

-$62 Loss in marginal milk/yr (cow slot)

Replacement cost savings $43 Replacement cost savings/ year (cow slot)

Difference **-$19 Net loss/cow slot (herd)**

-$55 Net loss/cow replaced/year

[1]Based upon a whole herd replacement and depreciation model as presented in Overton, M. and S. Eicker. 2022. J. Dairy Sci. Vol. 105, Suppl. 1:140

21

zoetis

21

Is There Evidence Across the Industry that an Insufficient Heifer Supply Has Hurt Dairy Performance?

Retrospective data analysis, presented Jan 30, 2025 at National Mastitis Council annual meeting

"Short" herds

Replacement risk for 2023-2024 was at least 2% points ***lower*** than 2020-2022 (herd-level average = -6%)

AND

Heifers calving in 2023-2024 was at least 2% points ***lower*** than 2020-2022 (herd-level average = -12%)

N=12 herds; 207,963 lactations

"Surplus" herds

Replacement risk for 2023-2024 was at least 2% points ***higher*** than 2020-2022 (herd-level average = 3%)

AND

Heifers calving in 2023-2024 was at least 2% points ***higher*** than 2020-2022 (herd-level average = 10%)

N=7 herds; 83,149 lactations

22 Overton and Eicker, NMC January 30, 2025

zoetis

22

A Few Summarized Results

Changes by End of Lact Year Group: 2020-2022 → 2023-2024

	"Short" Herds	"Surplus" Herds
Sold	-13%	+11%
Died	+7%	-1%
Dry	+6%	-4%

	"Short" Herds	"Surplus" Herds	Difference (Short – Surplus)
Sold	-2.6 lb	0.9 lb	-3.5 lb
DIM at Sold	10 d	-15 d	25 d
Dry	-2.8 lb	4.2 lb	-7.0 lb
DIM at Dry	1 d	-8 d	9 d
Change in % with 2+ Cases of Mastitis	+12%	- 1%	

All results shown significant with p<0.05

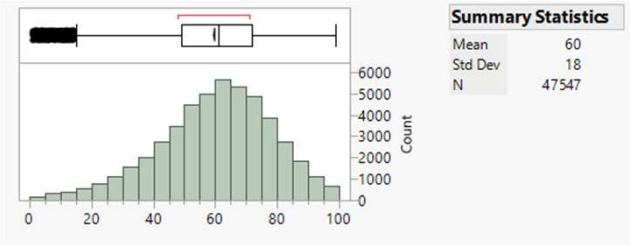
23 Overton and Eicker, NMC January 30, 2025

zoetis

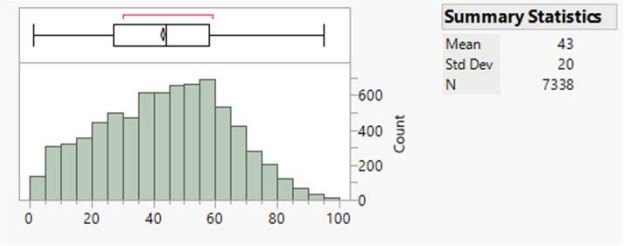
23

One More Example: 18 California Herds Following HPAI[1]

Average milk/d (lb) during final 30 d prior to dry off



Average milk/d (lb), final 30 d prior to SOLD (>200 DIM)



Cows already pregnant during HPAI: dry-off milk ~normal (60 lb)

Average milk prior to being sold after 200 DIM: down significantly (43 lb vs. 53 for cows sold prior to HPAI)

Predicted optimal cut point for these herds (if a replacement is available) was ~65 lb

Cows were retained longer than optimal

24 [1]Overton and Eicker, "A Look Back at California Dairies: Economic and Management Considerations Following HPAI", California ARPAS Conference, Oct 29, 2025

zoetis

24

Keeping Inferior Cows In the Herd Longer Lowers Cost But Also Lowers Profitability

Do not get caught “cutting costs” (or chasing sunk costs) and end up hurting profitability

Strive to make replacement decisions *before* the cow becomes a liability vs. “waiting to see what happens”

Earlier replacement decisions tend to be associated with higher salvage values, thus lowering net replacement cost/transaction

These concepts apply equally to first lactation cows…

25

zoetis

25

But, But, But… She Hasn’t Paid for Herself…

Average Cow	Calving to Dry (d)	Total Milk (lb)	Avg/day	Milk + Calf Income	Feed	Dry Cow &Transition	Housing & Other Costs	Running Net
Lact 1	332	25862	78	$6,242	($2,390)	($395)	($2,490)	$966
Lact 2	324	29865	92	$7,083	($2,582)	($423)	($2,430)	$2,614
Lact 3	79	8697	110	$2,636	($706)	($451)	($593)	$3,500
Total	**735**	**64,424**		**$15,960**	**($5,678)**	**($1,270)**	**($5,513)**	**$3,500**
Average/day			88	$21.71	($7.73)		($7.50)	$4.76/d

15th Percentile Cow	Calving to Dry (d)	Total Milk (lb)	Avg/day	Milk + Calf Income	Feed	Dry Cow &Transition	Housing & Other Costs	Running Net
Lact 1	332	19138	58	$4,829	($2,027)	($395)	($2,490)	($83)
Lact 2	324	22100	68	$5,451	($2,163)	($423)	($2,430)	$353
Lact 3	338	24399	72	$5,934	($2,329)	($451)	($2,535)	$972
Lact 4	334	24756	74	$6,009	($2,336)	($487)	($2,505)	$1,654
Lact 5	330	25185	76	$6,099	($2,347)	($470)	($2,475)	$2,460
Lact 6	336	25077	75	$6,077	($2,359)	($495)	($2,520)	$3,163
Lact 7	33	2573	78	$1,349	($238)	($525)	($248)	$3,502
Total	**2027**	**143,227**		**$35,750**	**($13,799)**	**($3,247)**	**($15,203)**	**$3,502**
Average/day			71	$16.63	($6.81)		($7.50)	$1.73/d

26

zoetis

26

But, But, But… She Hasn't Paid for Herself…

Average Cow	Calving to Dry (d)	Total Milk (lb)	Avg/day	Milk + Calf Income	Feed	Dry Cow &Transition	Housing & Other Costs	Running Net
Lact 1								$966
Lact 2								$2,614
Lact 3								$3,500
Total								**$3,500**
Average/								$4.76/d

The decision to replace a cow should never consider when she has paid for herself, but rather what is most profitable for that slot

The lower producing cow takes more than 2.5 X longer to reach the same economic endpoint *(Chasing Sunk Costs!!!)*

When you have low producing cows, do you *REALLY* want to keep them long enough for them to pay for themselves???

(Remember, the lower the producer, the longer it will take)

15th Perce Cow								nning Net
Lact 1								($83)
Lact 2								$353
Lact 3								$972
Lact 4								$1,654
Lact 5								$2,460
Lact 6								$3,163
Lact 7	33	2573	78	$1,349	($238)	($525)	($248)	$3,502
Total	**2027**	**143,227**		**$35,750**	**($13,799)**	**($3,247)**	**($15,203)**	**$3,502**
Average/day			71	$16.63	($6.81)		($7.50)	$1.73/d

27

zoetis

27

Estimating Replacements Needs Involves Speculation

Projecting Future Heifer Needs Starts with an Evaluation of Historical Data

Historical cow replacement rate – % of milking and dry cows that are replaced each year

Historical heifer completion rate – % of heifers actually enter the lactating herd

NEITHER of these will likely be **exactly** the same in the future but we must start with a reasonable approximation and then add some buffer

Many Things Can and Do Change That Will Alter Heifer Needs

- Cow health challenges
- Heifer quality
- Milk price
- Genetic potential
- Heifer cost
- Market cow value

28

zoetis

28

Heifer Completion Rate

Very much misunderstood metric

TERRIBLE metric for monitoring

- Tremendous lag ➔ Instead, we should monitor performance within each management stage
- Can be difficult to interpret
- A higher completion rate is not necessarily better – perhaps herds are holding on to poor quality heifers (chronic health issues, poor genetics)
- A lower completion rate is not necessarily worse
  - What if the herd was selling excess heifers to a neighbor?
  - What if the herd is aggressively limiting breeding opportunities?

BUT! It is important to understand for future planning purposes

A big issue that I have noticed ➔ tendency to overestimate how many heifers make it to calving

29

zoetis

29

My Approach for Heifer Completion Rate

Heifer Completion (Liveborn to Calving): Key Stages and Measures

- % of heifers that conceive that actually calve
- % of heifers reaching 365 days of age that conceive
- % of heifers sold from 91 to 365 days of age
- % of heifers died from 91 to 365 days of age
- % of liveborn heifers sold by 90 days of age
- % of liveborn heifers died by 90 days of age

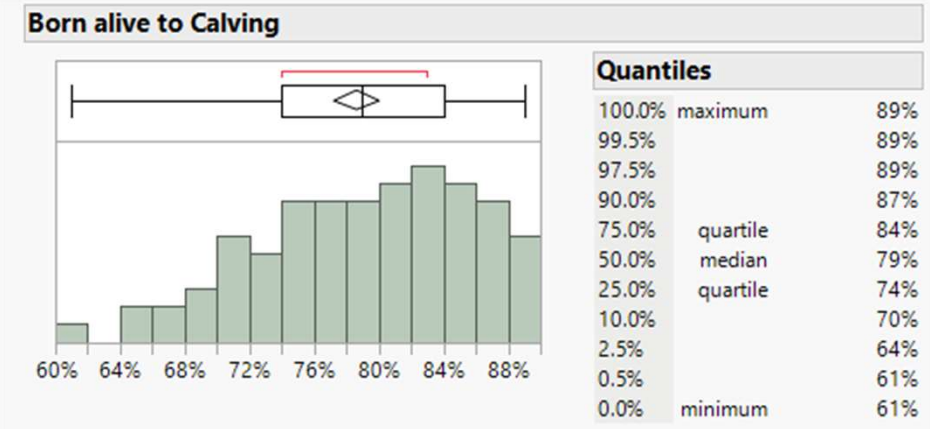
(Work Backwards from Calving when I calculate completion rate)

30

zoetis

30

Heifer Completion Rate: Born Alive to Calving (85 U.S. Herds*)



Quantiles		
100.0%	maximum	89%
99.5%		89%
97.5%		89%
90.0%		87%
75.0%	quartile	84%
50.0%	median	79%
25.0%	quartile	74%
10.0%		70%
2.5%		64%
0.5%		61%
0.0%	minimum	61%

Summary Statistics	
Mean	79%
Std Dev	7%

Note: This dataset excluded herds producing heifers for another herd

31 *Zoetis internal data on file

zoetis

31

Stage-specific Risks That Contribute to Heifer Completion Rate

	Median	Interquartile Range
% of Heifers That Conceive That Fail to Calve	3%	2%–5%
% That Fail to Conceive (≥365 Days of Age)	6%	4%–8%
Sold from 91 to 365 Days	2%	1%–4%
Died from 91 to 365 Days	3%	2%–6%
Sold by 90 Days	0%	0%–1%
Died by 90 Days	4%	3%–6%
Heifer Completion – Liveborn to Calving	**79%**	**74%–84%**

Data based on 85 Commercial US dairy herds (Zoetis internal data on file)

Note: These are NOT benchmarks or goals. Higher is not necessarily better and lower is not necessarily worse.

32

zoetis

32

How Many Heifers Should a Dairy Produce per Year?

One approach for consideration

	All	L=1	L=2	L>2
Avg # Milking and Dry	1000	313	256	431
# Sold	311	75	59	178
# Died	59	12	9	37
Herd Turnover	37%	28%	27%	50%
Total Replacements Needed – Status quo	**370**			

Year	# Replaced	Avg # M & D	Replacement Rate
2015	395	990	40%
2016	339	1010	34%
2017	361	995	36%
2018	388	1000	39%
2019	365	1005	36%
2020	380	1005	38%
2021	371	1000	37%
2022	361	1005	36%
2023	386	980	39%
2024	350	1010	35%
Average	**370**	**1000**	**37%**

Standard Deviation = 2%

2% of 1000 = 20

33

zoetis

33

One Approach to Estimate Replacement Needs

	All	L=1	L=2	L>2
Avg # Milking and Dry	1000	313	256	431
# Sold	311	75	59	178
# Died	59	12	9	37
Herd Turnover	37%	28%	27%	50%
Total Replacements Needed – Status quo	**370**			

Year-to-Year Variation (1 std dev of 10-yr RR = 2% of herd)		20 →	**390**
Cushion for unanticipated needs (% of the herd)	**3%**	30 →	**420**

34 (Note: This is NOT an inventory calculation; thus, age at first calving is not needed)

zoetis

34

One Approach to Estimate Replacement Needs

	All	L=1	L=2	L>2
Avg # Milking and Dry	1000	313	256	431
# Sold	311	75	59	178
# Died	59	12	9	37
Herd Turnover	37%	28%	27%	50%
Total Replacements Needed – Status quo	**370**			

Year-to-Year Variation (1 std dev of 10-yr RR = 2% of herd)		20 →	**390**
Cushion for unanticipated needs (% of the herd)	**3%**	30 →	**420**
Net # Heifer Needed to Enter Lactation =			**420**

Our final target for this herd, based on the assumptions above, is 420 heifers that calve

35

(Note: This is NOT an inventory calculation; thus, age at first calving is not needed)

zoetis

35

# Heifers Needed to Calve		**420**
% of Preg. Heifers removed before Calving	4%	
		438 # Heifers that Get Pregnant
% of Breeding Heifers that Fail to Conceive	6%	
		465 # Heifers Enter Breeding Pen
% Sold: 91 to 365 days	2%	
% Dead: 91 to 365 days	3%	
% Prebreeding Selective Removals	2%	
		500 # Heifers reaching 90 days
% Sold: Liveborn to 90 days	1%	
% Died: Liveborn to 90 days	4%	
% Postweaning Selective Removals	3%	
Heifer completion (born alive to calving)	**77%**	**544** # Heifers Born Alive

39

zoetis

39

Other Factors that Impact the Number of Heifers that Enter the Herd

	Median	Interquartile Range
Stillborn Risk:	2.9%	2.2% - 3.7%

% of Animals (pregnancies) that make it to calving

Lactation #	0	1	2	3+	ALL
Median	96%	89%	85%	78%	89%
Interquartile Range	92% - 98%	87% - 91%	82% - 88%	74% - 81%	88% - 91%

Warning! These values are NOT meant to be goals or guidelines. Actual results should be the consequence of appropriate management decisions based upon health, heifer supply, and economic conditions.

40

zoetis

40

# Heifers Needed to Calve		**420**
% of Preg. Heifers removed before Calving	4%	
		438 # Heifers that Get Pregnant
% of Breeding Heifers that Fail to Conceive	6%	
		465 # Heifers Enter Breeding Pen
% Sold: 91 to 365 days	2%	
% Dead: 91 to 365 days	3%	
% Prebreeding Selective Removals	2%	
		500 # Heifers reaching 90 days
% Sold: Liveborn to 90 days	1%	
% Died: Liveborn to 90 days	4%	
% Postweaning Selective Removals	3%	
Heifer completion (born alive to calving)	**77%**	**544** # Heifers Born Alive
% Stillborn	3%	
	75%	**561** # Dairy Females births
Removals from d-40 preg to calving	12%	
% of Female Pregnancies to Enter Herd	**66%**	**638** # of d-40 Female Pregnancies Needed

42

zoetis

42

Final Question for Consideration: Regarding Ongoing Breeding Decisions…

Assuming that just enough heifers will be produced with the breeding plan thus far, what type of sire should be used to produce the *LAST 100* pregnancies in a 2500-cow herd?

100 pregnancies represents 4% of total herd size

Breeding options:

- Sexed dairy semen
- Beef semen

zoetis

43

Assumptions Used for Subsequent Scenarios

Herd size (milking and dry)	2,500
Replacement rate (last year)	34%
Heifers needed/year	850
Stillborn risk	3%
Heifer completion rate	80%
Interest rate	8%
Springer heifer future value	$3,200

	Option 1	Option 2
Semen options	Sexed, Holstein	Beef
100 pregnancies --> liveborn calves	85 F; 12 M	97 BeefX
Calf values	$750; $1000	$1,300
"Extra" replacement springers	68	buy as needed
Potential replacement rate	37%	?

[1]https://premierlivestockandauctions.com/market-reports/, last accessed 12/2/25

[2]https://www.ams.usda.gov/mnreports/lsmdairycomp.pdf, last accessed 12/2/25

zoetis

46

Let's Take a Look at Calf Values…

	Option 1 - Breed Extra with Sexed Semen		Option 2 - Breed Extra with Beef Semen
	Female Holstein	Male Holstein	Holstein X Beef
# Born	88	12	100
# Born alive	85	12	97
Value/calf at birth	$750	$1000	$1,300
Total value at birth	$64,020	$11,640	$126,100
Total calf value produced	**$75,660**		**$126,100**

If we compare the value of the liveborn calves (and assume 3% stillbirth risk for all calves), we see what appears to be an easy decision!

~$50,000 advantage for Option 2 → bring on the beef semen!

But not so fast… we need to evaluate the longer-term perspective as well!

zoetis

47

Let's Take a Longer-Term View of a Hypothetical Scenario with 2 Options:

Scenario:

The herd is convinced that the extra heifers will be valuable

There is extra capacity for raising them

Options: breed for a few more heifers or breed for more beef cross calves

Extra heifers raised in Option 1 represent "marginal heifers" and raising costs are marginal

Marginal raising cost = -$1,700 (not including initial calf value)

In Option 2 when beef semen is used, the herd plans to buy extra heifers "as needed"

zoetis

48

Scenario…

Extra heifers are desired/needed AND there is extra capacity for raising them (marginal heifers)

	Option 1 - Breed with Sexed Semen		Option 2 - Breed with Beef Semen	
	Female Holstein	Male Holstein	Beef Sire	Purchased Springers
# Born alive	85	12	97	73
Value/calf at birth	$750	$1000	$1,300	
Total value at birth	$64,020	$11,640	$126,100	
Total young calf value produced	**$75,660**		**$126,100**	
Marginal raising cost (not incl. initial value)	($1,700)			
Total raising costs (dead heifers, incl. calf value)	($5,595)			
Total raising cost/value (sold heifers, incl. calf value)	$1,862			
Net cost/springer calving (incl/ calf value)	**($2,505)**			
Total Raising Costs	**($171,039)**			
Springer heifer present value	$3,200			($3,200)
Total Springers Realized	68			68
Total investment (or cost) for springers (NPV)	**$218,522**			**($218,522)**
Final Net by Option	**$123,143**		**($92,422)**	
Final Net (Option A - Option B)	**$216,263**			

Under these assumptions of equal final springer numbers, using sexed dairy semen is more valuable due to the profit made of raising vs. purchasing heifers

50

zoetis

50

Sensitivity Analysis for our Scenario
(Marginal Raising Cost)

(Net Benefit of Option 1 (sexed dairy semen) vs. Option 2 (beef semen)

Springer Value	# Springers Purchased Later for Option B: 0	1	25	40	68	Breakeven #
$2,900	-$25,539	-$22,639	$46,961	$90,461	$172,497	9
$3,200	**-$2,957**	**$243**	**$77,043**	**$125,043**	**$215,565**	**1**
$3,500	$19,625	$23,125	$107,125	$159,625	$258,633	N/A
$3,800	$42,206	$46,006	$137,206	$194,206	$301,701	N/A

Springer values/costs and cull heifer values decide the breakeven # for purchase.

Assumes $2500 marginal heifer raising cost, including calf value

(Note: I have attempted to link the springer and cull heifer values based on market conditions but calf values are NOT linked)

Based on current economic conditions, there is money to be made in producing some extra heifers even if no additional heifers are purchased.

This advantage ***does not*** consider the potential genetic and production differences between home-grown vs. purchased springers

51

zoetis

51

Overall Summary

Beef cross values have been a two-edged sword for the dairy industry – don't lose sight of a dairy's opportunities for raising heifers or its ultimate goal of enhancing milk production

The potential replacement of a cow with a fresh heifer is all about improving the herd

- Replacing cows is expensive but failing to replace cows at the right time is also expensive
- Remember, salvage value matters!

Producing a few extra replacement heifers creates several profitable options → don't get caught short!

a) More cows can be selectively replaced on the basis of milk production
b) Dairies can raise and sell excess springers or even fresh cows (after collecting the calf)
c) Dairies can genomically test their heifers and use this information to make better breeding decisions and selectively remove some of the inferior future replacements

zoetis

52

Take Home Action Points

Make sure you are using enough sexed semen to produce a bit of a surplus of heifers

- 3-5% as a start but a bit more if they are willing

Look at a 2 or 3-year window for establishing historical heifer needs

Use the correct herd-specific completion rate

- Based on my 85-herd data set, average heifer completion rate ~ 79%

Given sufficient heifers, strive to make earlier replacement decisions in order to reduce lost opportunity, improve herd productivity, and improve salvage value (and welfare)

There are lots of options for how extra heifers may be allocated!

zoetis

53

Thank You for Your Attention!

Any Questions?

Michael.Overton@zoetis.com



All trademarks are the property of Zoetis Services LLC or a related company or a licensor unless otherwise noted. ©2025 Zoetis Services LLC. All rights reserved.

zoetis

54

54

Dairy Outlook: State of the World Dairy Industry



High Plains Dairy Conference,
Amarillo, USA, 2-3 March 2026



Dr. Torsten Hemme

Researcher & Entrepreneur; Founder of IFCN

torsten.hemme@outlook.com





Its about Cows, People, …





My Personal Background

1965 born on a dairy farm, Germany

1980th Army services, work on dairy farms

1990th: Education at University Göttingen, Texas A&M University, PHD in 1999

2000 - 2023: Founder and CEO of the IFCN Dairy Research Network

IFCN
Dairy Data · Knowledge · Inspiration

Other activities:

- Lecturer Dairy Economics University Kiel
- Started a Dairy Farm in NZ 2003
- Foundation and consulting role

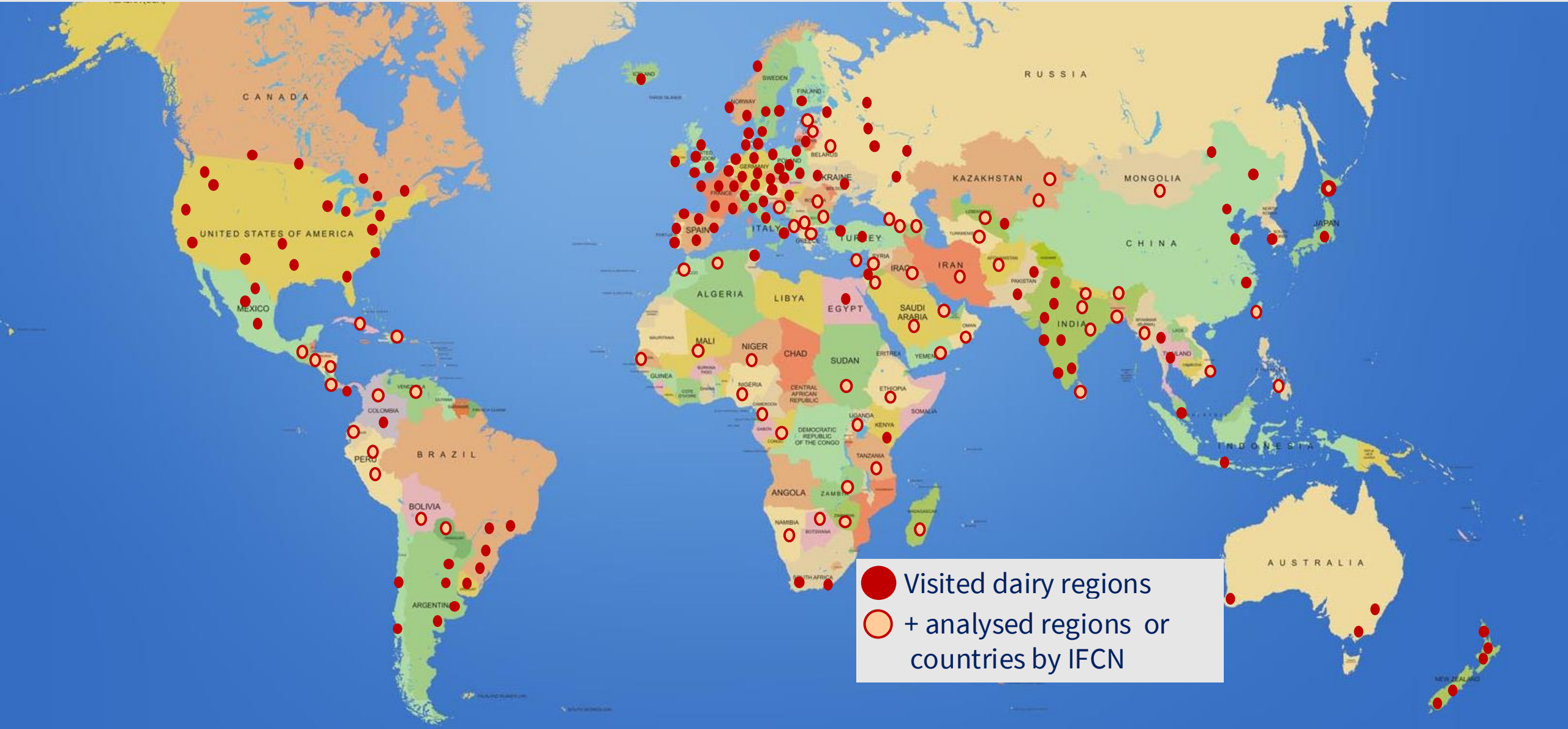
FOUNDATION CONSULTING

Hemme dairy farm since 1589



The oldest house on our farm built 1706

My Dairy Experiences the last 30 years



HIGH PLAINS DAIRY CONFERENCE

- Dairy demand
- Dairy supply
- Dairy prices
- Dairy outlook
- Summary

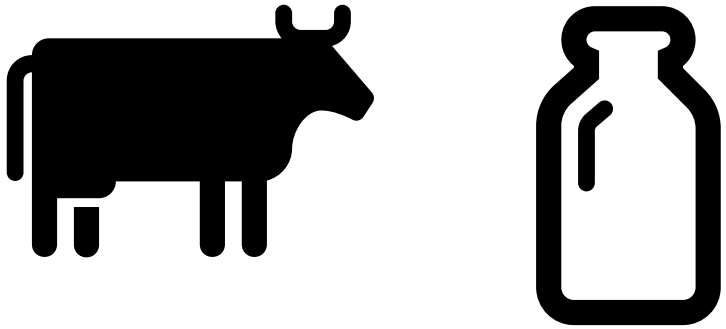


Dairy Outlook: State of the World Dairy Industry

High Plains Dairy Conference,

Amarillo, USA, 2-3 March 2026

Dairy is big



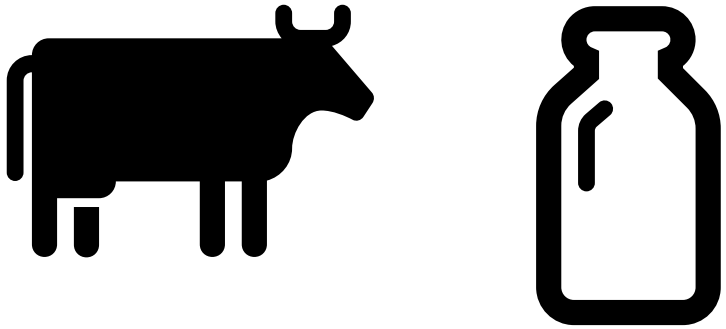
Dairy

> 1000 billion US$*

(consumer value of milk and related beef)

* Estimation on IFCN Dairy Report 2025; 2024 : 1006,8 mill t milk production;

Dairy is bigger than Apple + Microsoft + Google



Dairy

> 1000 billion US$*

(consumer value of milk and related beef)



Apple + Microsoft + Google together =

= 986 billion US$

based on sales 2024

* Estimation on IFCN Dairy Report 2025; 2024 : 1006,8 mill t milk production;

The dairy story is told best by a glass of milk



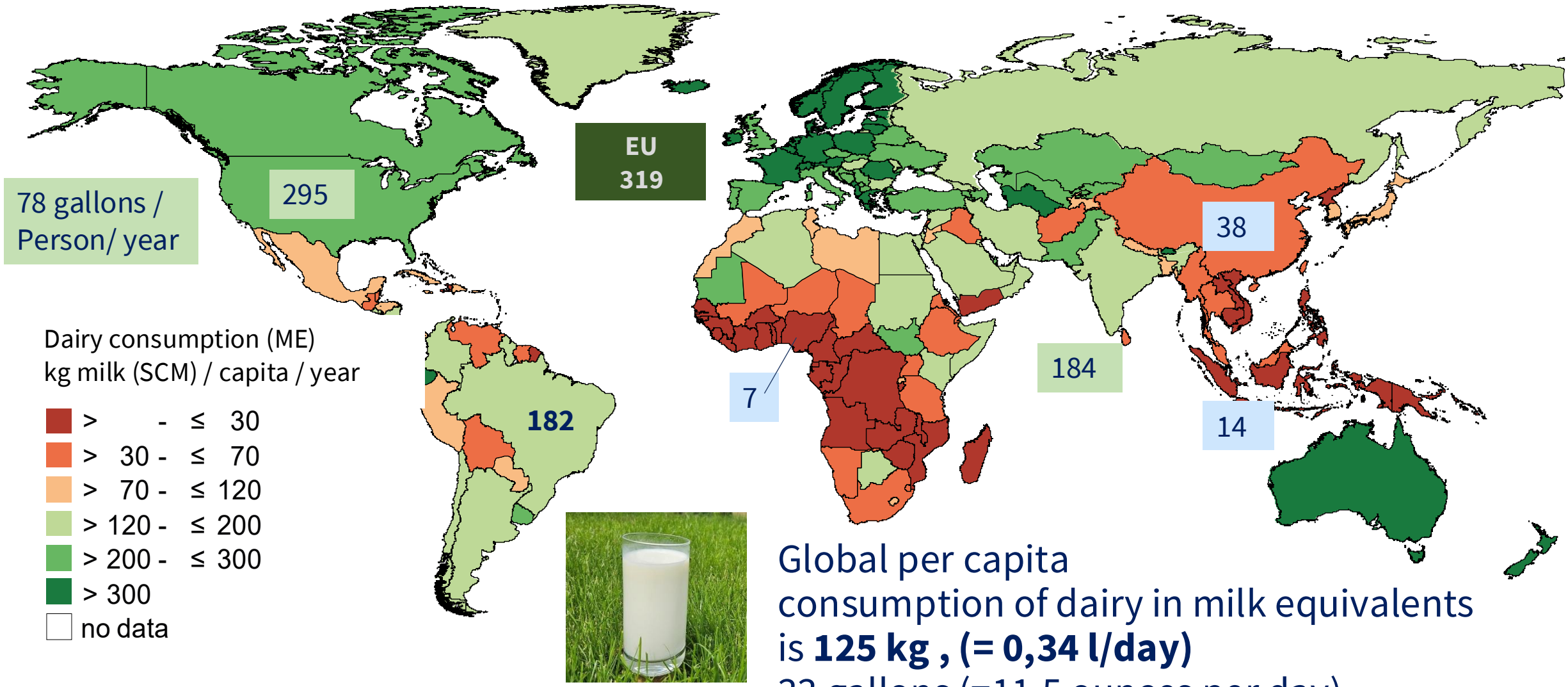
A glass of milk,
0,34 l milk

=

the world average dairy consumption per person / day

* Sourcse : IFCN Dairy Report

Dairy demand per capita differs between countries



Global per capita consumption of dairy in milk equivalents is **125 kg , (= 0,34 l/day)**
33 gallons (=11,5 ounces per day)

Source: IFCN Dairy Report
Remarks: Demand in per capita consumption in kg milk equivalents in 2023.

Dairy demand in the future



Some people see

Great farmers, great animals, products, etc.

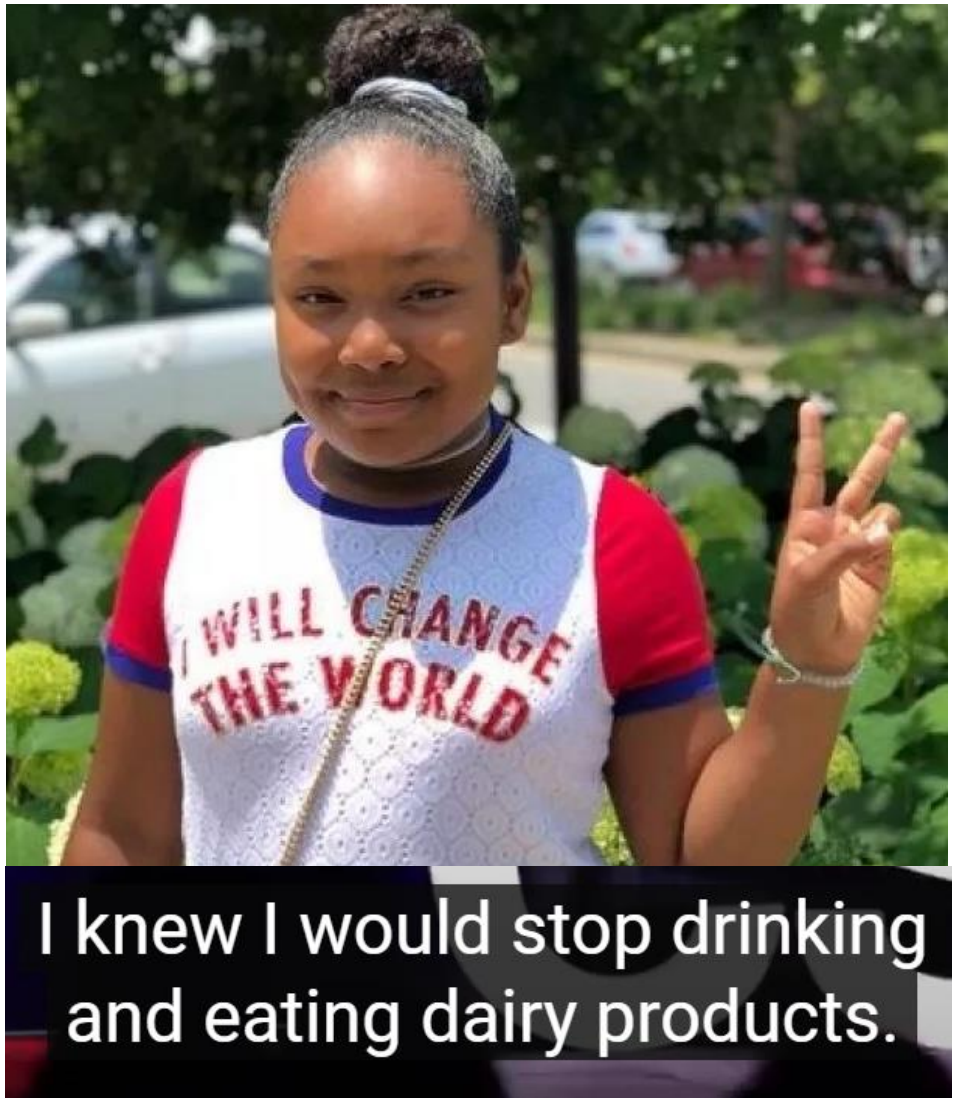
Some people see dairy as

bad for the planet, bad for the animals and bad for humans, etc.

Let’s see their arguments

Quelle: IFCN Dairy Report 2023: Konsum von Milchprodukten 125 kg Milch/ Kopf / Jahr in Milchäquivalenten, das sind 0,34 l / Tag.

One glass milk per day ☹ Hypotheses 1



Genesis Butler:
Animal agriculture the key reason for climate change



2017: TED presentation at age of 10 years

2019: 1 Million US$ collected to offer the **Pope** for go for 40 days vegan

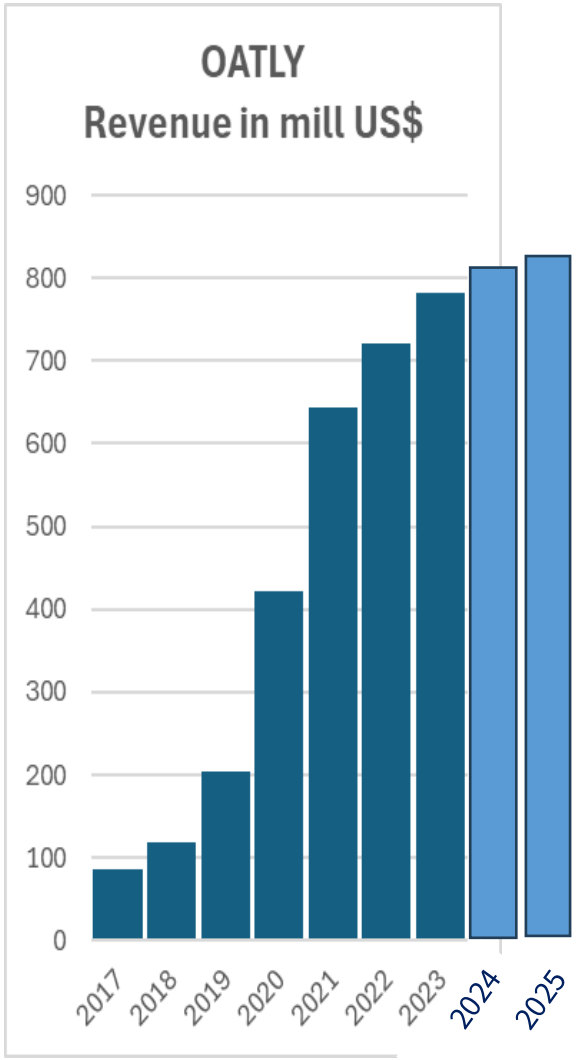
2025: now 18 years old + more to come

Dairy alternatives – on the rise?



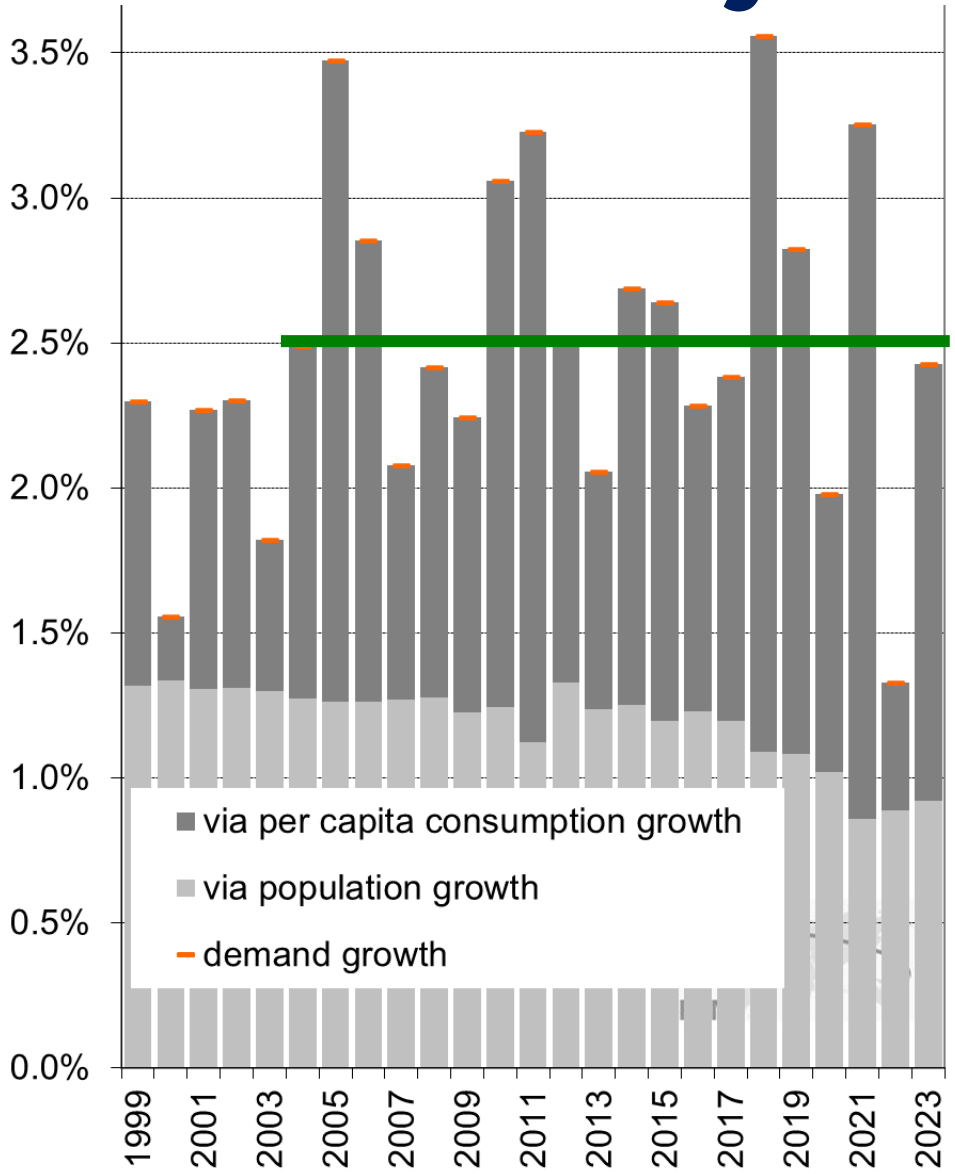
Facts 1: Oatly Sales + Share Price







Fact: Global Dairy Demand growth in % per year



Source: D3.2 IFCN Annual Sector Database with Long-term Dairy Outlook;

+2,5 % per year

Drivers for dairy demand

1. More people

2. More dairy / capita*
   USA **+16%**;
   EU-28 **+ 8%**
   Asia > **+ 25%**
   Africa **-2%**



* 2013 – 2023 * Trends 2024/25, 2026 to be watched

- Dairy demand
- Dairy supply
- Dairy prices
- Dairy outlook
- Summary

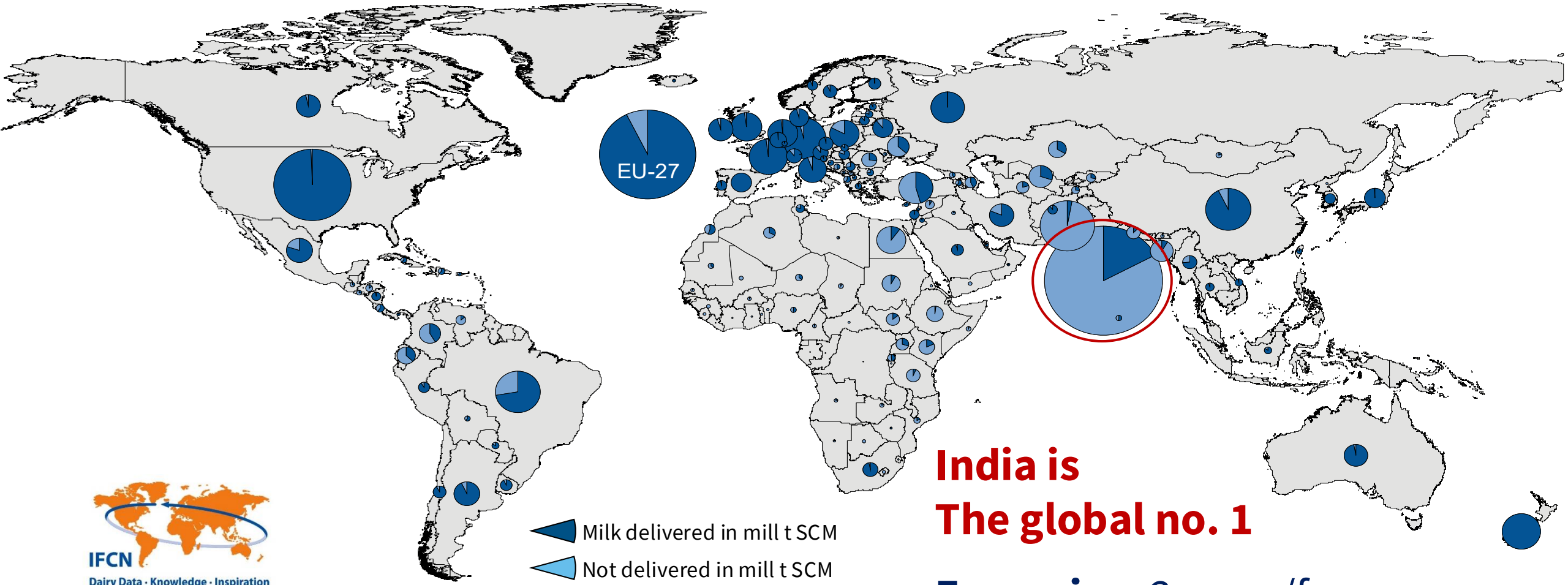


Dairy Outlook: State of the World Dairy Industry

High Plains Dairy Conference,

Amarillo, USA, 2-3 March 2026

Global Milk Production (Cows + Buffalo; 4% fat; 3.3% protein)



IFCN
Dairy Data · Knowledge · Inspiration

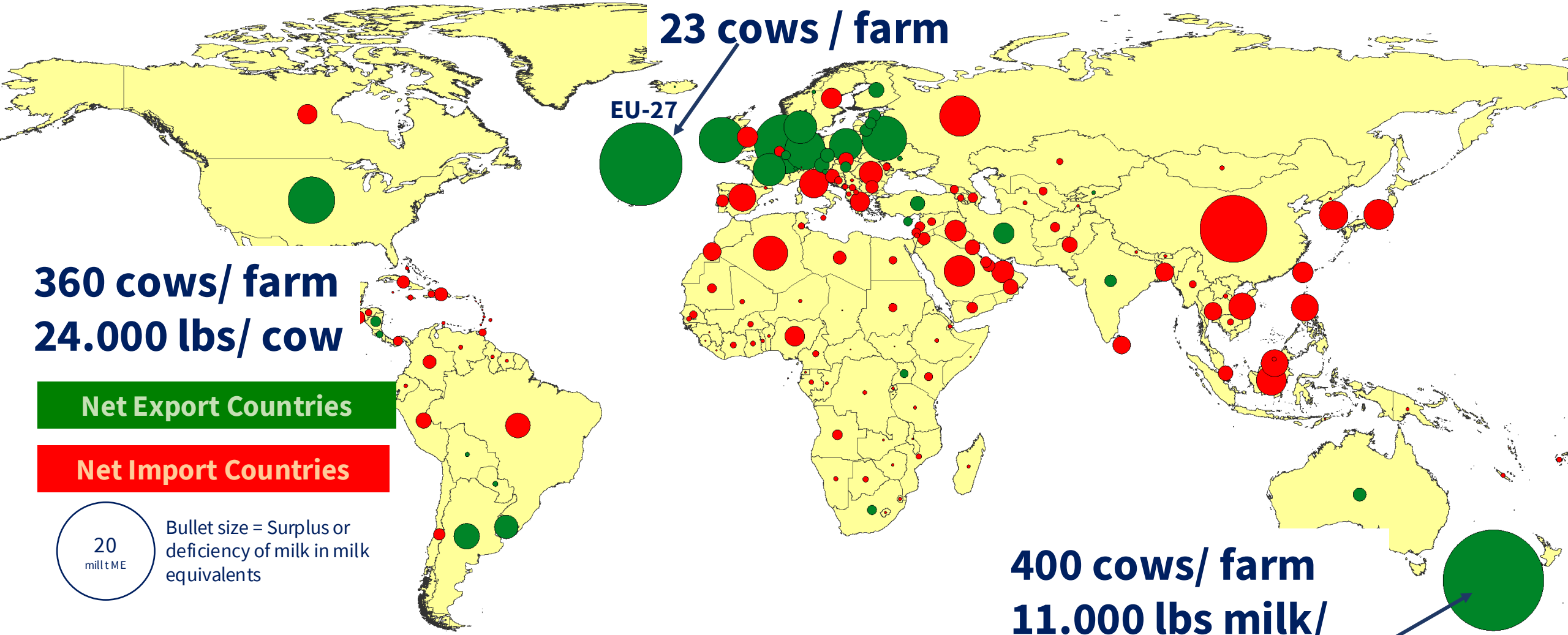
India is
The global no. 1

Farm size: 2 cows/farm
Yield: 4000 lbs/cow

Source: IFCN Dairy Report 2023

Remarks: Cow and buffalo milk production and milk delivered in mill t SCM – solid corrected milk (4% fat, 3.3% protein).

Dairy Trade – simple chart on milk surplus and deficit



Source: IFCN Dairy Report
Remarks: Demand in per capita consumption in kg milk equivalents

HIGH PLAINS
DAIRY CONFERENCE

Dairy demand

Dairy supply

Dairy prices

Dairy outlook

Summary

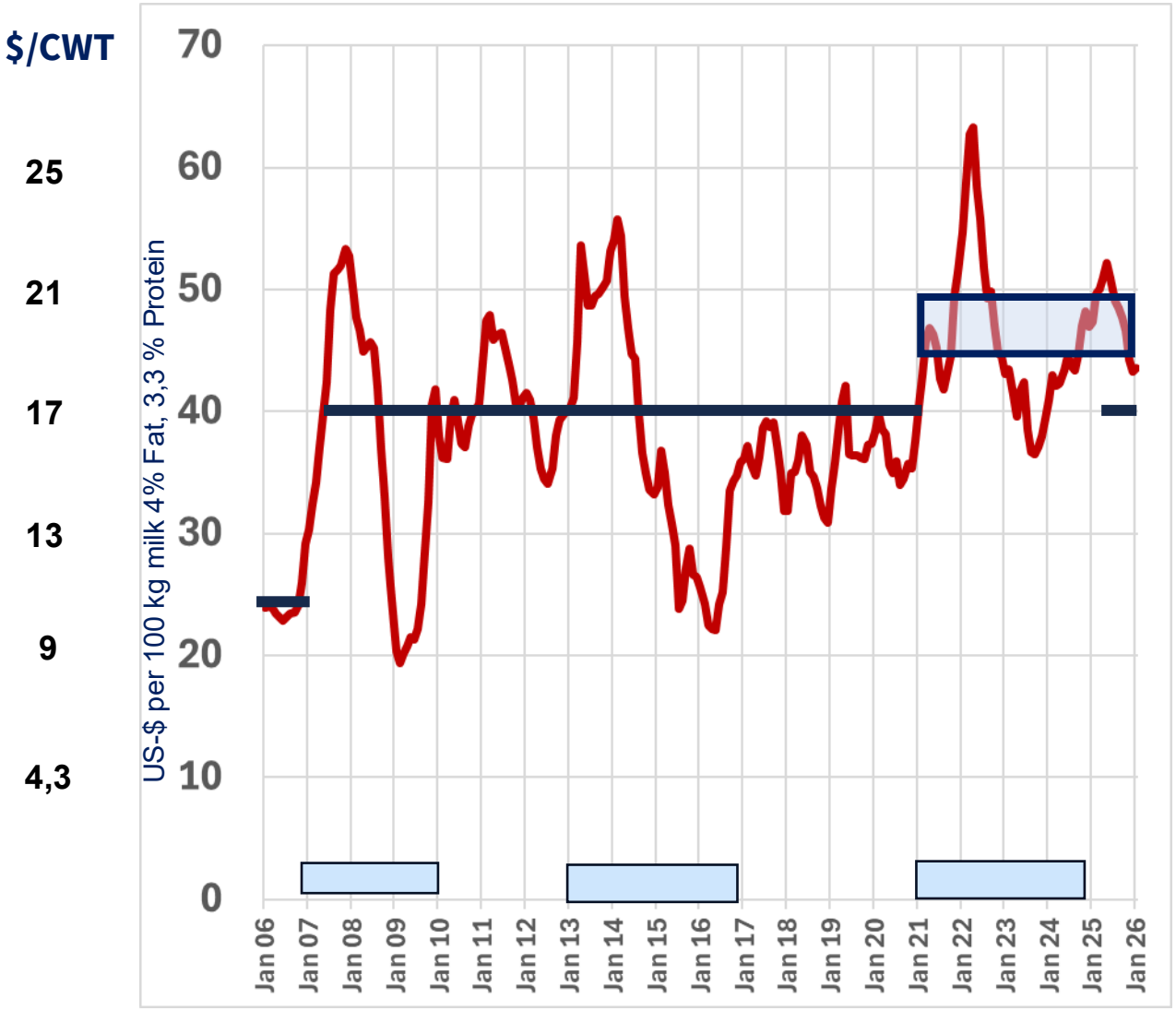


Dairy Outlook: State of the World Dairy Industry

High Plains Dairy Conference,

Amarillo, USA, 2-3 March 2026

World milk price, 2007 – Feb 2026



Three price levels (simplified)

until – 2006 – 11 $/ cwt

2007 – 2021 – 17 $/ cwt

2022-25 new level 20 $/ cwt **? (+20%)**

Last 12 months moving towards to the 17 $/ cwt level

Volatility and price cycles

Volatility is very high (+/- 50% around the mean)

Price cycles run for 3- 4 years

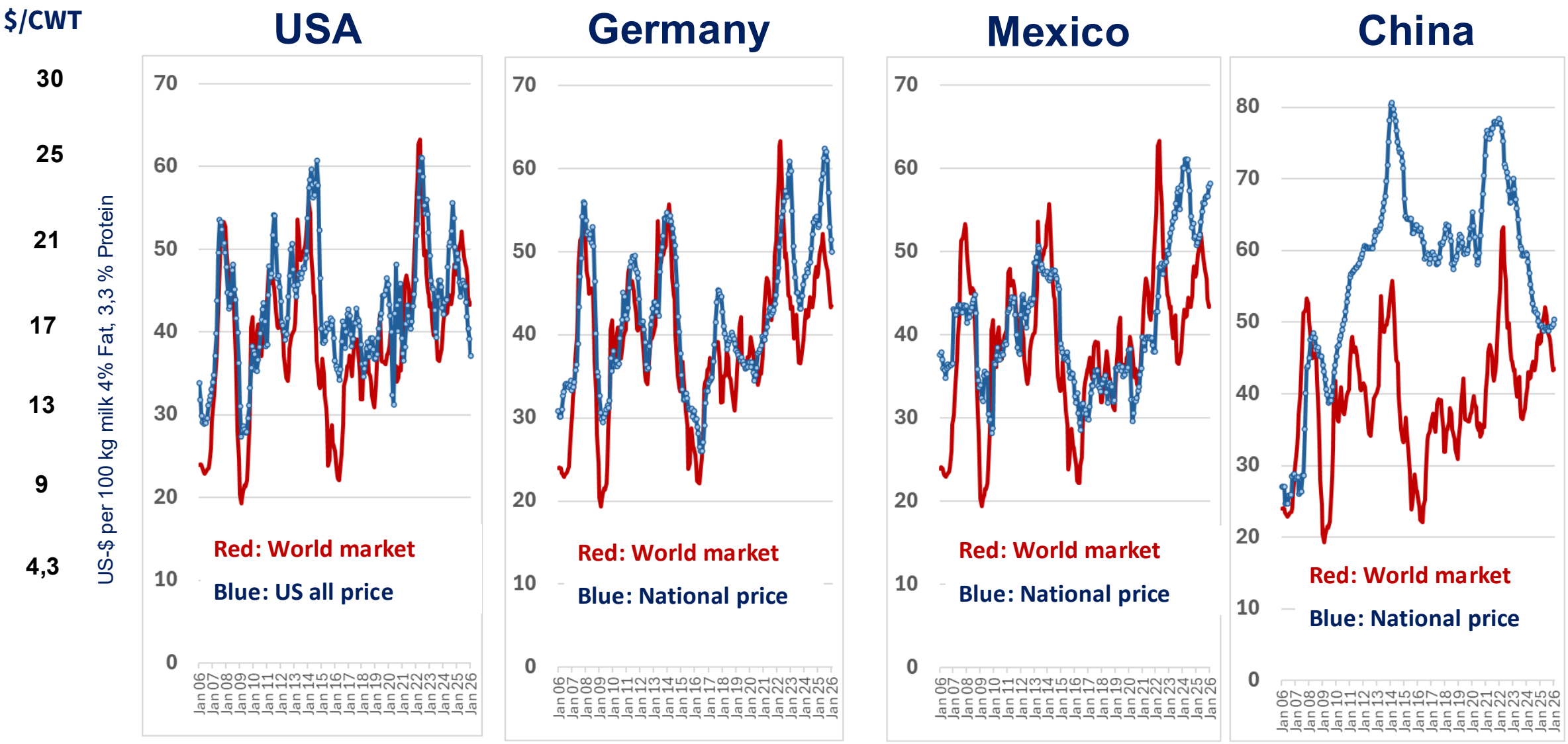
Key questions for the future

1. Future volatility - yes!
2. Level shift yes or no?
3. Where in the cycle are we now?



Source: IFCN world milk price is based on the dairy commodity prices butter/SMP, cheese/whey and whole milk powder; mainly Oceania prices

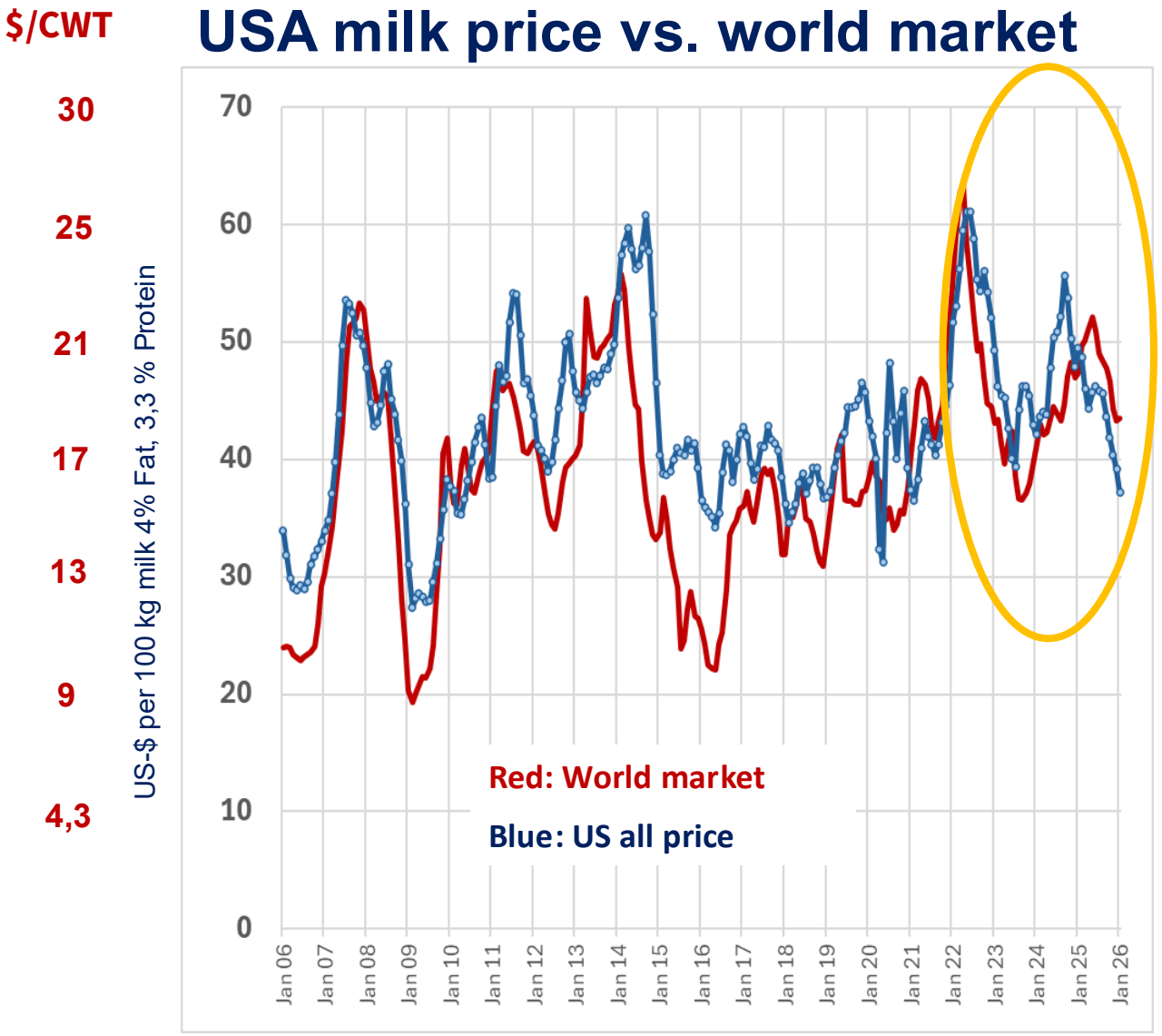
World milk price drives national prices



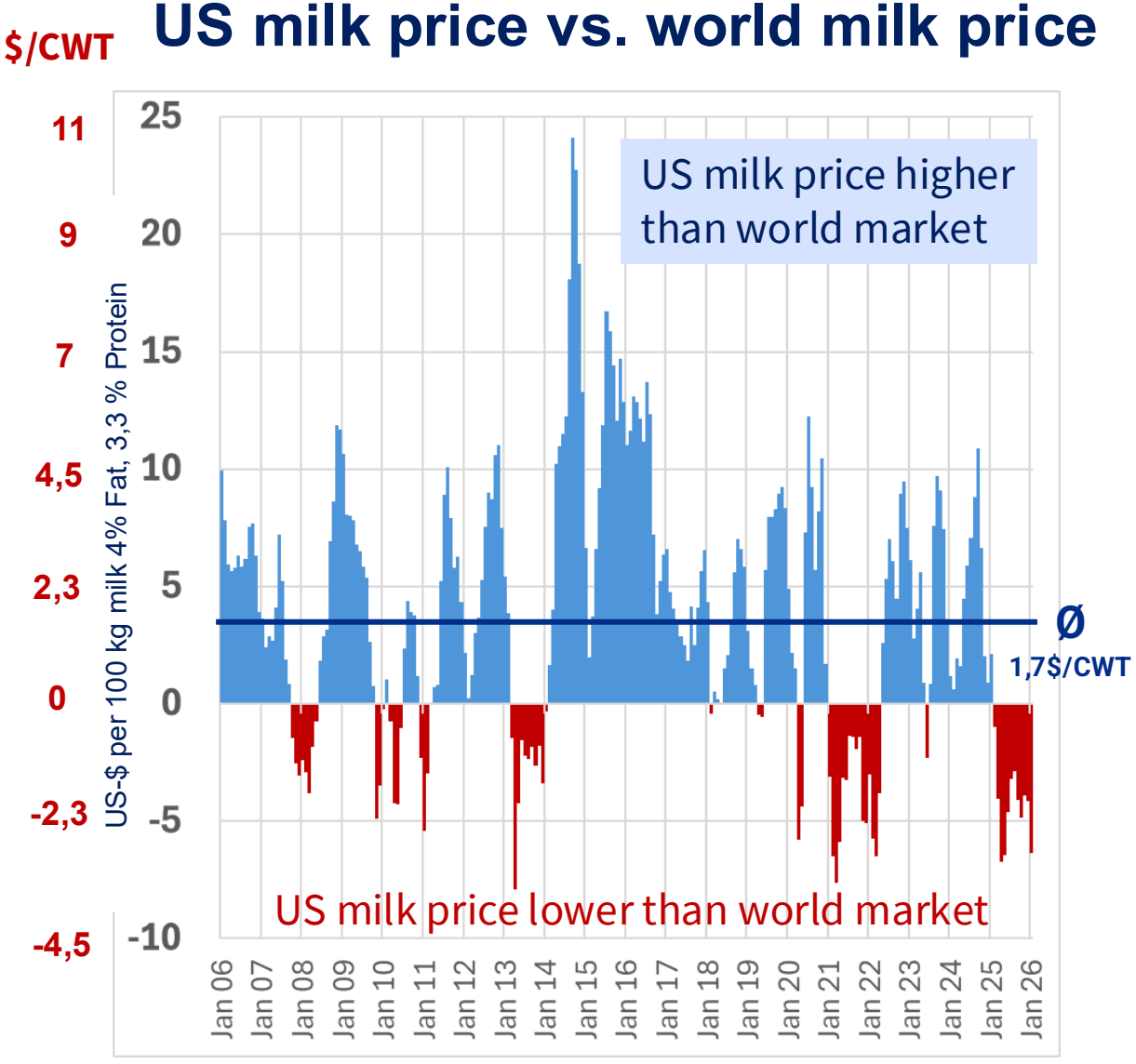
Source: IFCN Database 3.4: Monthly real-time database for 65 countries 2006 – Jan 2026

World milk price drives national prices

USA milk price vs. world market



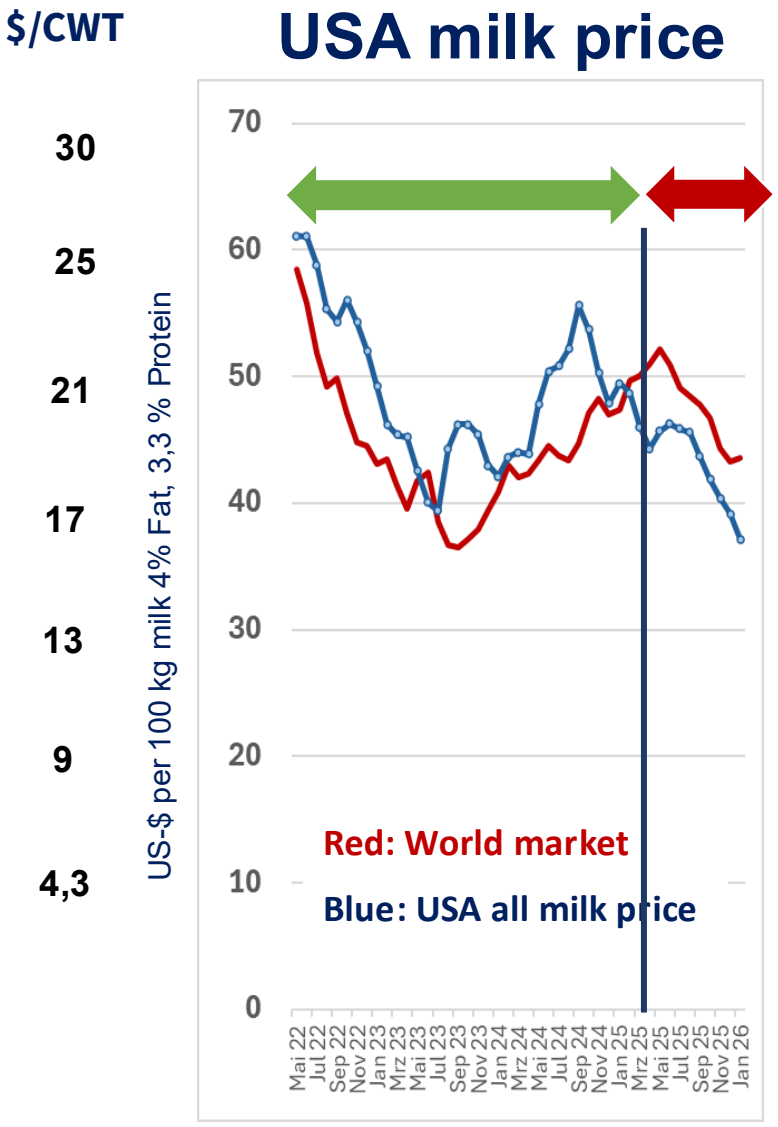
US milk price vs. world milk price



Source: IFCN Database 3.4: Monthly real-time database for 65 countries 2006 – Jan 2026

US milk price before and after Liberation Day

An oversimplified perspective





US milk price before Liberation Day - April 2, 2025
=> aprox. 2,05 US$ / CWT higher than world market price

US milk price after Liberation Day - April 2, 2025
=> aprox. 2,13 US$ / CWT lower than world market price

Economic impact for US dairy farmers*

4,18 US$ / CWT / = 809 million US$/ month

4,18 US$ / CWT / = 9,7 billion US$/ year

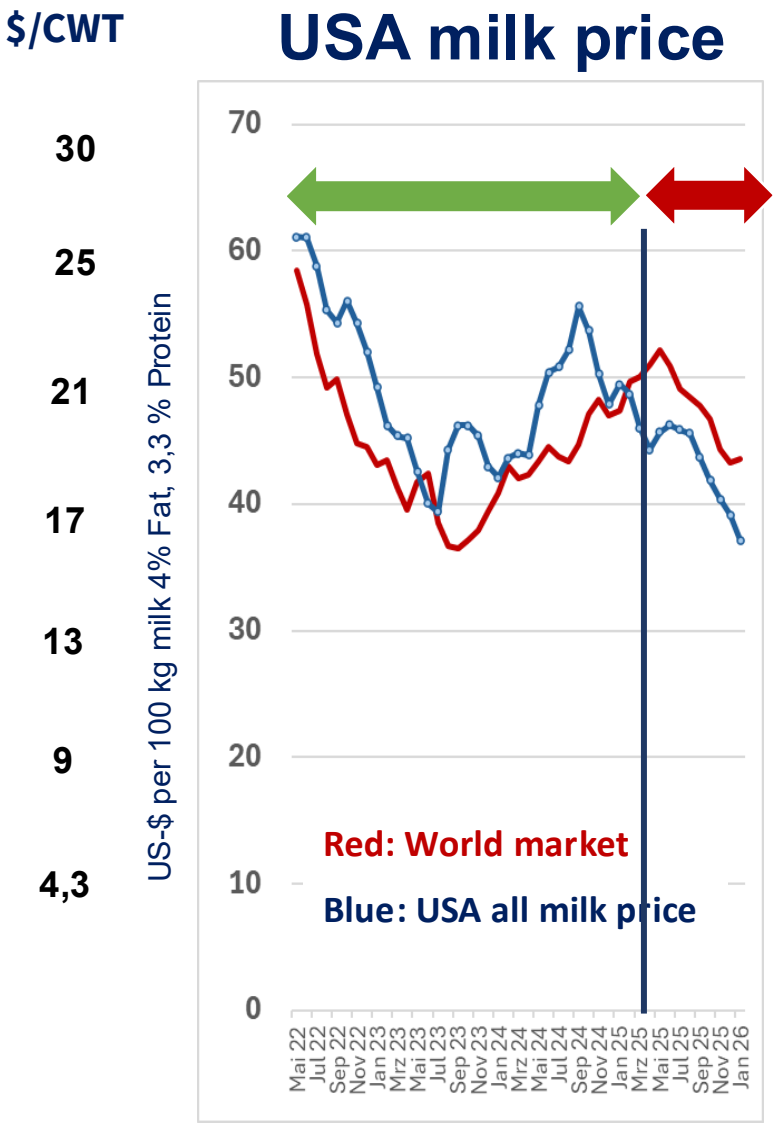
or aprox. 20% of farmers milk check

Source: IFCN Database 3.4: Monthly real-time database for 65 countries 2006 – Jan 2026

* Simplified view: The impact of strong milk production growth, increase of components and trade policy issues worked together.

US milk price before and after Liberation Day

An oversimplified perspective







Source: IFCN Database 3.4: Monthly real-time database for 65 countries 2006 – Jan 2026

HIGH PLAINS
DAIRY CONFERENCE

- Dairy demand
- Dairy supply
- Dairy prices
- **Dairy outlook**
- Summary



Dairy Outlook: State of the World Dairy Industry

High Plains Dairy Conference,

Amarillo, USA, 2-3 March 2026

Dairy Outlook 2050 - Who will win?





Key Scenarios to Predict the Dairy Future

+ **DEMAND** Strong preferences for dairy products

INCOME RESTRICTED



PRO DAIRY

IFCN SCENARIO

DEMAND / SUPPLY GROWTH

LIKE 2010 - 2023

- **POLICY & ECONOMICS** +

„STAGNATION OR SHRINKING ?“



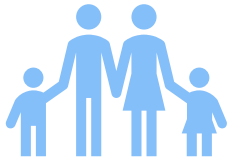
RICH AND PICKY

- **DEMAND** More dairy-free diets (+ less food waste)

Source: D3.2 IFCN Annual Sector Database with Long-term Dairy Outlook; Status March 2024

The Dairy World in 2050 vs 2020

Scenario Pro Dairy



9.6 billion people
+ 24% ;
+2 bn



144 kg per capita/ year
+20%,
+24 kg milk /capita

49% more milk consumed
+456 mill t milk
= 4,5x USA today;
ca. 20x NZ today



Less dairy farms
Increase in farm size



Less dairy cows
Higher milk yields



Demand growth
driven by emerging dairy countries

(Rest of the World)



The balance defines future prices



Supply growth driven by

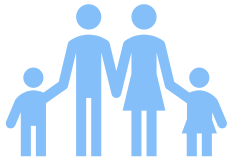
1. **Local for local**
   Emerging countries

2. **Local for exports**
   ? tbd; NZ/AU; EU; US, AR/UY, others

IFCN outlook 3 / 2024 – Pro dairy scenario (People positive about dairy, good economic growth

The Dairy World in 2050 vs 2020

Scenario Pro Dairy



9.6 billion people
+ 24% ;
+2 bn



144 kg per capita / year
+20%,
+24 kg milk/capita

49% more milk consumed
+456 mill t milk
= 4,5x USA today;
ca. 20x NZ today



Less dairy farms
Increase in farm size



Less dairy cows
Higher milk yields



Demand growth
driven by emerging dairy countries

(Rest of the World)



In this scenario
Demand > Supply



Supply growth driven by

1. **Local for local**
   Emerging countries

2. **Local for exports**
   ? tbd; NZ/AU; EU; US, AR/UY, others

IFCN outlook 3 / 2024 – Pro dairy scenario (People positive about dairy, good economic growth

Technology for dairy farming



- Dairy demand
- Dairy supply
- Dairy prices
- Dairy outlook
- Summary



Dairy Outlook: State of the World Dairy Industry

High Plains Dairy Conference,

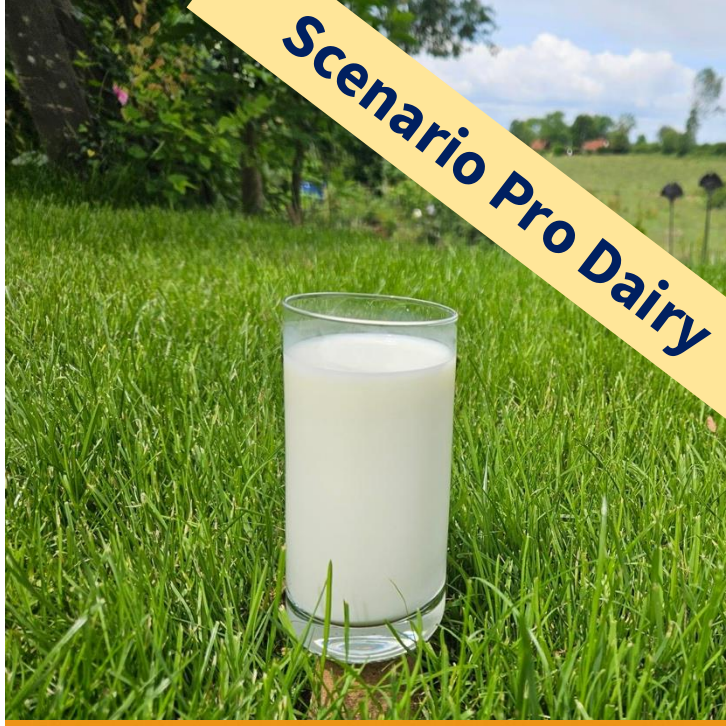
Amarillo, USA, 2-3 March 2026

Summary

2000 - 2020 We had golden years for dairy



Even in golden times there were very bumpy roads





2020 - 2050: Golden times also possible*

- Dairy demand strong ! + dairy protein renaissance ?
- Demand growth > Supply growth possible
- Milk price level shift possible

* IFCN outlook – Pro dairy scenario

How the U.S. fits into global dairy developments?

I see opportunities for the USA
to become the No. 1 dairy export region
by 2050 feeding 1 billion people with dairy



Where to play 2050?
How much dairy exports of production 16%, 25%, 50%?

How to win with your dairy products?
Competitive dairy products
+ review your framework today (FMMO, ..)
+ align the dairy strategy with trade policy, other politics …
+ partnerships to support local dairy production



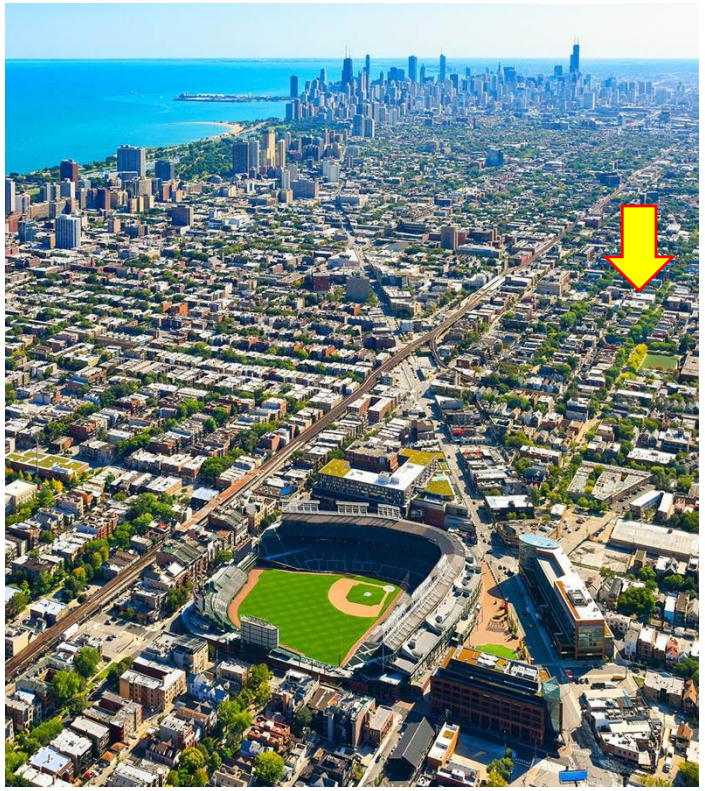
HIGHGROUND Dairy

STATE OF THE US DAIRY INDUSTRY

Curtis Bosma









About HighGround Dairy

- Insights
- Insurance
- Brokerage
- Advisory

CLIENTS ACROSS THE GLOBAL DAIRY SUPPLY CHAIN








Today’s Big Questions

What business are we in?

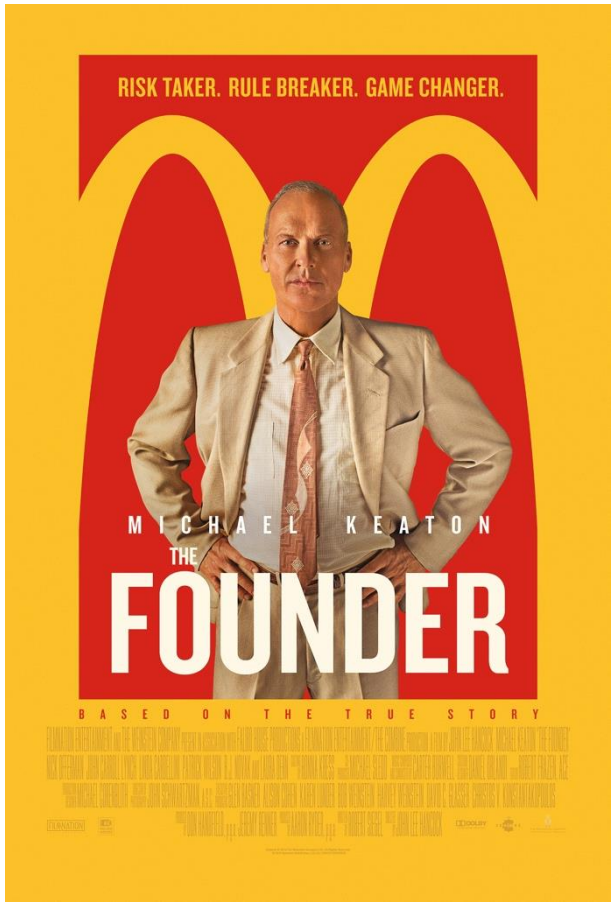
Where are these markets going?

How do we monitor margins?

What should we do going forward?

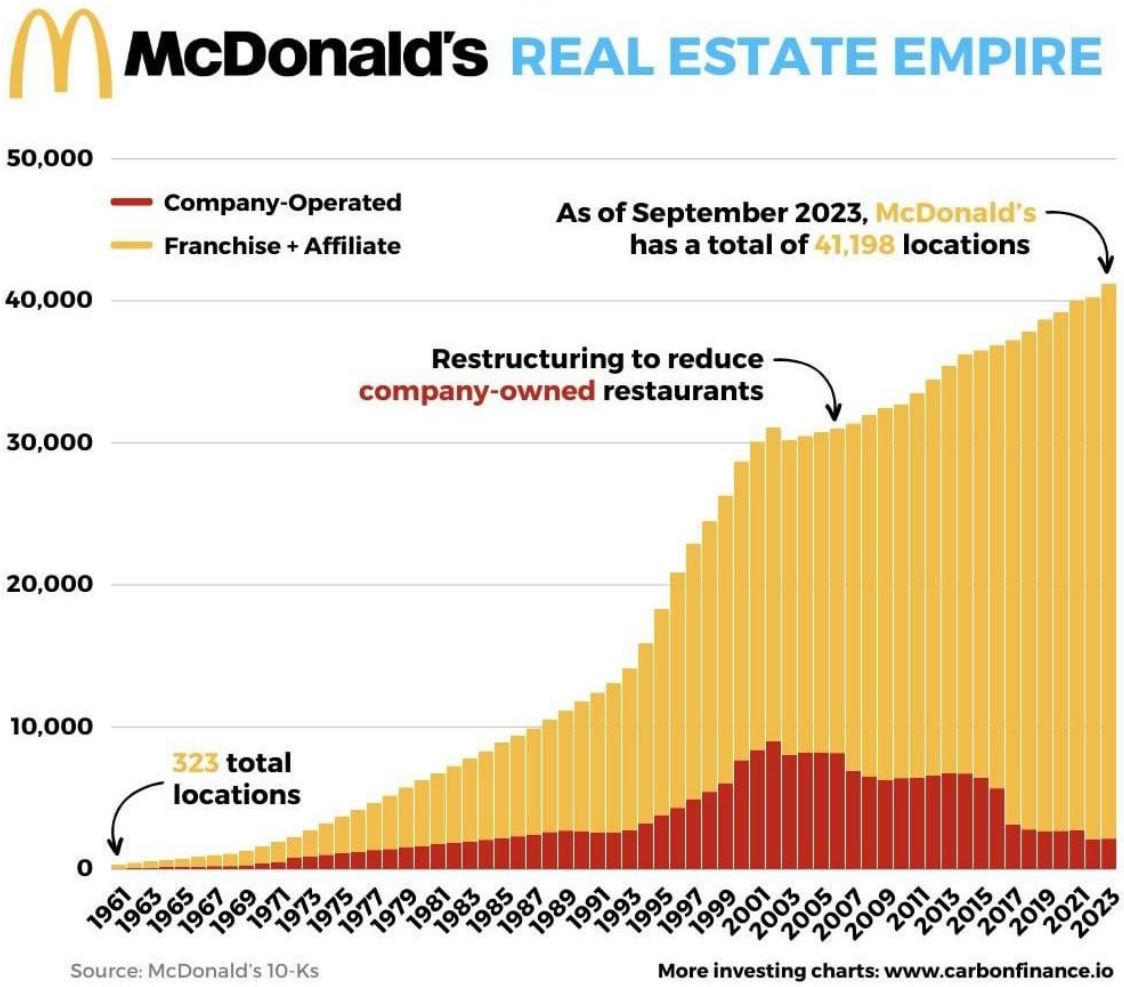
“You’re not in the burger business”

The Founder (2016)



- Most people think McDonald’s became dominant by selling more burgers
- The breakthrough wasn’t food quality or kitchen efficiency
- It was a shift in how the business was **structured**, not how it was **operated**
- McDonald’s realized the product creates traffic, but the economics sit underneath the product
- That insight transformed a restaurant chain into a durable, scalable business

“You’re not in the burger business”



- McDonald’s growth accelerated when they shifted away from owning restaurants and toward owning the underlying real estate
- Franchisees run the day-to-day operations, but **McDonald’s controls the asset that appreciates** over time
- Rent is often tied to restaurant sales, which means McDonald’s captures upside without taking operational risk
- They moved from being an operator to being a platform

What We've Been Taught To Optimize

- Milk Production (lbs/cow/day)
- Milk Solids (Butterfat + Protein)
- Feed Intake (DM lbs/cow/day)
- Feed Efficiency
- Preg Rate

These are all critical operational metrics,
but none of them actual measure profitability.



What business are we in?

FEED



MILK

BEEF

Dairies are not in the **EFFICIENCY** business.

Dairies are in the **MARGIN** business.

Problem #1

The conversion process **IS NOT SIMPLE**.









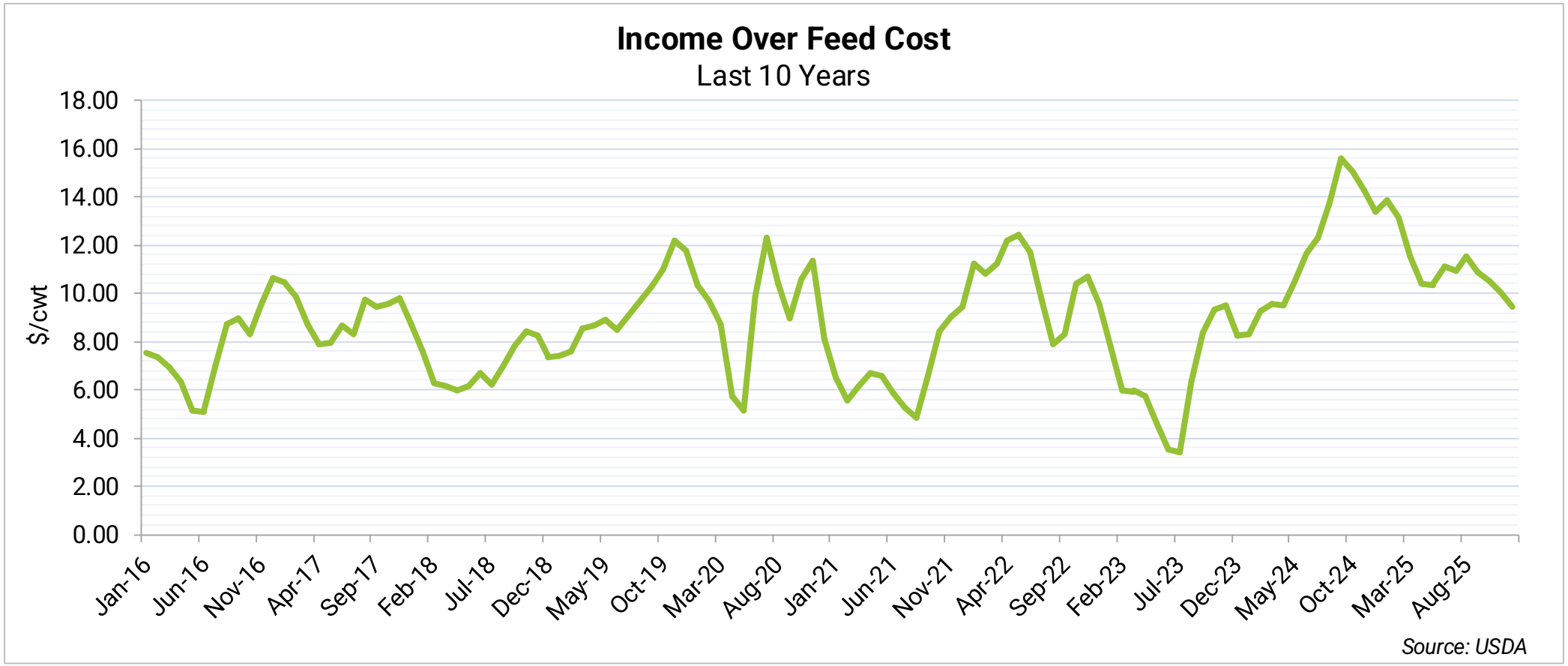





Problem #2

Even if we do everything perfectly…

MARKETS CAN FORCE A NEGATIVE FINANCIAL OUTCOME



Elite Operator Mindset

1. **Make better decisions faster**
   70% certainty is enough — move fast, correct often

2. **Think in margins, not metrics**
   Filter every decision: *what does this do to my margin?*

3. **Spend time at the right level**
   Employees **operate**
   Managers review **tactics**
   Owners **strategize**



Levels of Decisions

Operational

- *Daily milking schedules, feed ration mixing, monitoring bulk tank temperatures and milk quality*
- Activities guided by **established protocols**

Tactical

- *Adjusting rations to improve herd performance, allocating labor between outside / parlor tasks*
- Involves **a few variables** and are aimed at achieving **specific outcomes**

Strategic

- *Building a new freestall barn, investing in a robotic milking system, bringing the next generation into the operation (succession planning), risk management strategy for milk price volatility*
- Involves **multiple variables** and **uncertain outcomes**



Levels of Decisions

	TERM	IMPACT
Operational	SHORT	LOW
Tactical	MEDIUM	MEDIUM
Strategic	LONG	HIGH



Own your financial position

Who is looking at my financial statements? What are they looking for?

1. **Banker**

   Can you repay the loan? They're evaluating risk, collateral, and cash flow coverage

2. **Accountant**

   How do we reduce your tax bill? They're focused on depreciation, deductions, and entity structure

3. **Business Owner**

   Is this operation actually profitable? Am I earning a return on my labor, my land, and my capital?

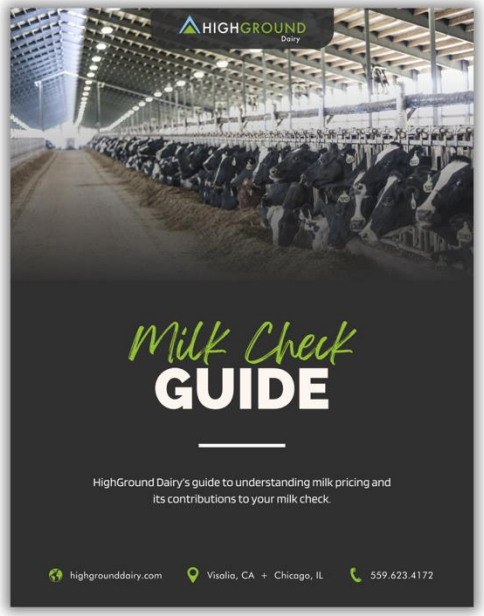


What is the goal?

GAIN **CLARITY + CONTROL** OF YOUR LEGACY

1. Think like an Elite Operator
2. Have **CLARITY** on your financial position
3. Take **CONTROL** – don’t let markets determine your legacy

Breaking Down Your Milk Check



SCAN ME

Figure 3: **Milk Check Example**

Cooperative X

Producer: Dairy A
Tulare, CA

Period: 12/01/2023 - 12/31/2023
Payment Date: 1/15/2024

PRODUCTION SUMMARY

Total Lbs: 1,000,000	BF: 40,000 4.00%	PRO: 32,000 3.20%	OS: 57,000 5.70%

BASE PRICING

PRICING

	Basis	Rate	Pounds	Total
Butterfat	per lb	2.9778	40,000	$119,112.00
Protein	per lb	1.4499	32,000	$46,396.80
Other Solids	per lb	0.2242	57,000	$12,779.40
PPD at Location	per cwt	1.0100	1,000,000	$10,100.00
Base Price	*per cwt*	*18.8388*		*$188,388.20*

Published California FMMO Prices

PREMIUMS

	Basis	Rate	Pounds	Total
Quality Premium	per cwt	0.0500	1,000,000	$500.00
Total Premiums	*per cwt*	*0.0500*		*$500.00*

ADJUSTMENTS

DEDUCTIONS

	Basis	Rate	Pounds	Total
Hauling Charge	per cwt	0.5000	1,000,000	$5,000.00
Fuel Surcharge	per cwt	0.0500	1,000,000	$500.00
Stop Charge	per cwt	0.0400	1,000,000	$400.00
National Promotion	per cwt	0.0500	1,000,000	$500.00
State Promotion	per cwt	0.1000	1,000,000	$1,000.00
Testing Fee	per cwt	0.0400	1,000,000	$400.00
Capital Retain	per cwt	0.1200	1,000,000	$1,200.00
Total Deductions	*per cwt*	*0.9000*		*$9,000.00*

NET PAY

BASE PRICE + PREMIUMS

	Basis	Rate	Total
Gross Pay	per cwt	18.89	$188,888.20
Less Deductions	per cwt	0.90	$9,000.00
Net Pay	*per cwt*	*17.99*	*$179,888.20*

MAILBOX PRICE

Policy Roundup

Bad News

- Retaliatory tariff threats (Canada & China)
- Immigration enforcement / labor uncertainty
- Updated FMMO make allowances hitting milk checks

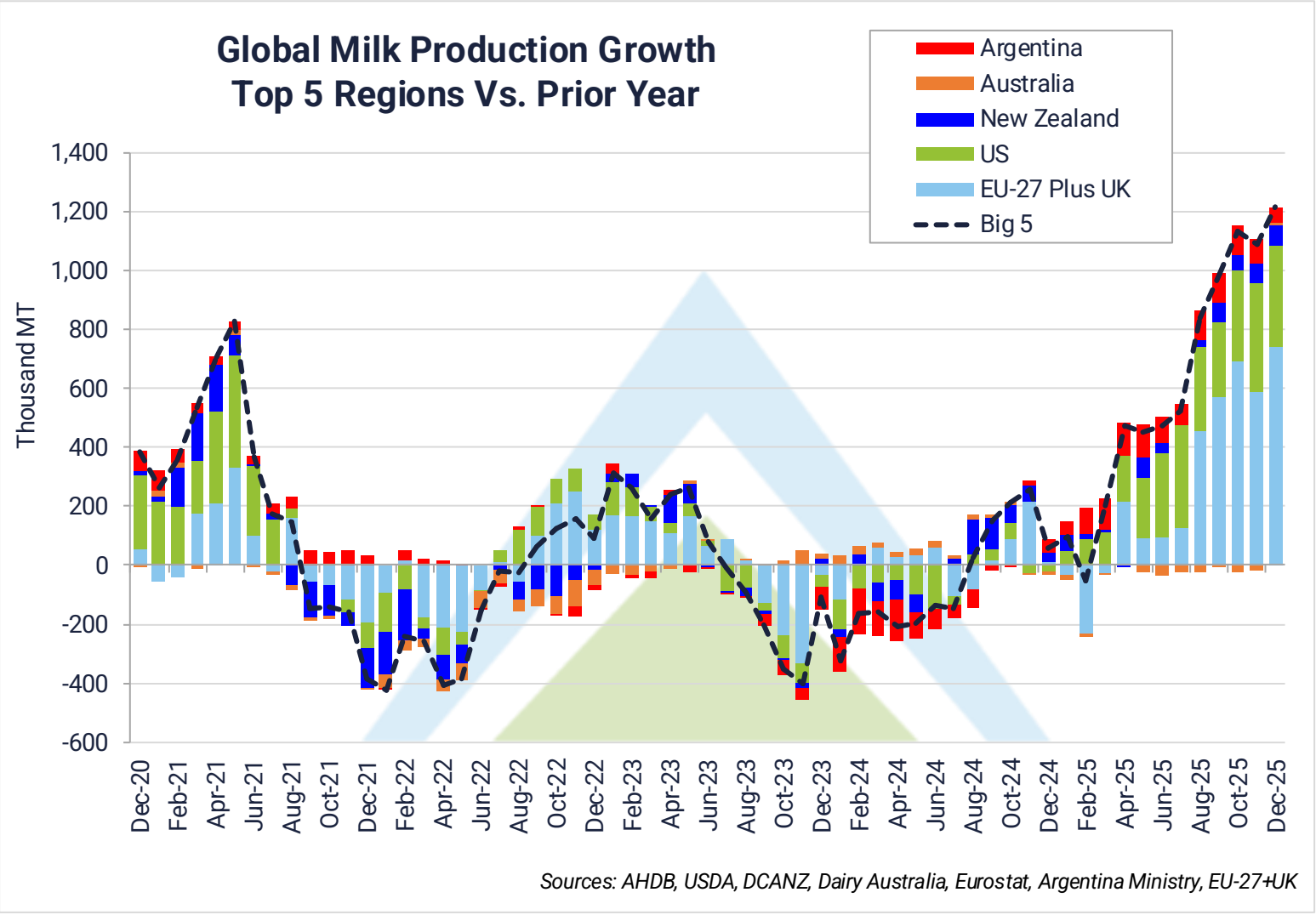
Good News

- New Dietary Guidelines (full-fat dairy, inverted food pyramid)
- Whole Milk for Healthy Kids Act
- Section 32 purchases ($148M in dairy, largest since COVID)
- DMC reauthorized & expanded through 2031





Global Milk Production



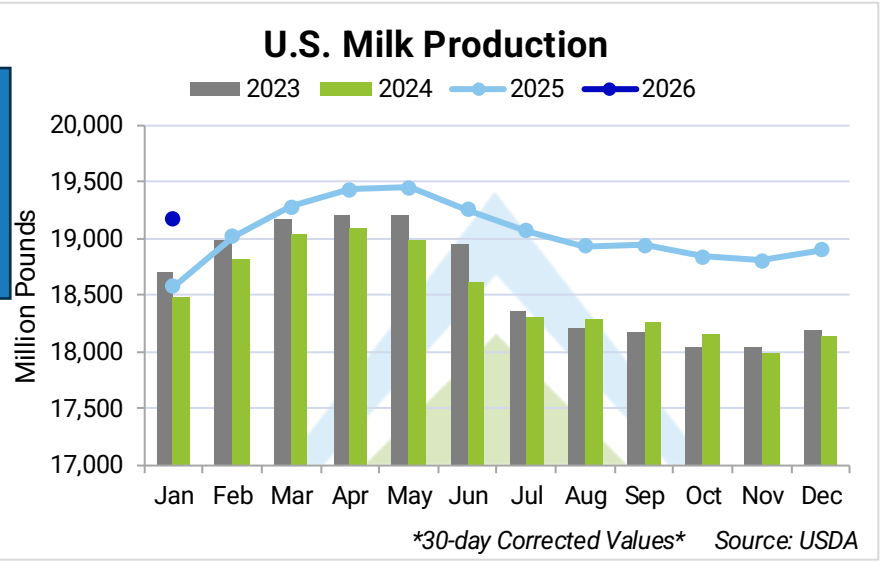
Sources: AHDB, USDA, DCANZ, Dairy Australia, Eurostat, Argentina Ministry, EU-27+UK

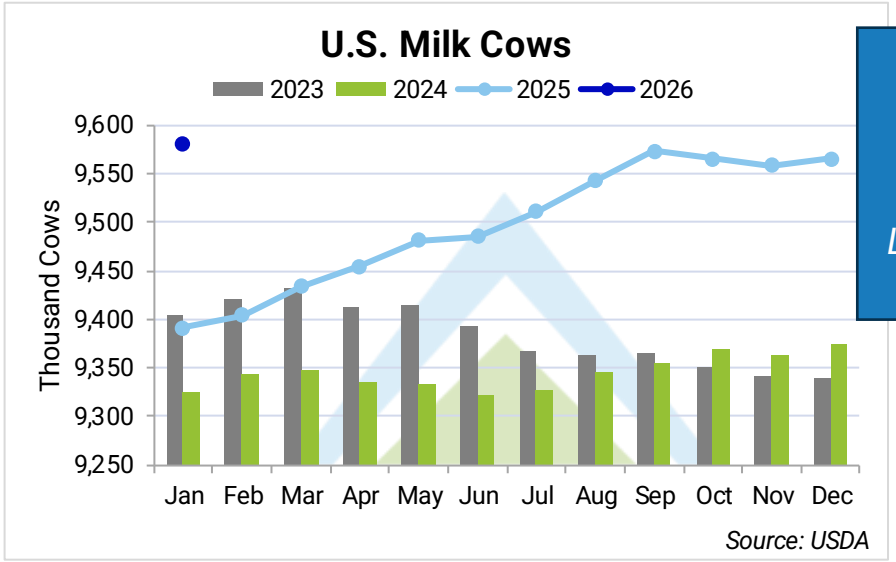
Year-Over-Year Percent Change in Production: Dec-25	
Country	**Percent Change**
EU-27 Plus UK	6.1%
United States	4.2%
New Zealand	2.5%
Australia	1.8%
Argentina	5.2%
Big 5	*4.9%*

Milk Production

Jan: +3.2% YoY

3%+ YoY for the 8th straight month

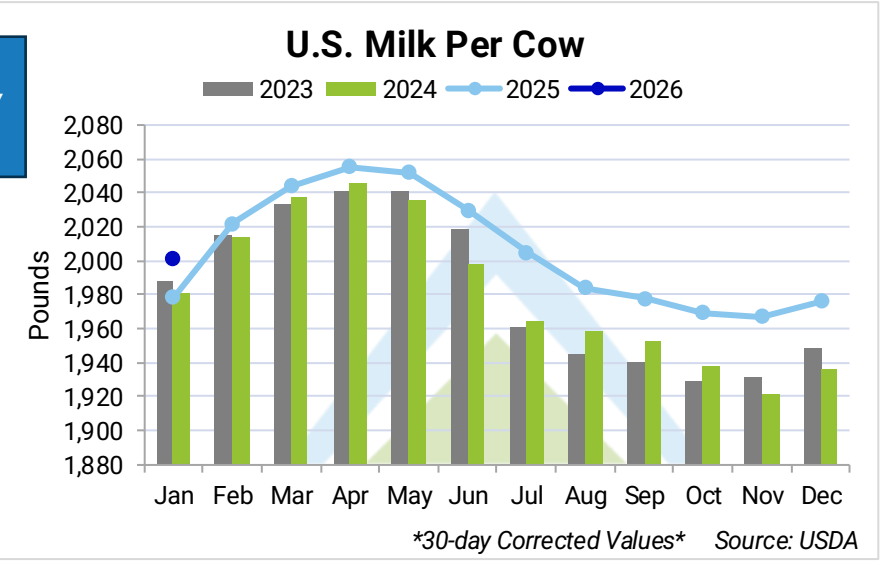


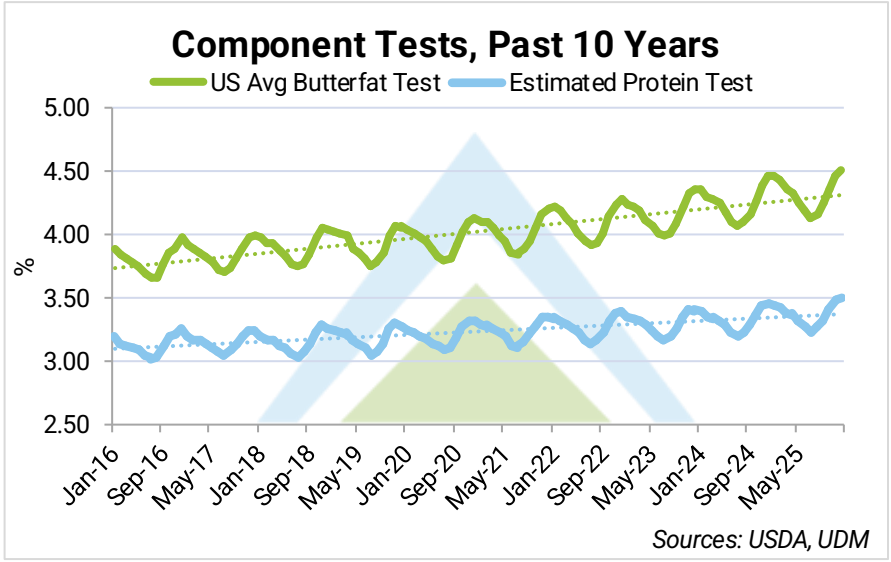


Jan:
+189k head YoY
+14k head M-M

Largest herd since 1993

Jan: +1.2% YoY

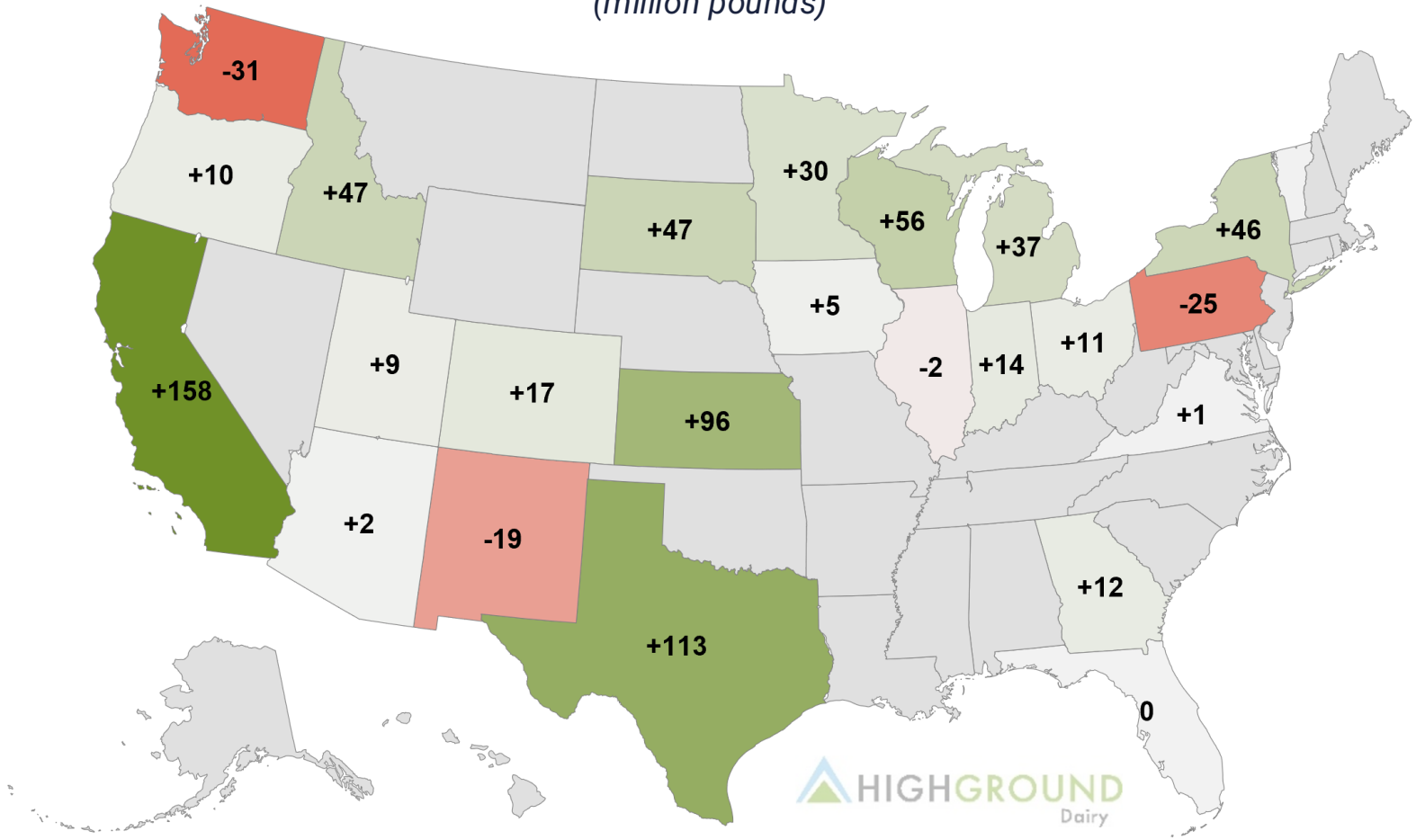




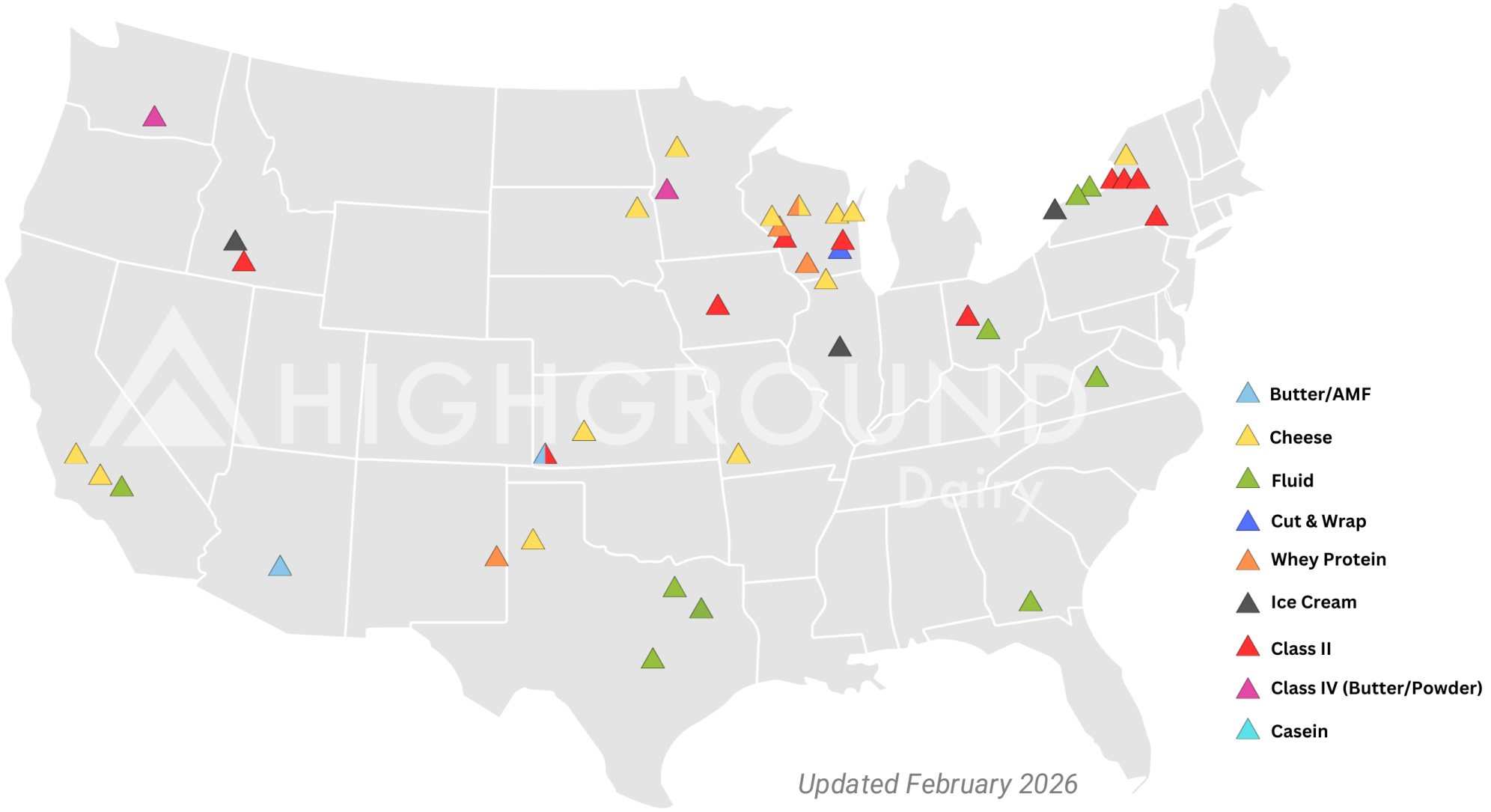
Milk Production

Year-Over-Year Change in Milk Production, January 2026

(million pounds)



Processing Capacity



Cheese

	2025	YOY
Supply		
Production	14,668	+3.2%
Imports	317	-9.3%
Total Supply	**16,339**	**+2.8%**
Utilization		
Domestic	13,602	+0.6%
Exports	1,351	+20.5%
Total Utilization	**14,954**	**+2.1%**
	(million lbs)	

Record Cheese Production

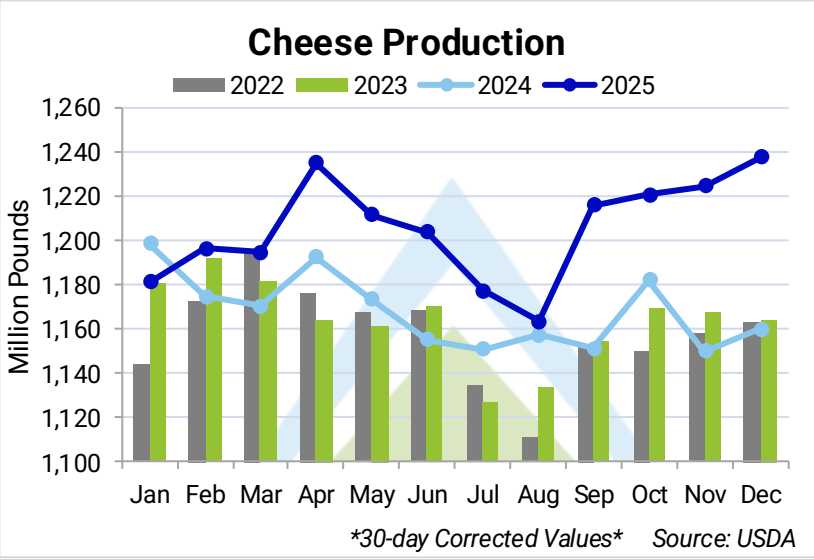
December output hit 1.238B lbs, up +6.7% YoY.

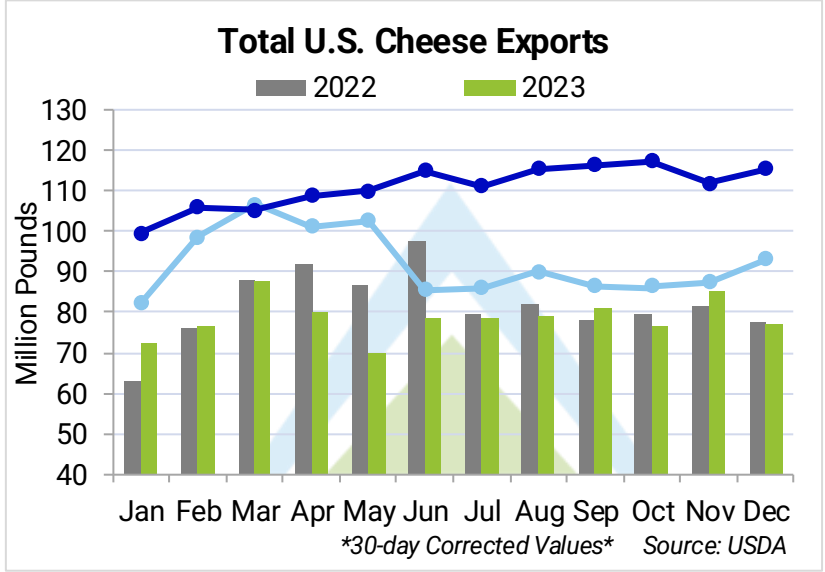
Exports are carrying a heavy load

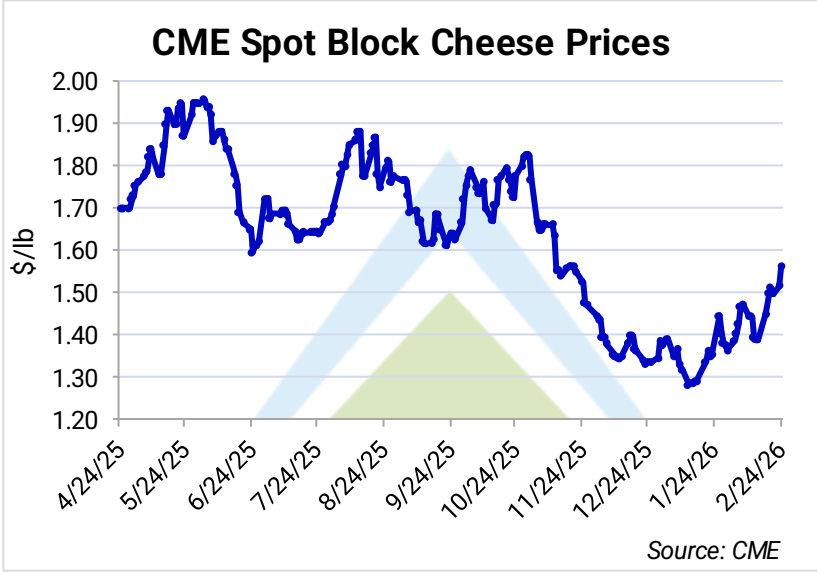
Despite record output, December stocks (1.372B lbs) **product is moving.** Export sales exceeded 110M lbs in 7 of the months in 2025

Limited upside in 2026

Without a meaningful shift in fundamentals, HighGround sees prices struggling to push past $1.60/lb in H1 2026 and $1.80/lb for the full year.







Dry Whey

	2025	YOY
Supply		
Production	826	-2.4%
Imports	3	+106.8%
Total Supply	**884**	**-2.3%**
Utilization		
Domestic	392	-14.8%
Exports	439	+9.7%
Total Utilization	**832**	**-3.4%**

(million lbs)

"The Year of Protein" is real and accelerating

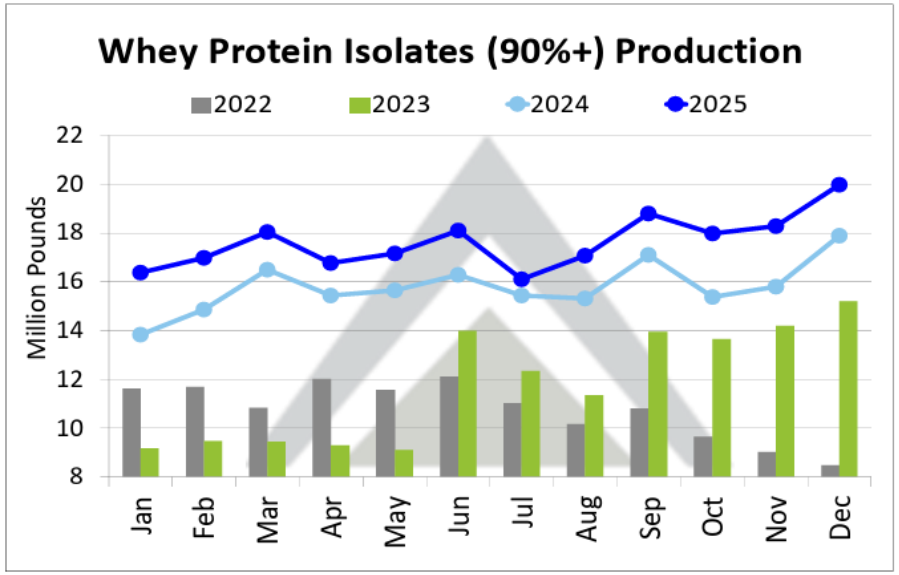
WPI and WPC-80 are both at record highs with domestic demand showing no signs of softening. The GLP-1 tailwind is structural: prices are falling, a pill form launched in 2026, and users are actively seeking high-protein foods.

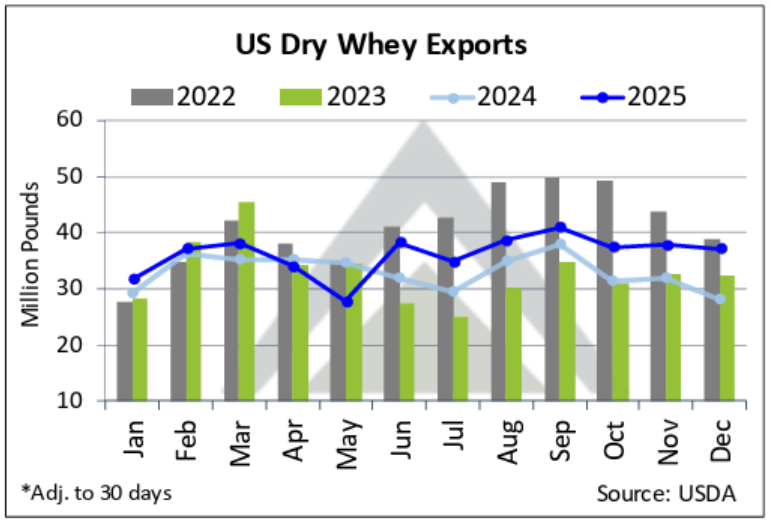
Exports held up despite tariff headwinds

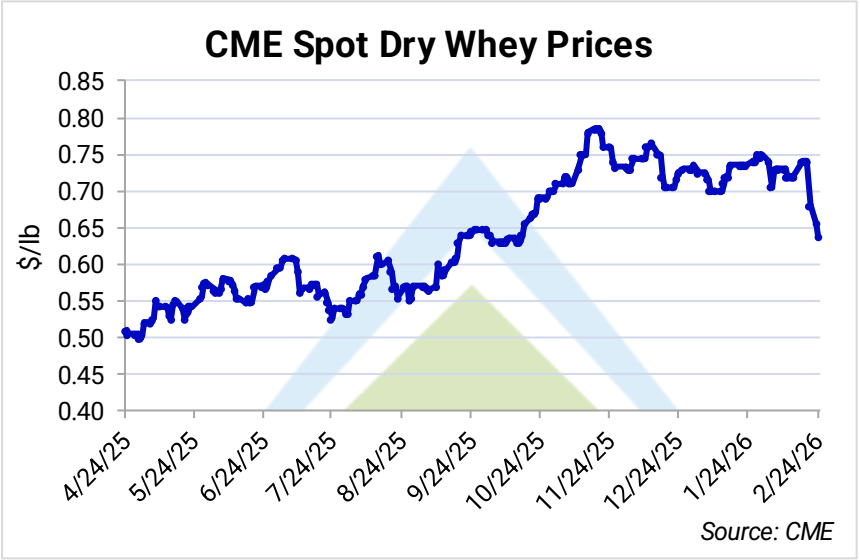
China was expected to pull back due to 2025 tariffs, but dry whey exports to China were actually up 24% through November. Japan, India, and the Netherlands picked up additional slack.

Borrowed strength has a ceiling

As WPC/WPI prices climb, lower-income importing nations may pull back on demand shifting production back to Dry Whey. HighGround sees $0.60–$0.70/lb for most of 2026.







Butter

	2025	YOY
Supply		
Production	2,362	+6.0%
Imports	98	-43.5%
Total Supply	**16,339**	**+2.1%**
Utilization		
Domestic	2,303	-0.7%
Exports	184	+163.0%
Total Utilization	**2,487**	**+4.1%**
	(million lbs)	

The market overcorrected to the downside

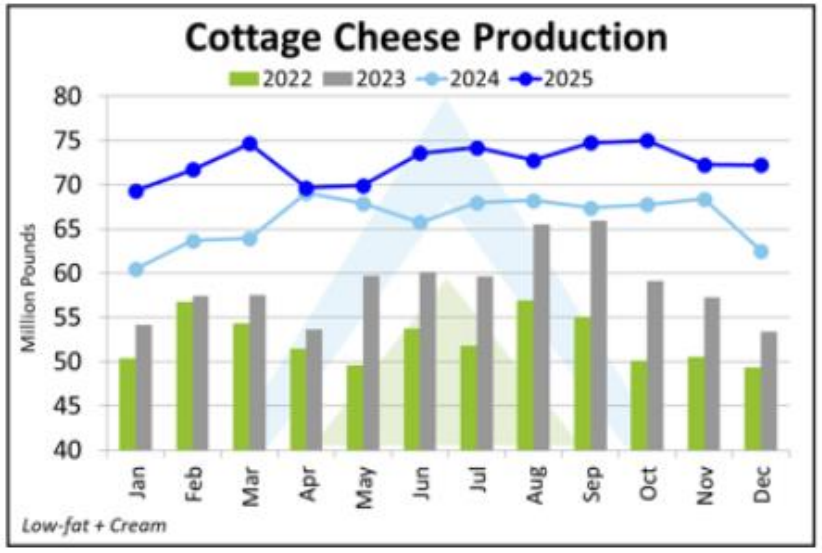
Butter hit $1.30/lb on Jan 9, its lowest since Feb 2021. Since then it's rallied $0.56/lb (+43%) to $1.86/lb — the highest since September 2025.

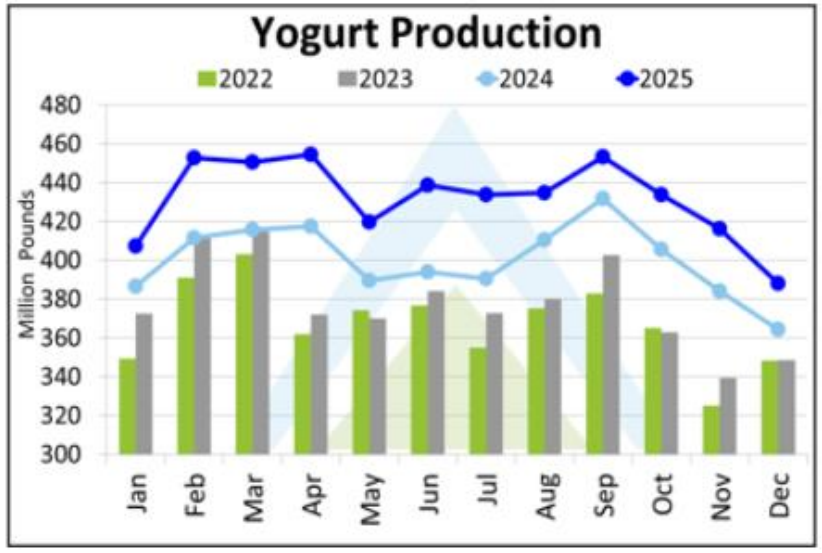
Supply tightened because milkfat went elsewhere

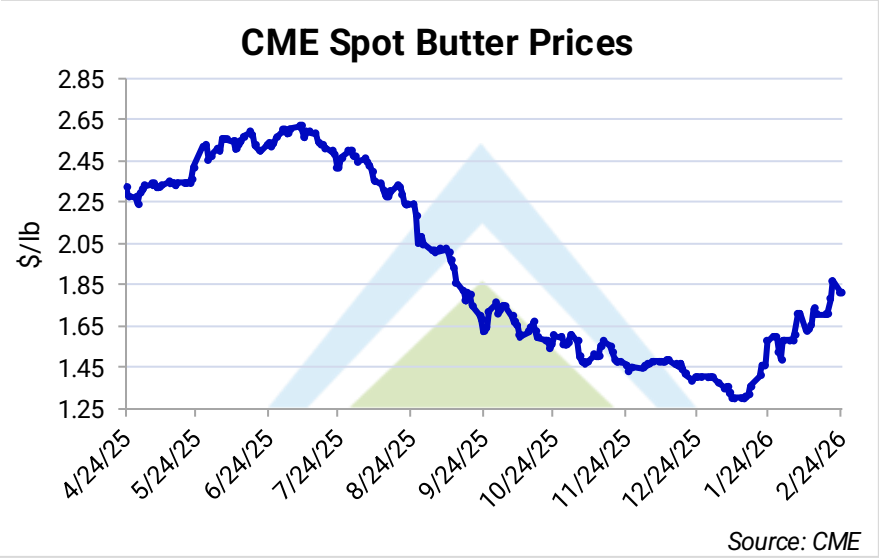
Milkfat diverted into cheese vats and Class II products (cottage cheese, yogurt). Butter wasn't the best home for the fat.

Spring flush is coming, and there's plenty of supply to make butter

Milk production is healthy, components are elevated, and with cheese vats running hard, any slowdown there could redirect fat back into butter quickly.







Nonfat Dry Milk

	2025	YOY
Supply		
Production	2,150	-5.2%
Imports	5	+419.6%
Total Supply	**2,360**	**-4.4%**
Utilization		
Domestic	663	+5.0%
Exports	1,488	-9.0%
Total Utilization	**2,151**	**-5.1%**

(million lbs)

A perfect storm, not a structural shift

Central US NFDM output was the smallest since 2018 (Dec output -12.5% YoY), with skim solids being pulled away from dryers by surging Class II demand (yogurt +8%, cottage cheese +11% vs. 2024). Financial short sellers at the CME were forced to cover, adding rocket fuel to an already thin market.

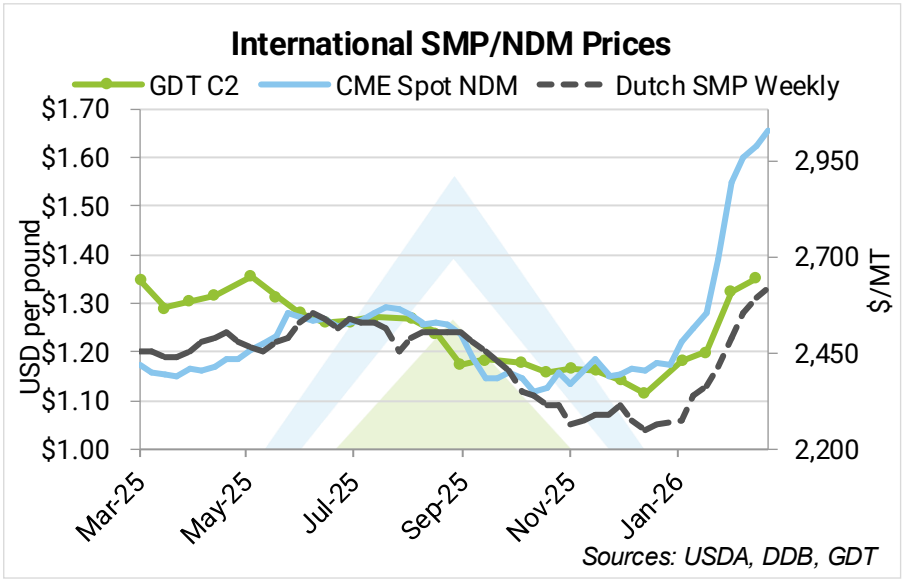
Global events poured gas on the fire

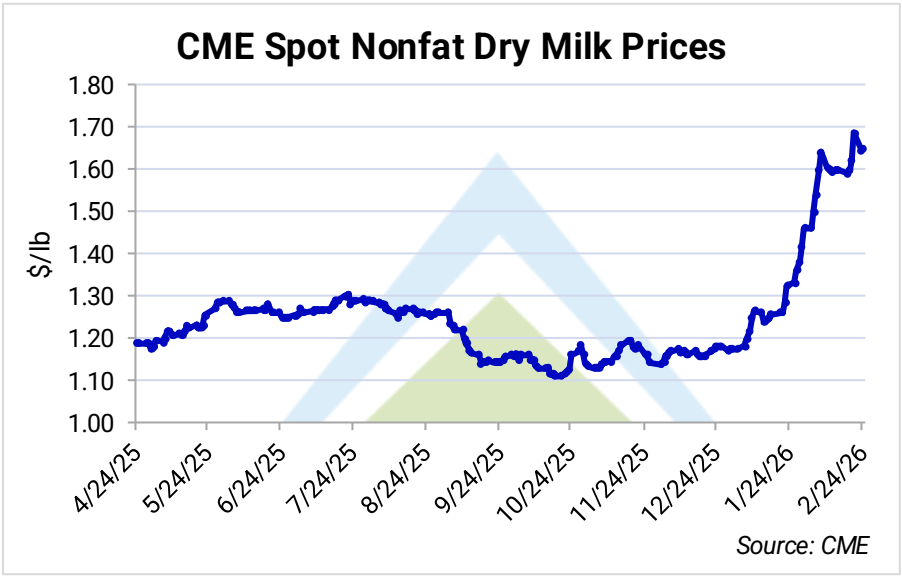
Geopolitical tension, widespread infant formula recalls, and low SMP stocks in China all triggered urgent international buying at the same time.

This is a squeeze, not a new reality

Global milk production is robust. There's no long-term scarcity. HighGround expects CME spot to cool back below $1.30/lb by April. Buyer anxiety is driving the price, not a genuine supply hole.





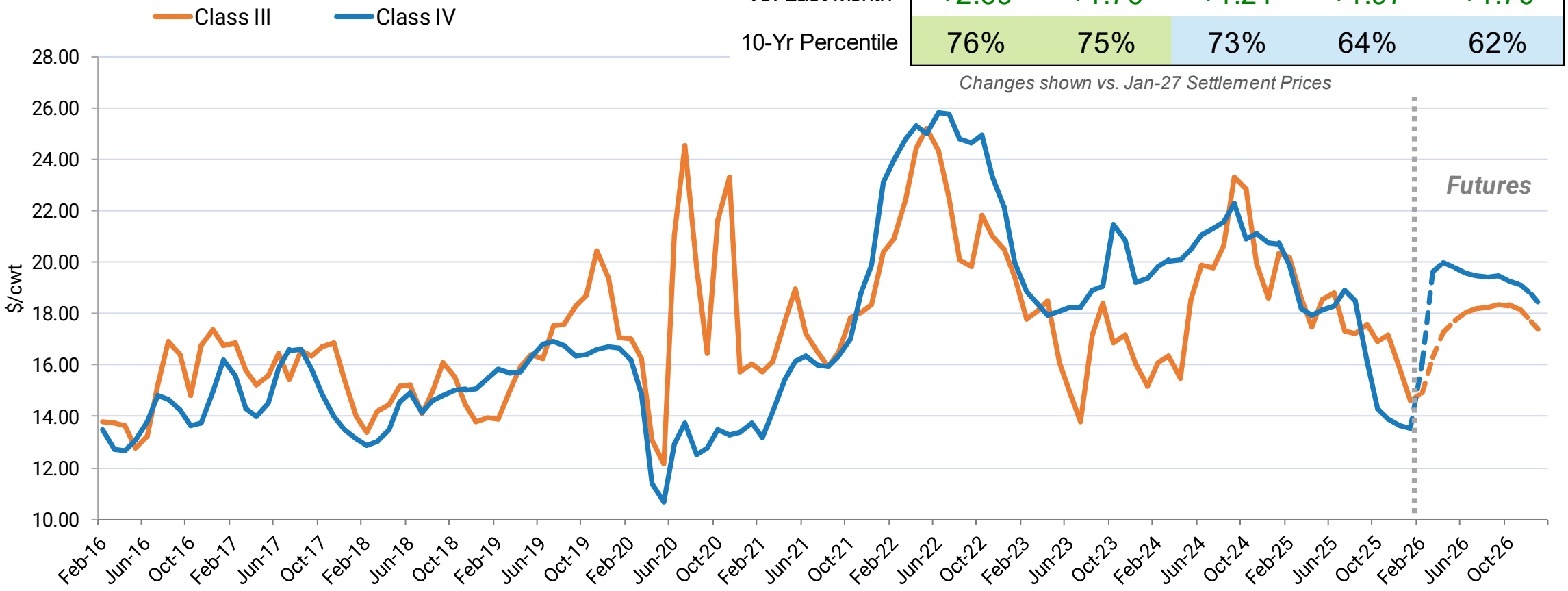


Class III and IV

CME Futures as of February 27, 2026

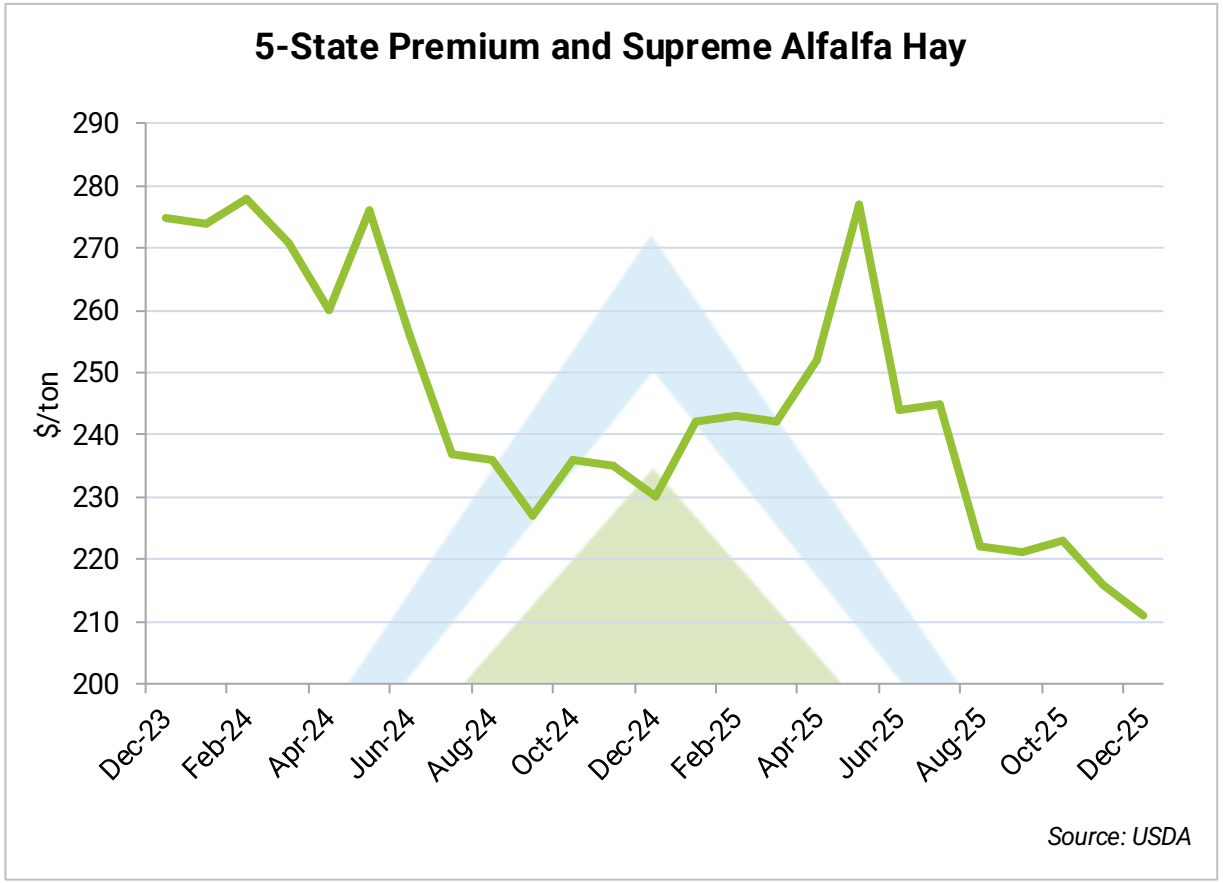
	Q2 2026	Q3 2026	Q4 2026	Q1 2027	Q2 2027
Class III ($/cwt)	**17.68**	**18.27**	**18.06**	**17.23**	**17.32**
Vs. Last Month	+0.78	+0.64	+0.45	+0.25	+0.21
10-Yr Percentile	63%	67%	66%	57%	58%
Class IV ($/cwt)	**19.79**	**19.45**	**19.05**	**18.12**	**17.85**
Vs. Last Month	+2.69	+1.76	+1.21	+1.97	+1.70
10-Yr Percentile	76%	75%	73%	64%	62%

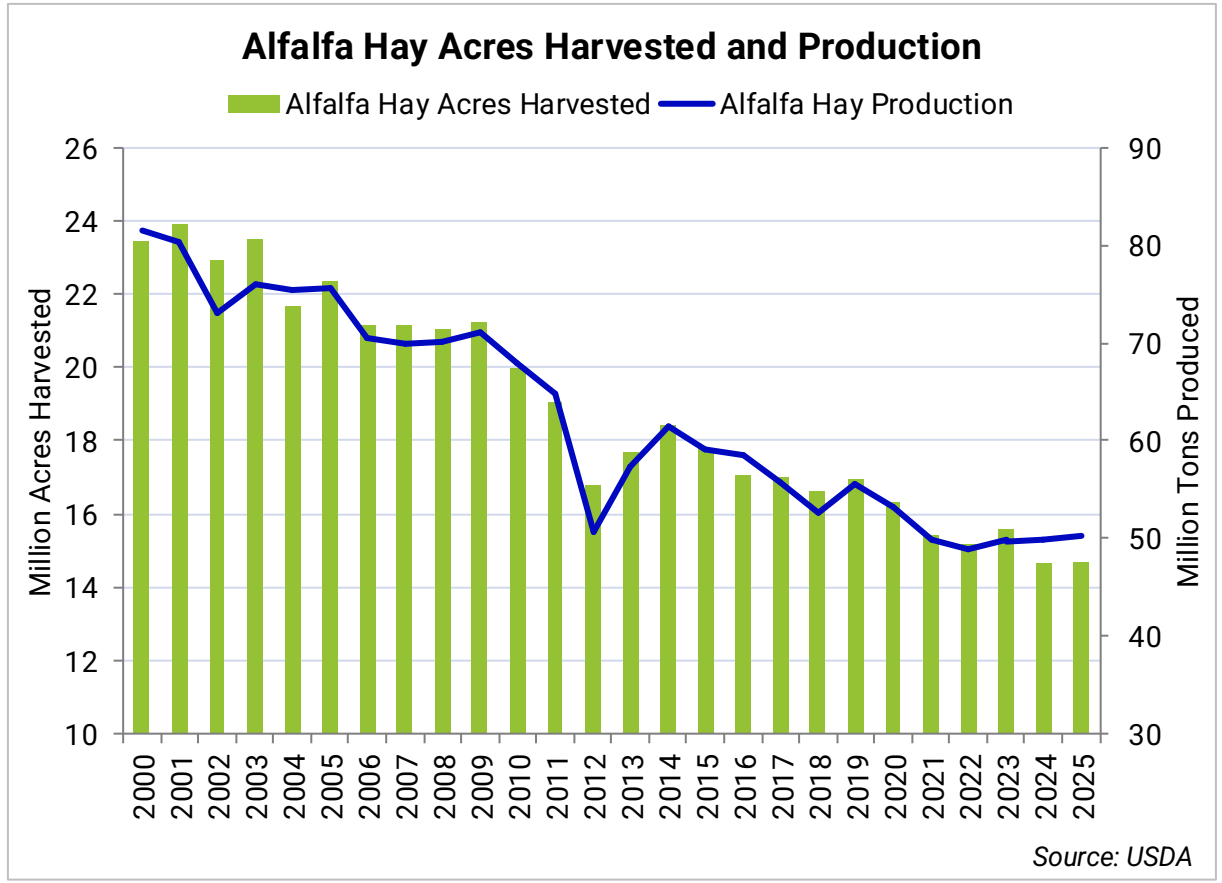
Changes shown vs. Jan-27 Settlement Prices



Source: USDA, CME

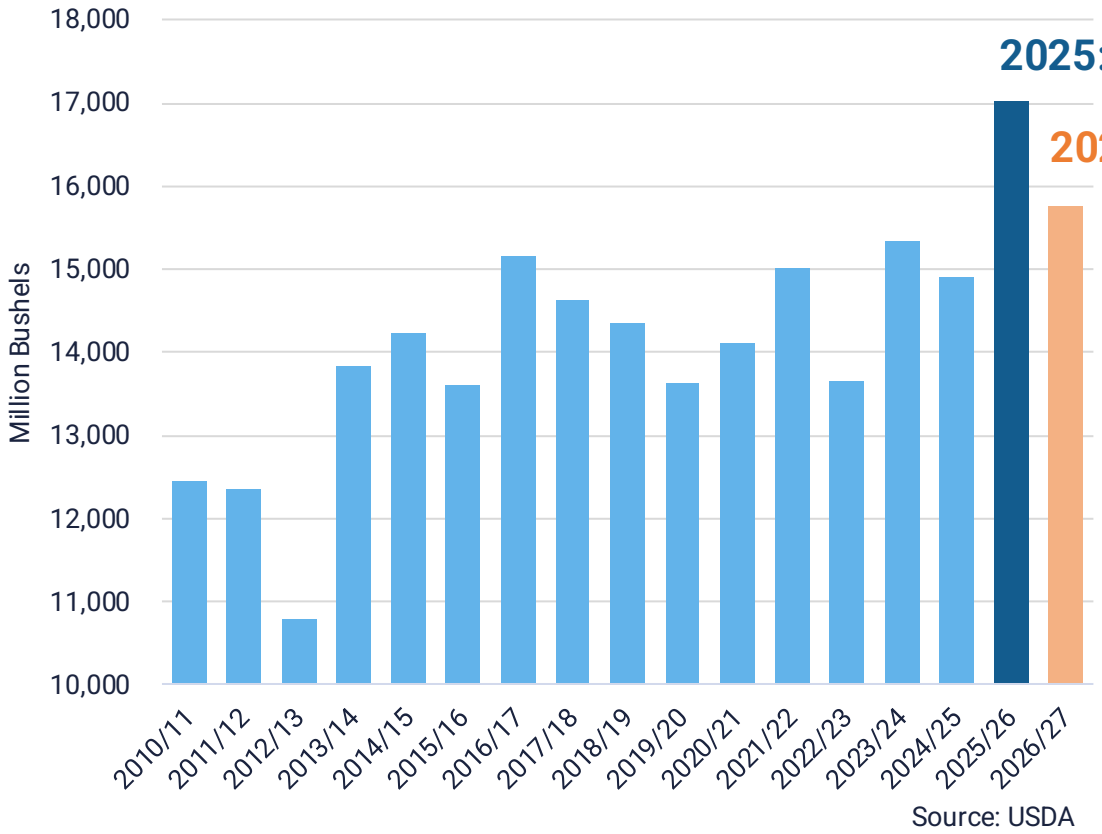
Are we still feeding hay?





Corn

US Corn Production



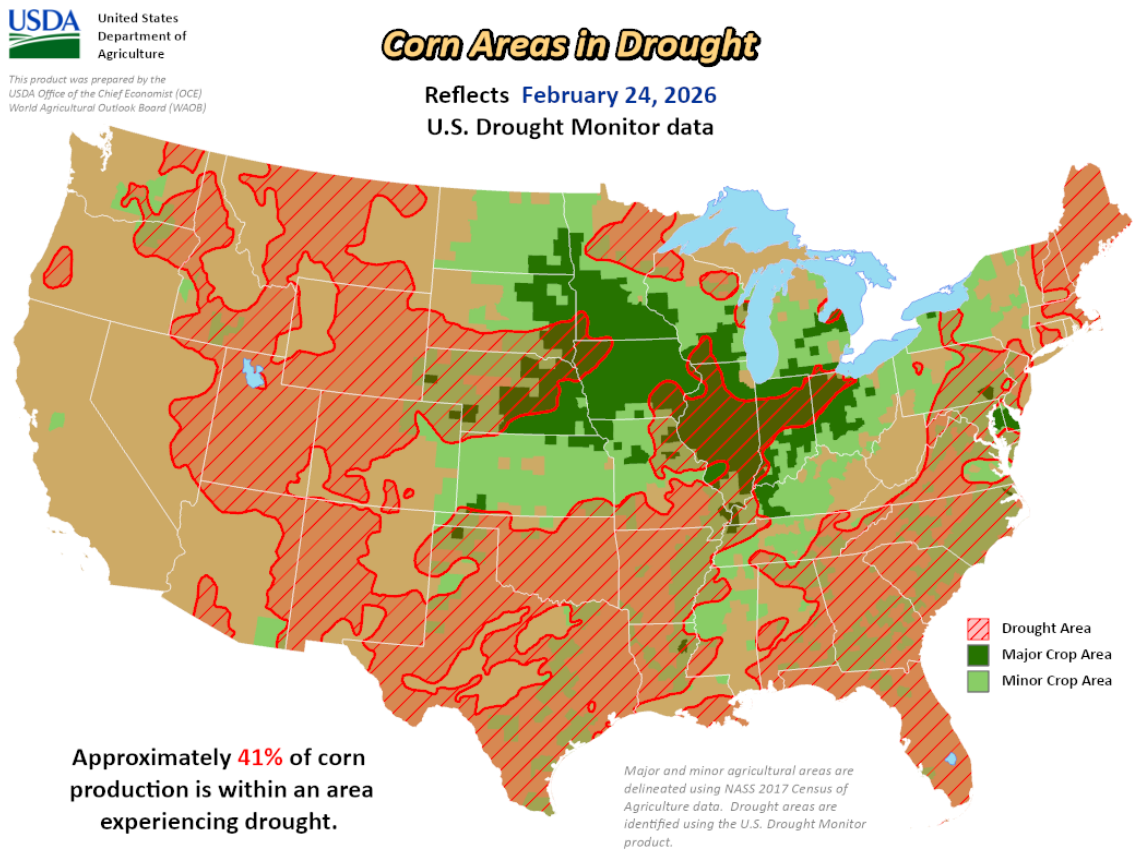
Source: USDA

2025 Corn Crop

Largest **EVER**

91.3 MM acres harvested / 186.5 bu per acre

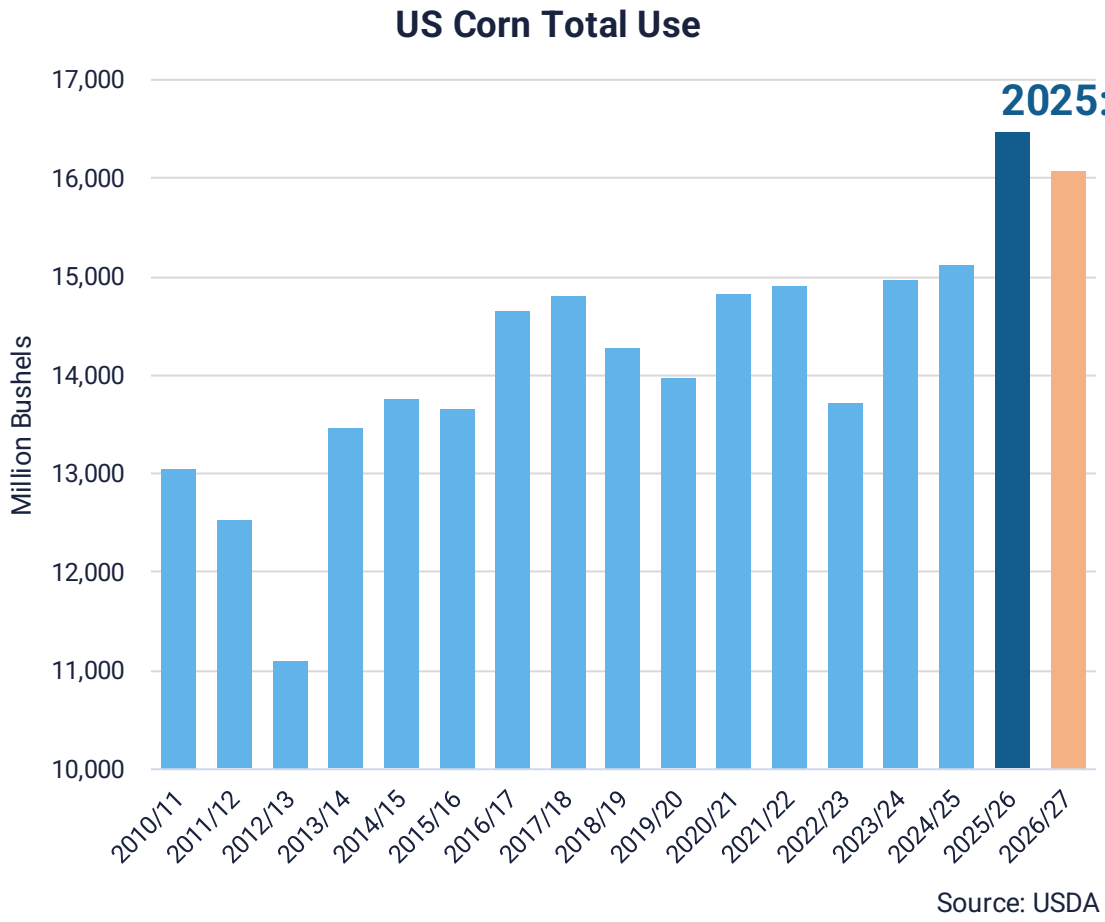
Est. 2.127 billion bushel Ending Stocks
(highest since 2018/19)

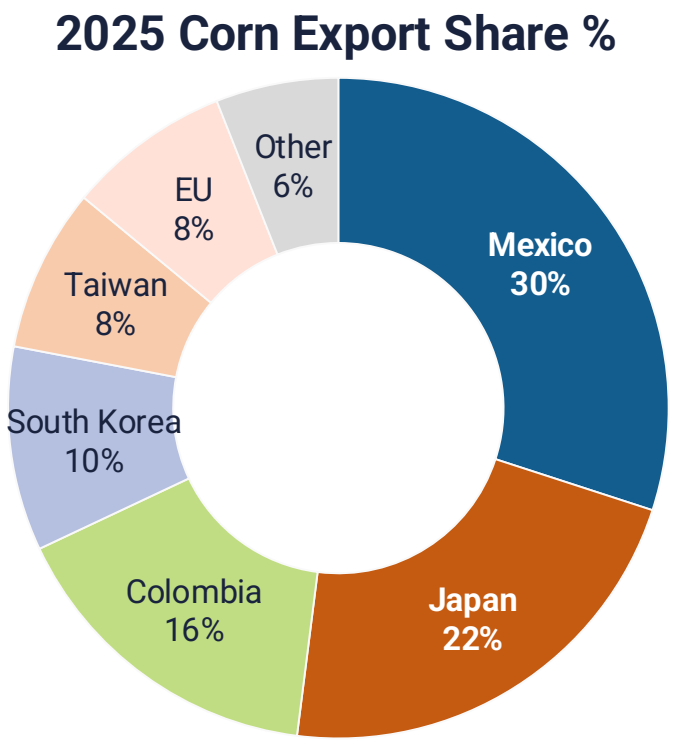


Corn

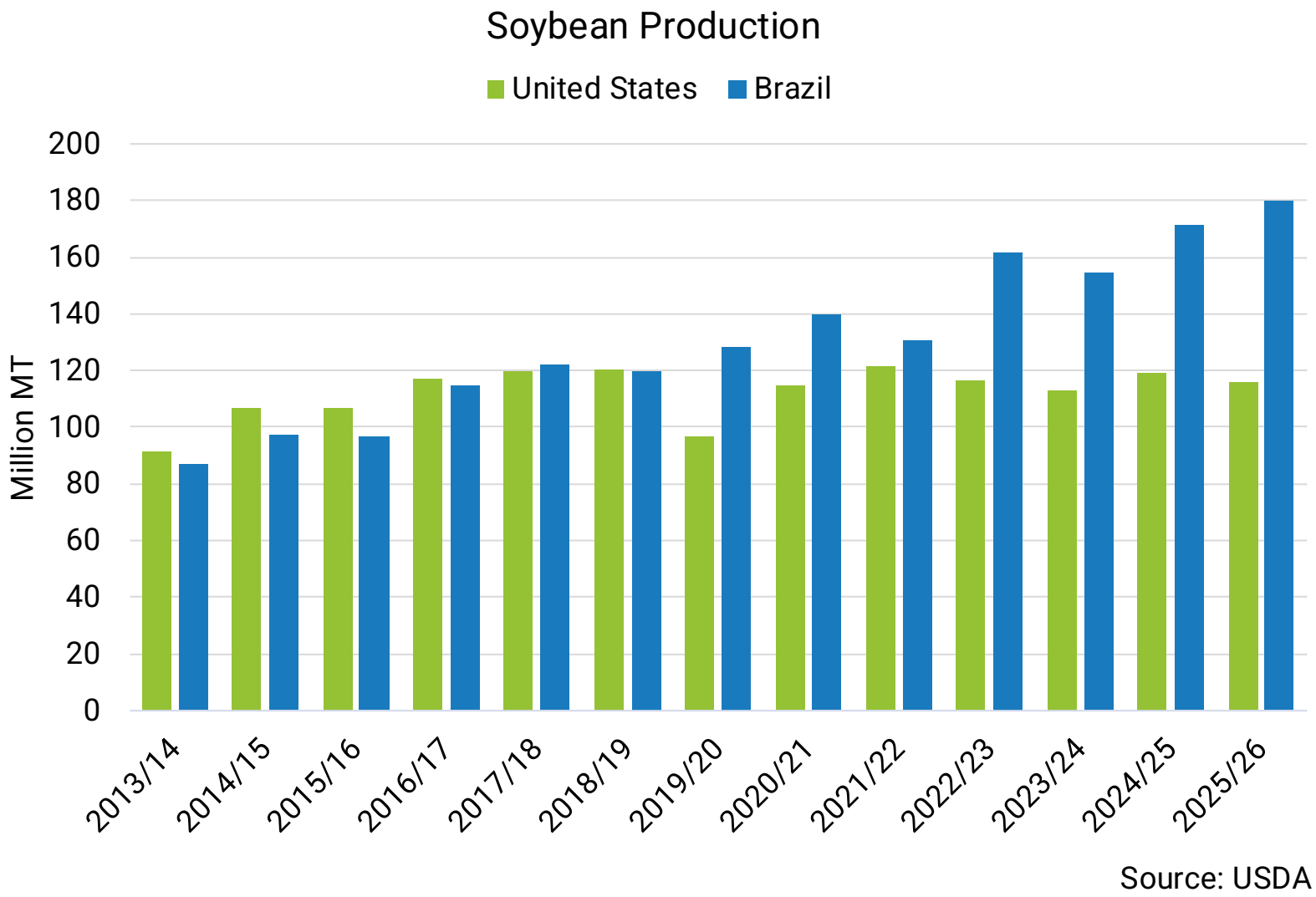
2025 Corn Demand

3.3 billion bushels of exports (ALL TIME HIGH)





Soybean Production

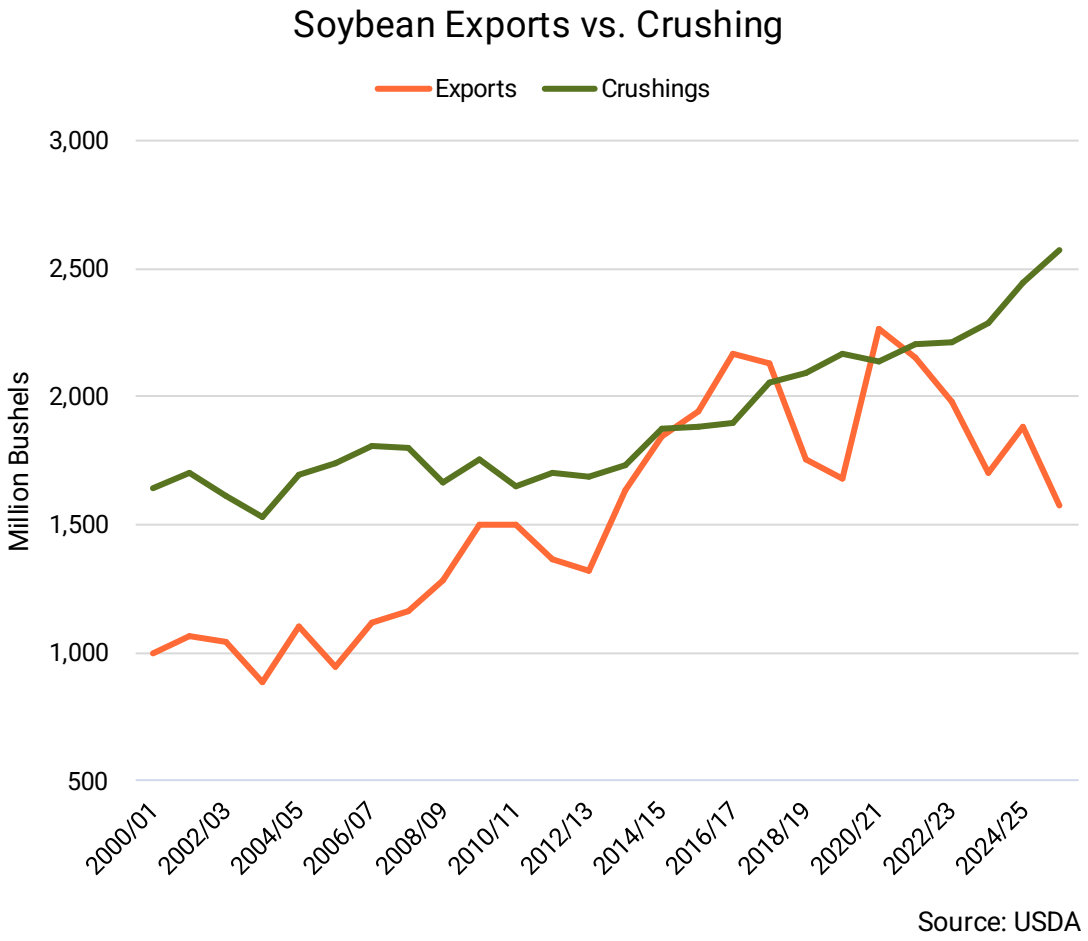


Source: USDA

Brazil Soybean Production

2013-2025: +107.6%

Soybean Use



Source: USDA

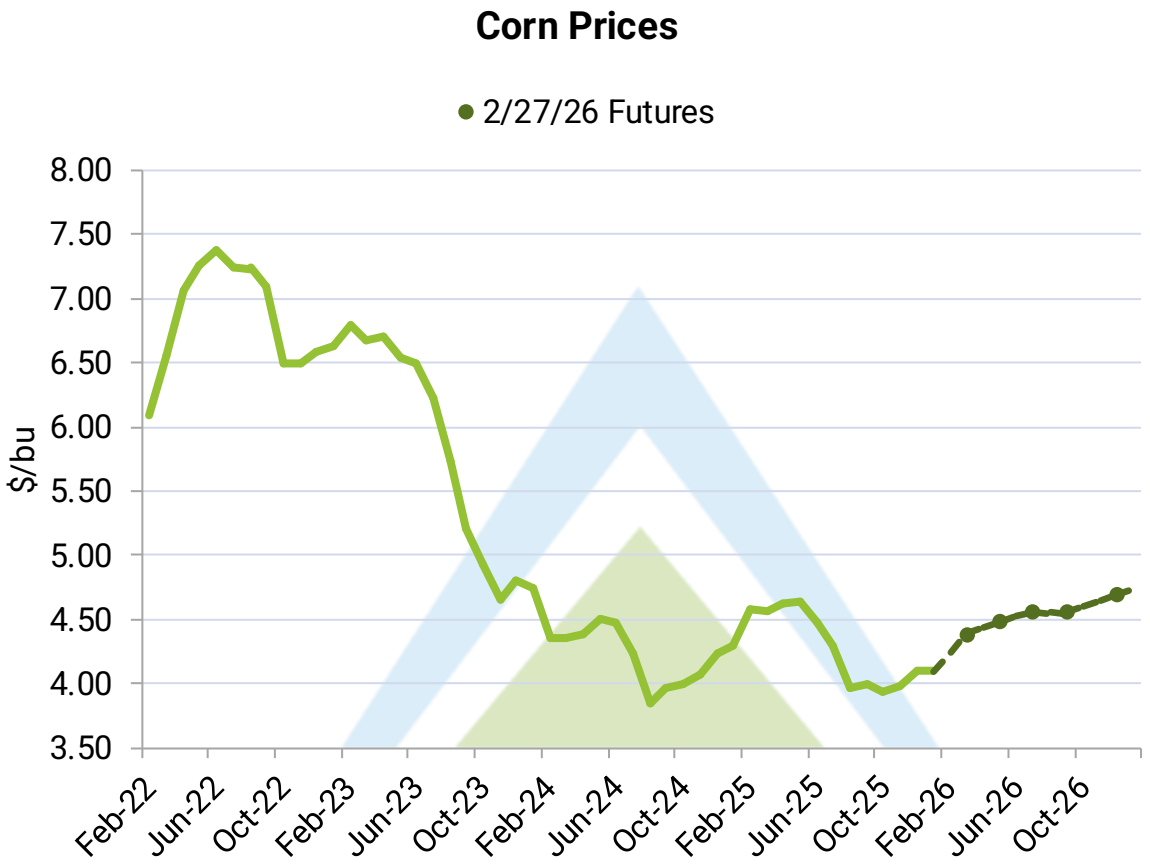
Trade War Impact on Exports

- China buys ~50% of U.S. soybean exports
- 2025/26 exports projected at 1,575M bu (lowest since 2003/04)

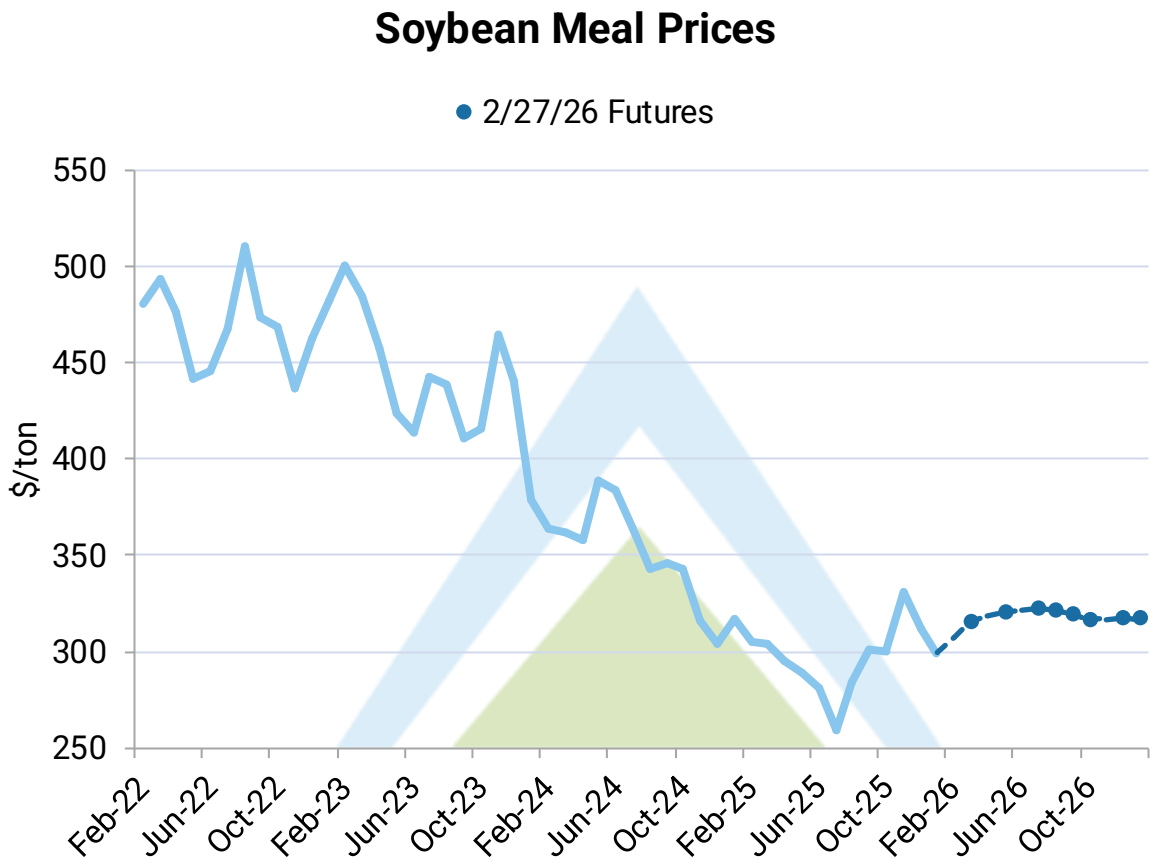
Crush Capacity Expansion

- U.S. crush capacity up 14% since 2023
- 2025/26 crush forecast at a record 2.57B bu
- Another 200M+ bu planned by 2030

Corn / Soybean Meal Pricing

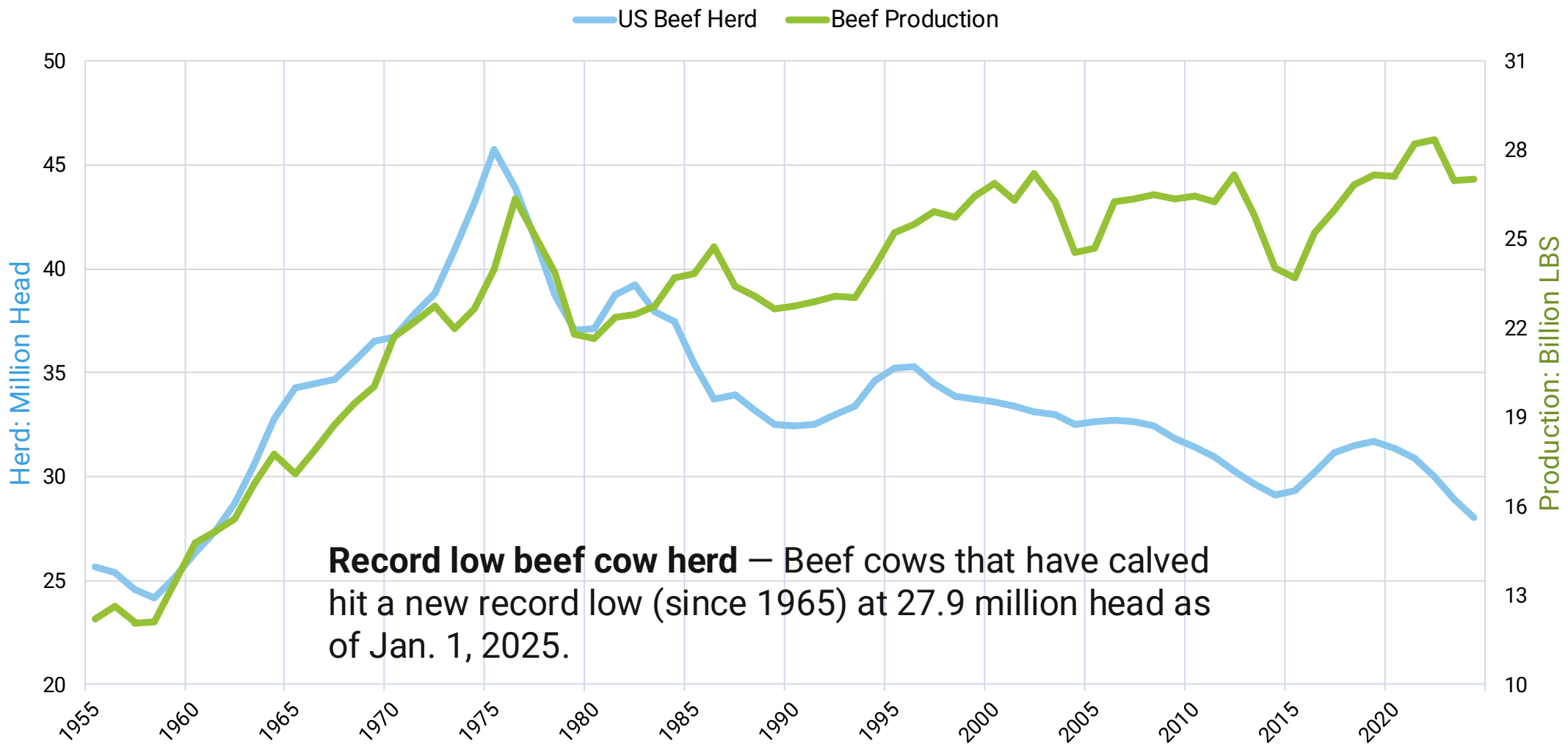


Source: USDA, CME



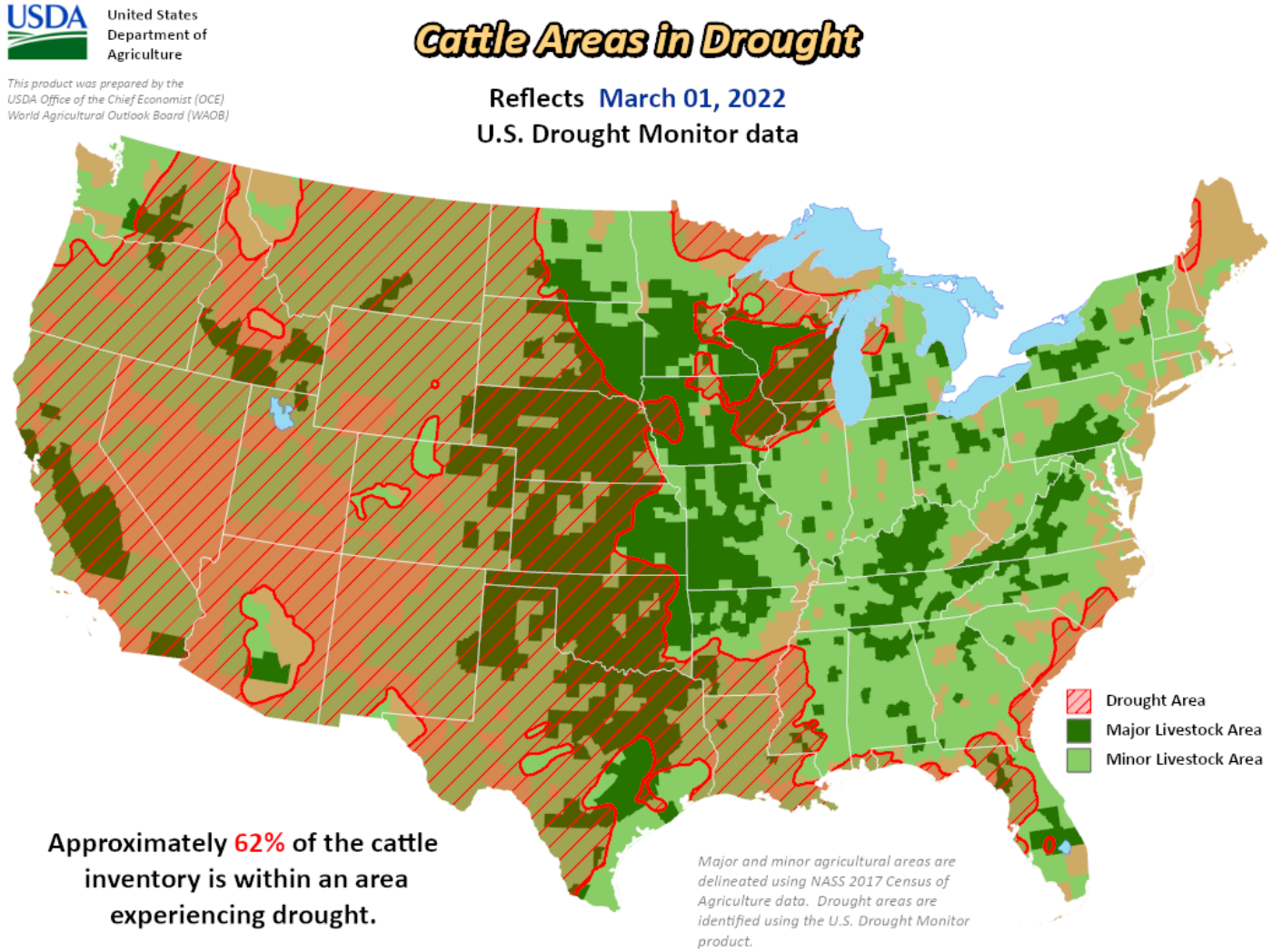
Source: USDA, CME

Herd Size vs. Production



Source: USDA

Where did all the cattle go?



1. 2022 drought across 62% of U.S. cattle country
2. Heifers moved to feedlots instead of retained for breeding
3. Strong cattle prices incentivized liquidation
4. Average beef operator age: 58.3

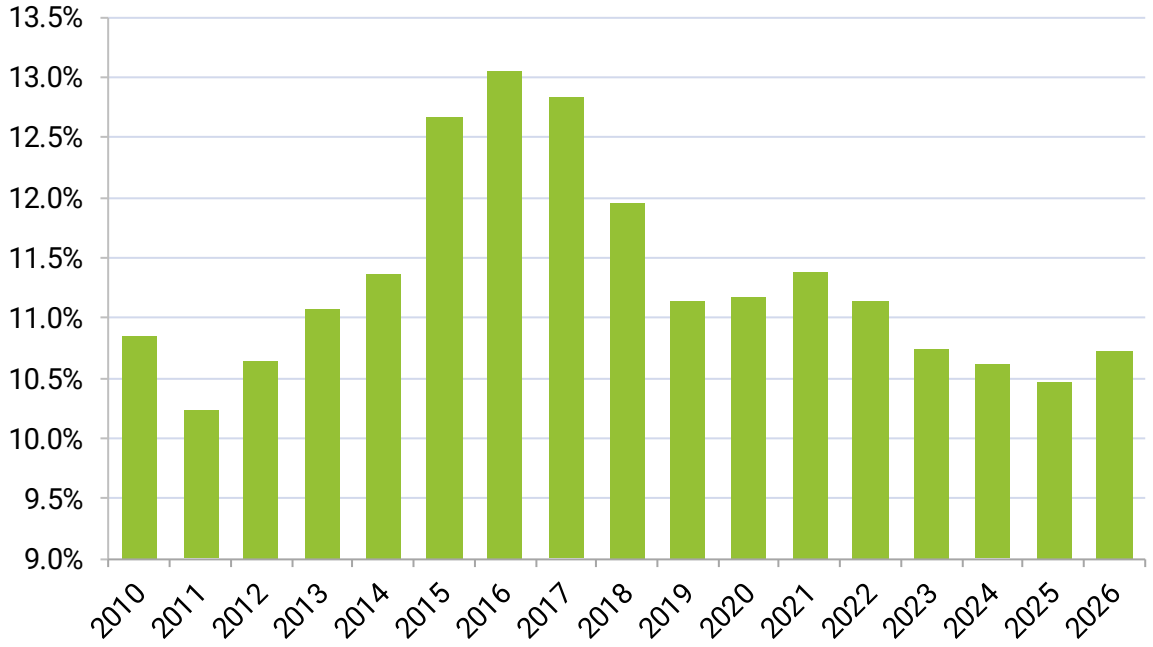
Restocking the Herd

Heifers still feeding, not breeding: 38.7% of cattle on feed, flat YoY

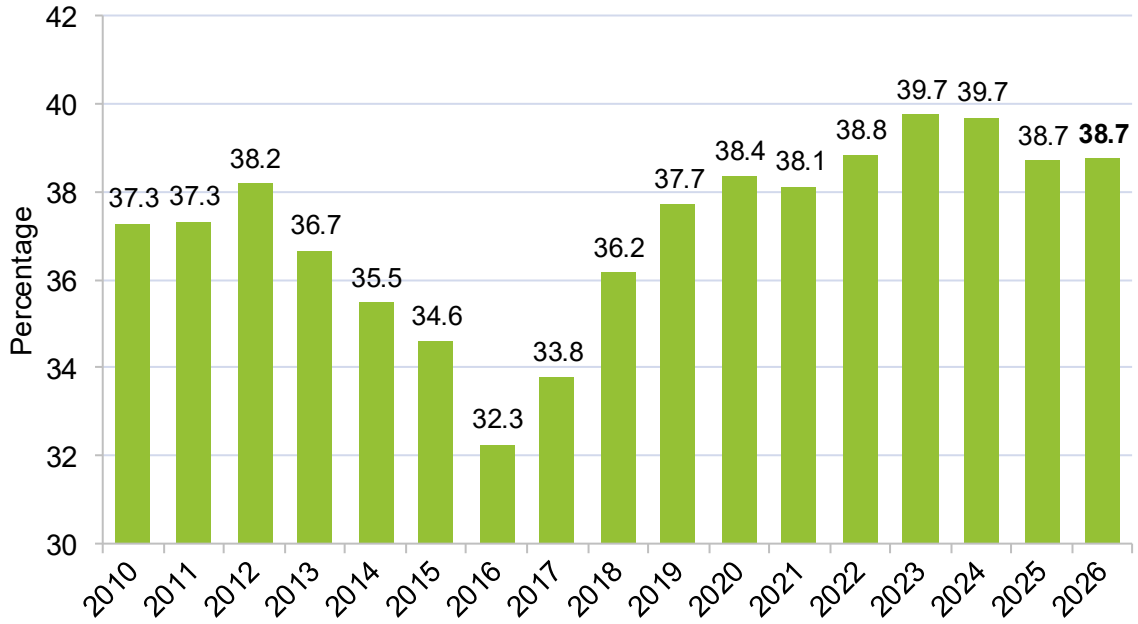
Packer margins deeply negative: -$126/head (Oct. 2025) as record cattle costs outpace box beef prices

Plant utilization falling: 77% capacity (vs. 85% a year ago) — some facilities cutting shifts

Restocking Rate (Expected to Calve / Beef Cows)

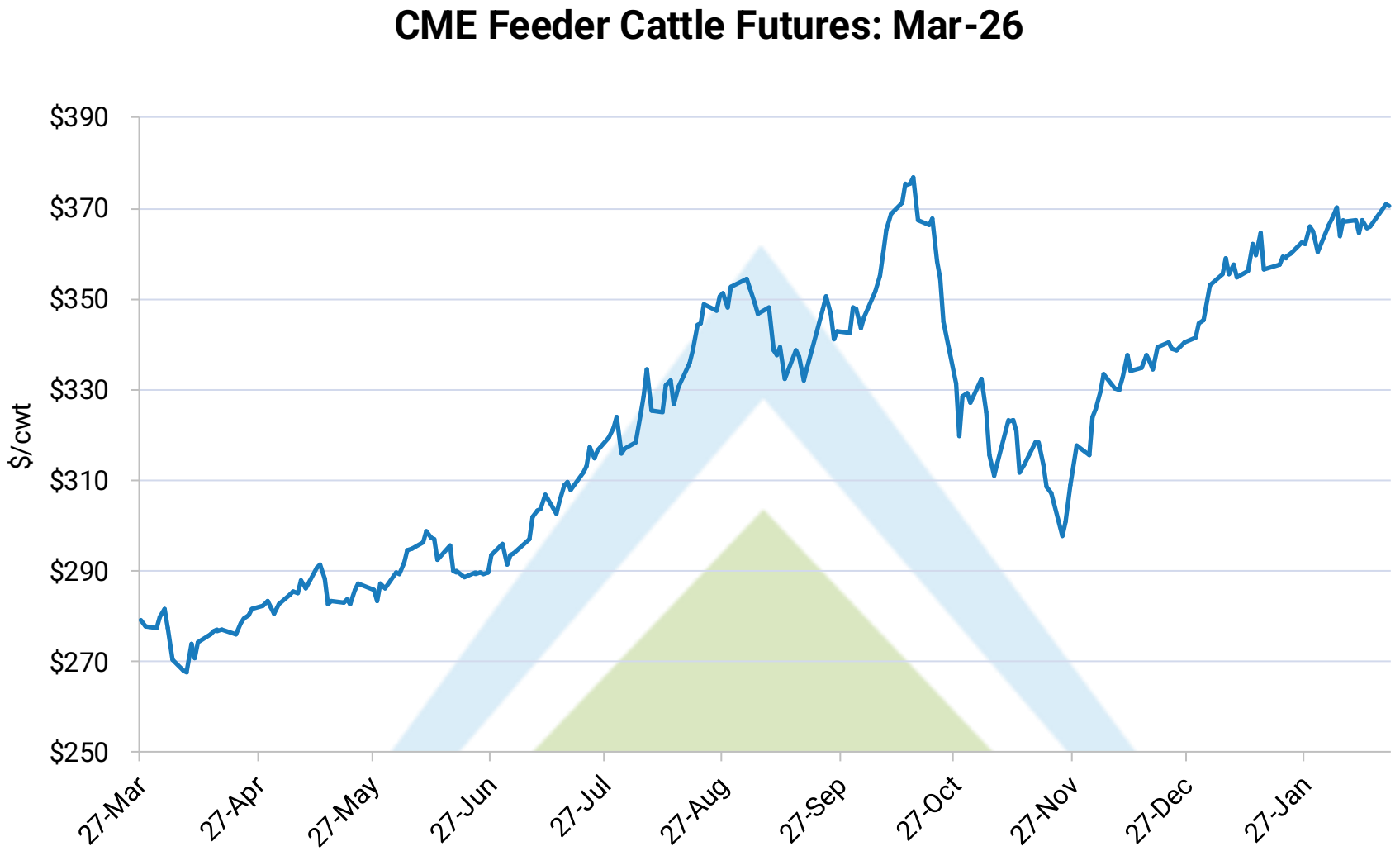


Heifer Share on Feed



Source: USDA

Cattle Futures



Source: CME

How do we monitor margins?

Accurately modeling dairy farm financials is inherently complex

- Input costs and revenues are both highly volatile
- Production data is abundant, but gaps and inconsistencies are common

No two dairy operations are alike

- Herd size, milkshed dynamics, and the balance of grown vs. purchased feed all vary significantly
- The one-size-fits-all approach is difficult

What are our priorities?

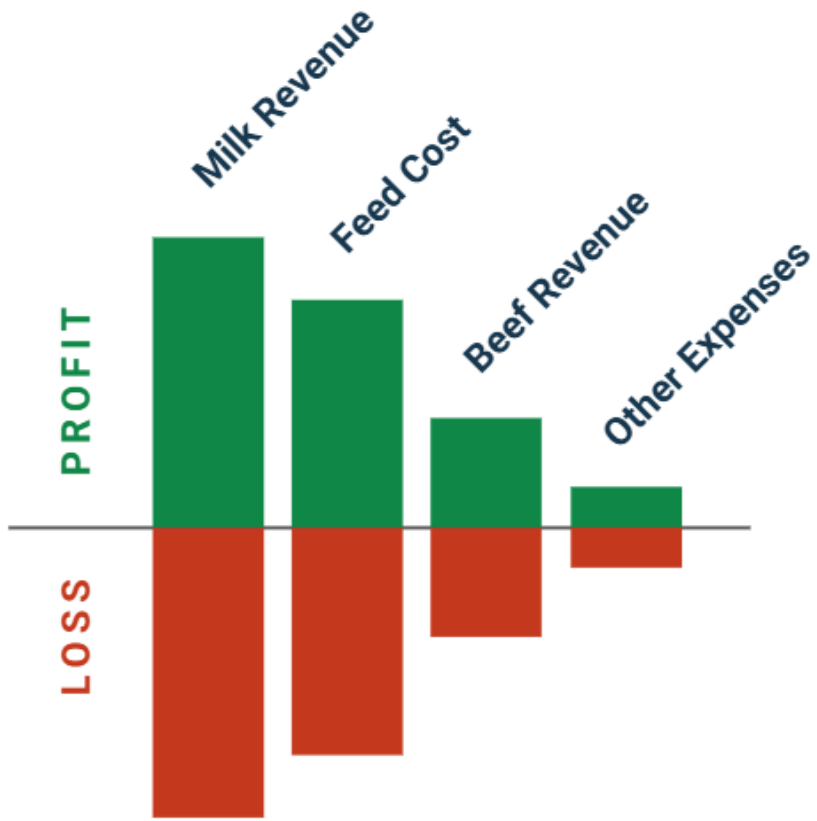
CONDENSED STATEMENT OF DAIRY FARM INCOME AND COSTS

COMPARISON BY AREA
FOR THE SIX MONTHS ENDED JUNE 30, 2024
(BASED ON PER HUNDREDWEIGHT OF MILK BASIS)

	Southern California	San Joaquin Valley	Kern County
Income:			
Milk sales	$ 22.23	$ 20.48	$ 20.24
Calves and other	1.49	1.43	1.58
Total income	$ 23.72	$ 21.91	$ 21.82
Cost of operations:			
Feed:			
Grain	$ 8.85	$ 8.79	$ 8.97
Hay and forages	4.28	3.43	4.74
Total feed	$ 13.13	$ 12.22	$ 13.71
Labor, (including fringe costs)	$ 2.83	$ 2.06	$ 1.88
Herd replacement costs	$ 1.12	$ 0.68	$ 0.85
Other costs:			
Milk hauling	$ 0.86	$ 0.54	$ 0.67
State and association charges	0.17	0.19	0.19
Veterinary, breeding, testing, etc.	0.99	0.55	0.45
Supplies	0.18	0.58	0.50
Repairs and maintenance	0.61	0.64	0.91
Utilities	0.35	0.36	0.44
Occupancy costs	0.47	0.60	0.46
Depreciation - equipment	0.25	0.39	0.36
Interest	0.98	0.71	0.84
Miscellaneous	0.92	0.85	0.70
Total other costs	$ 5.78	$ 5.41	$ 5.52
Total cost of operations	$ 22.86	$ 20.37	$ 21.96
Income (loss) from dairy operations	$ 0.86	$ 1.54	$ (0.14)
Farming operations, net	$ 0.00	$ (0.36)	$ 0.43
Net income (loss)	$ 0.86	$ 1.18	$ 0.29

3

See accompanying explanation of income and cost factors.



Milk Price Volatility

Commodity	Annualized Volatility
Butter	26.3%
Cheese	33.0%
Dry Whey	23.7%
Nonfat Dry Milk	18.5%
Class III	34.2%
Class IV	20.8%

Butterfat: 4.00%

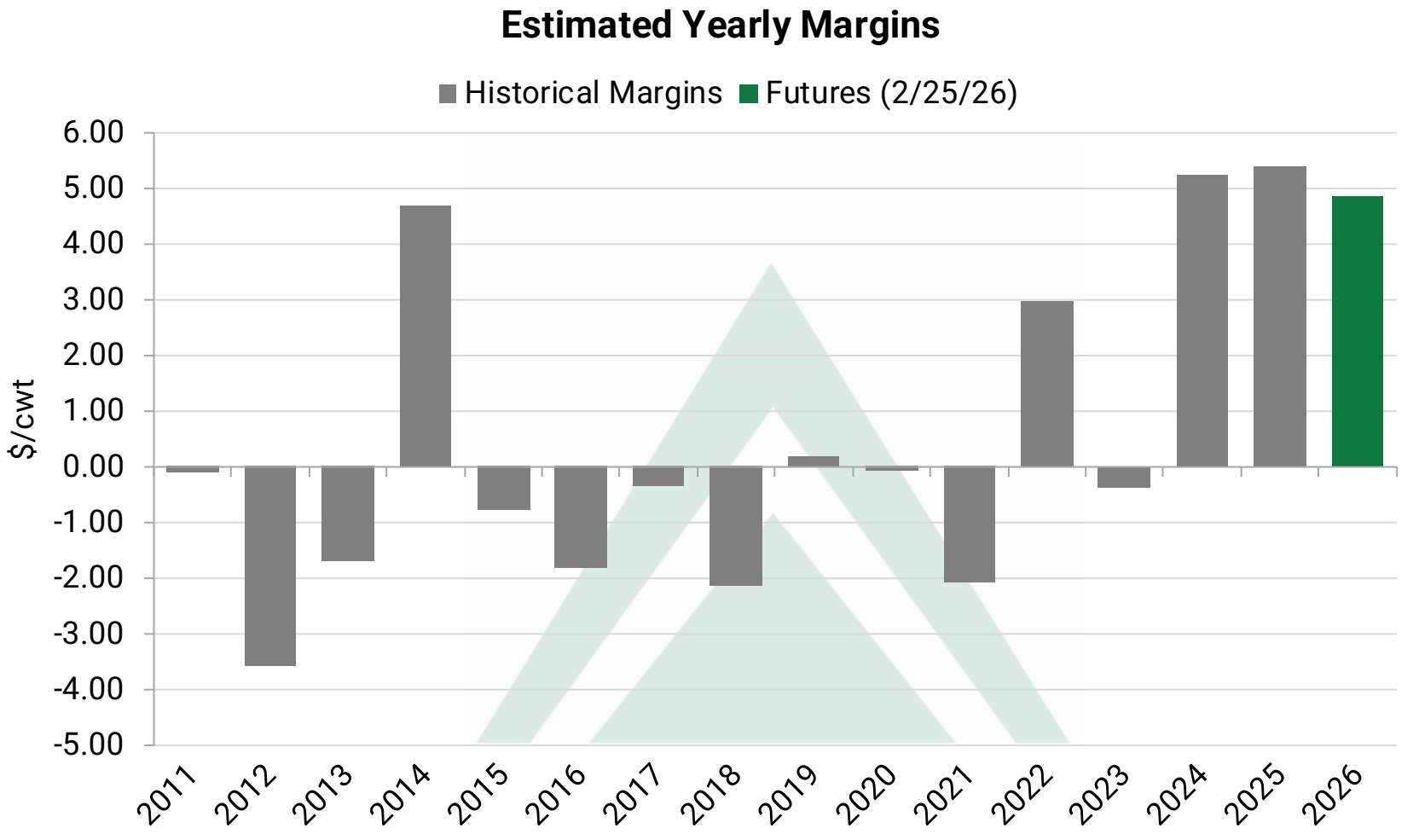
Protein: 3.20%

Other Solids: 5.70%

Utilization: 50% Class III / 50% Class IV

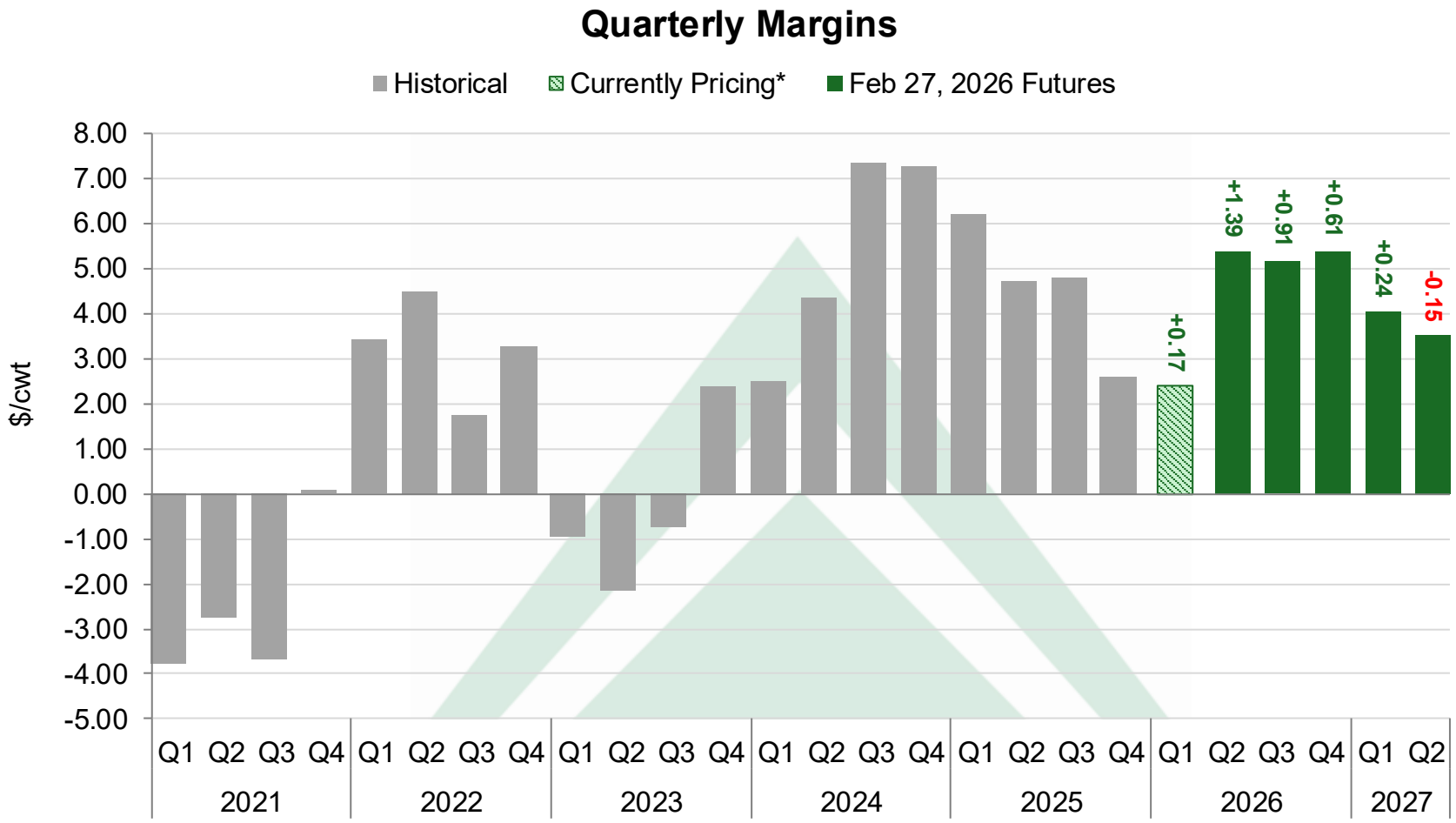
Annualized Milk Price Volatility = 31.5%

Margin Monitor

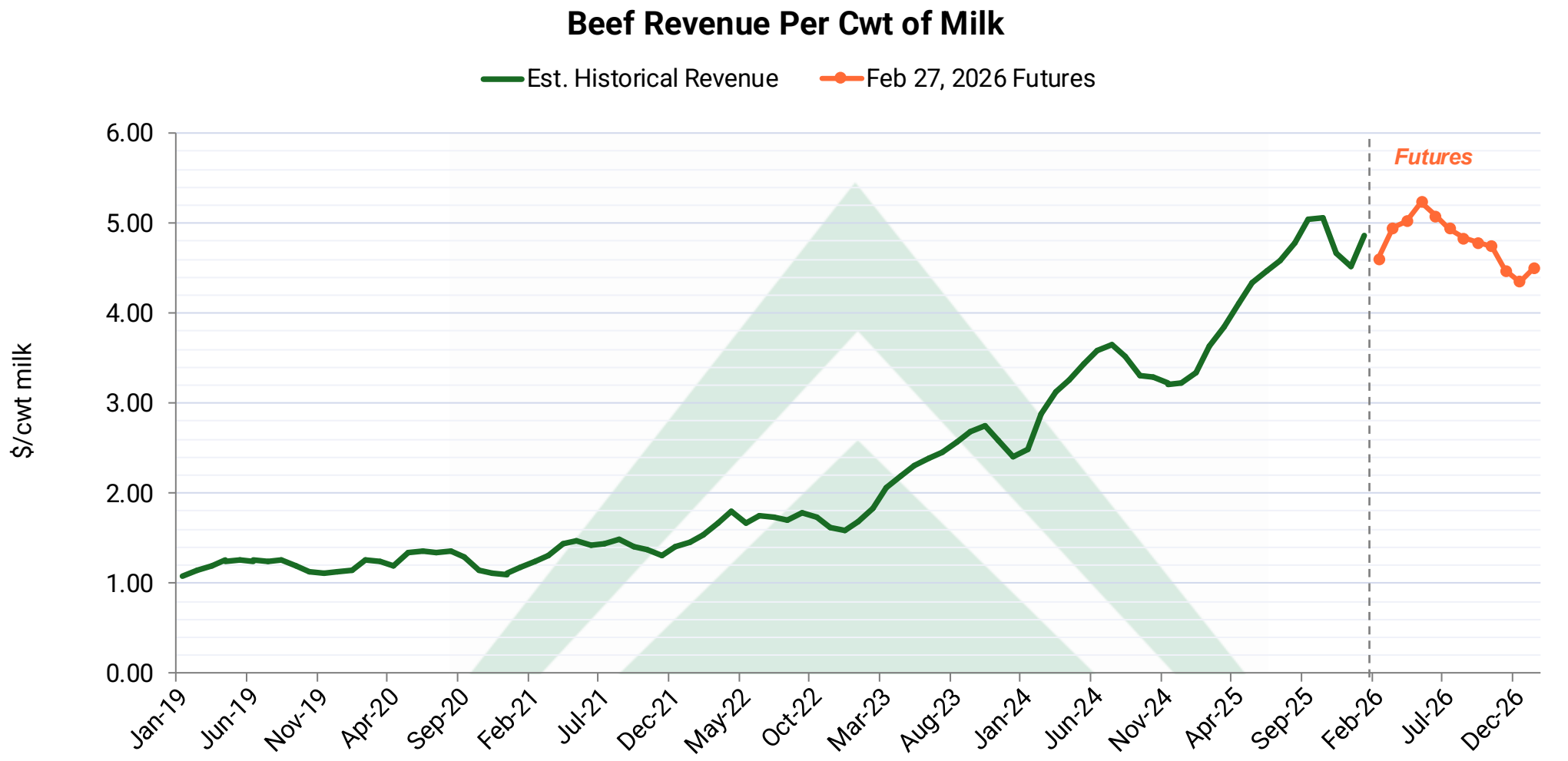


Source: USDA, CME, HighGround Calculations

Margin Monitor

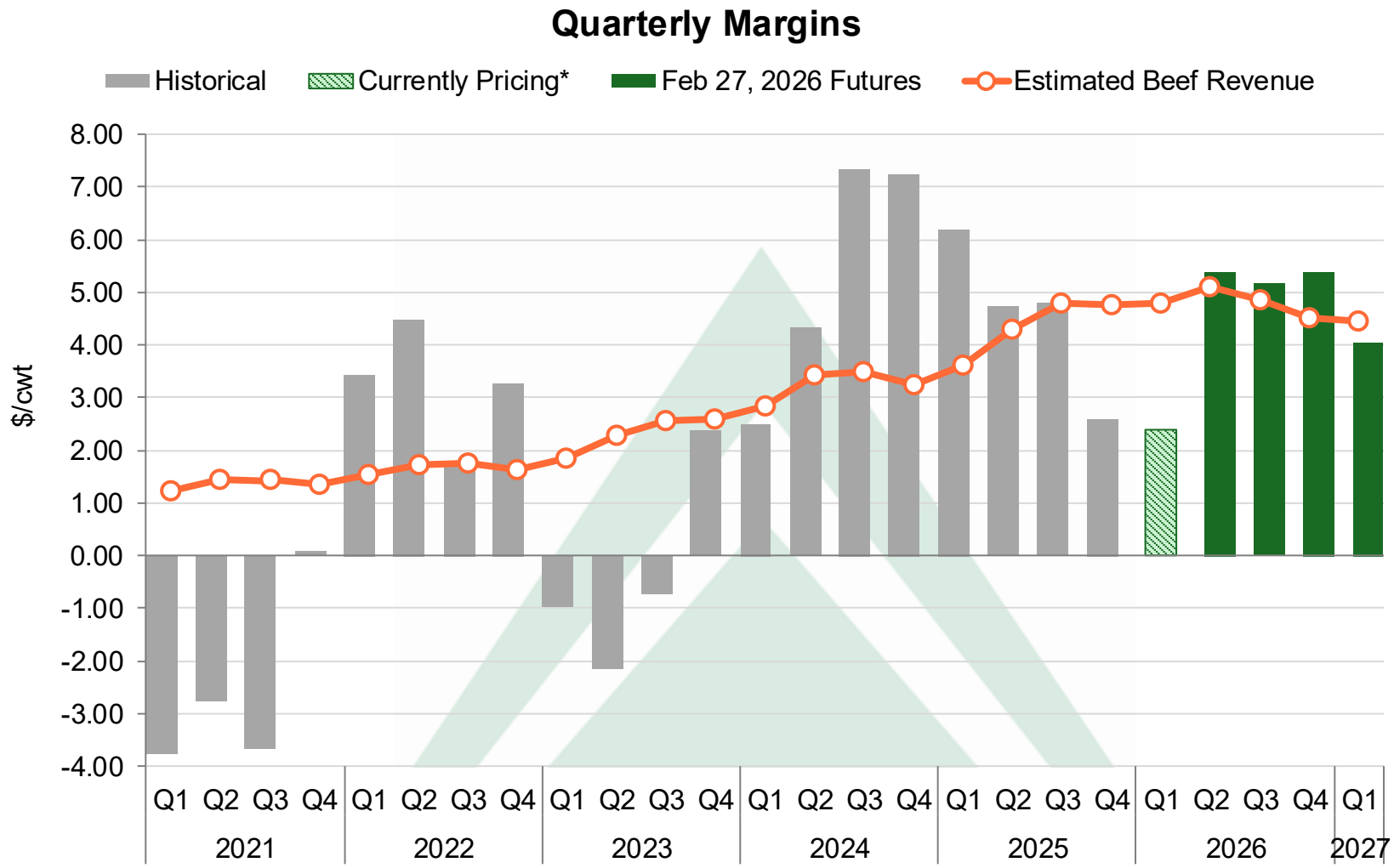


Beef Revenue



Sources: USDA, CME, HighGround Calculations

Beef Revenue

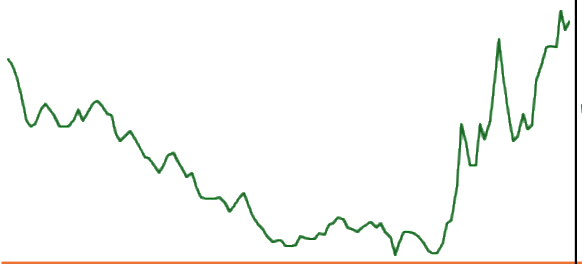


Margin Monitor

Q2 2026

Milk Revenue

$/cwt	vs. last month	10-Yr Percentile
20.83	+1.85	74%



Beef Revenue

$/cwt	vs. last month	10-Yr Percentile
5.11	-0.15	100%



Feed Cost

$/cwt	vs. last month	10-Yr Percentile
-11.26	+0.31	36%



Operating Costs

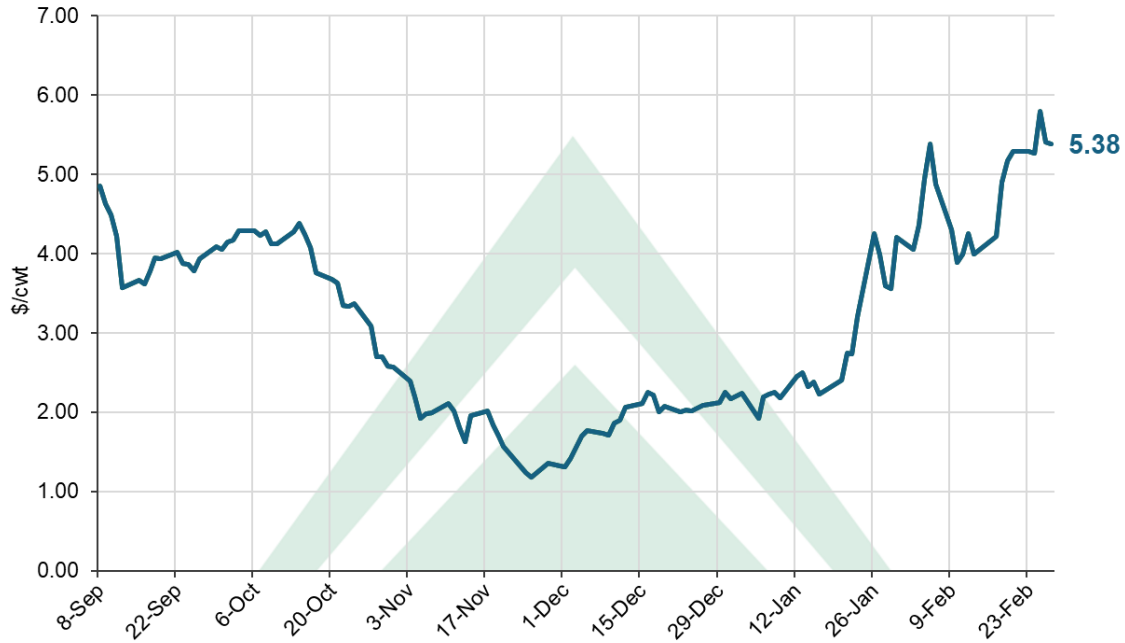
$/cwt
-9.30

Assumptions: 4.29% fat / 3.38% protein; 55% Class III / 45% Class IV; 60 lbs of corn and 14.7 lbs of SBM per cwt of milk; 50 cross calves per month at 85 lbs each and 27 cull cows per month at 1,300 lbs each; 2.43 mil lbs of milk per month; $3.00/cwt for other feeds

Margin

Margin = Milk Revenue + Beef Revenue - Feed Cost - Operating Costs

$/cwt	vs. last week	10-Yr Percentile
5.38	+0.08	93%



What should we do going forward?

1. Get equip with the tools (DRP, LRP, Futures Brokerage)
2. Secure nearby Class IV risk ASAP (Q2 DRP deadline – March 13)
3. Be consistent with managing beef calf/cull risk (LRP)
4. Don’t sleep on corn in 2026 (drought + strong exports)
5. Too busy? Too stressful? Too complicated? – We are here to help!

Thank You

Questions?

Curtis Bosma

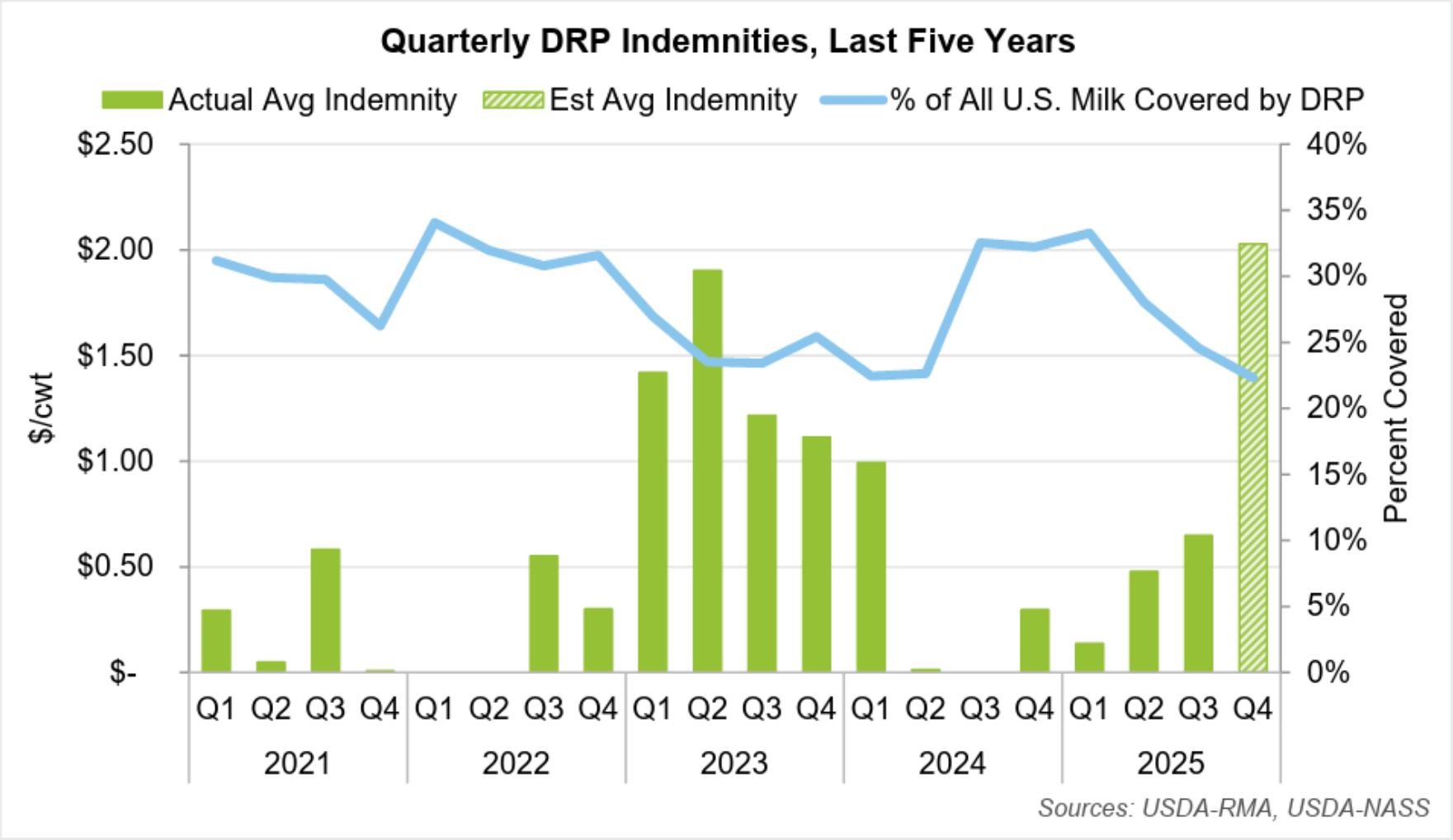
curtis.bosma@highgrounddairy.com

559-623-4172

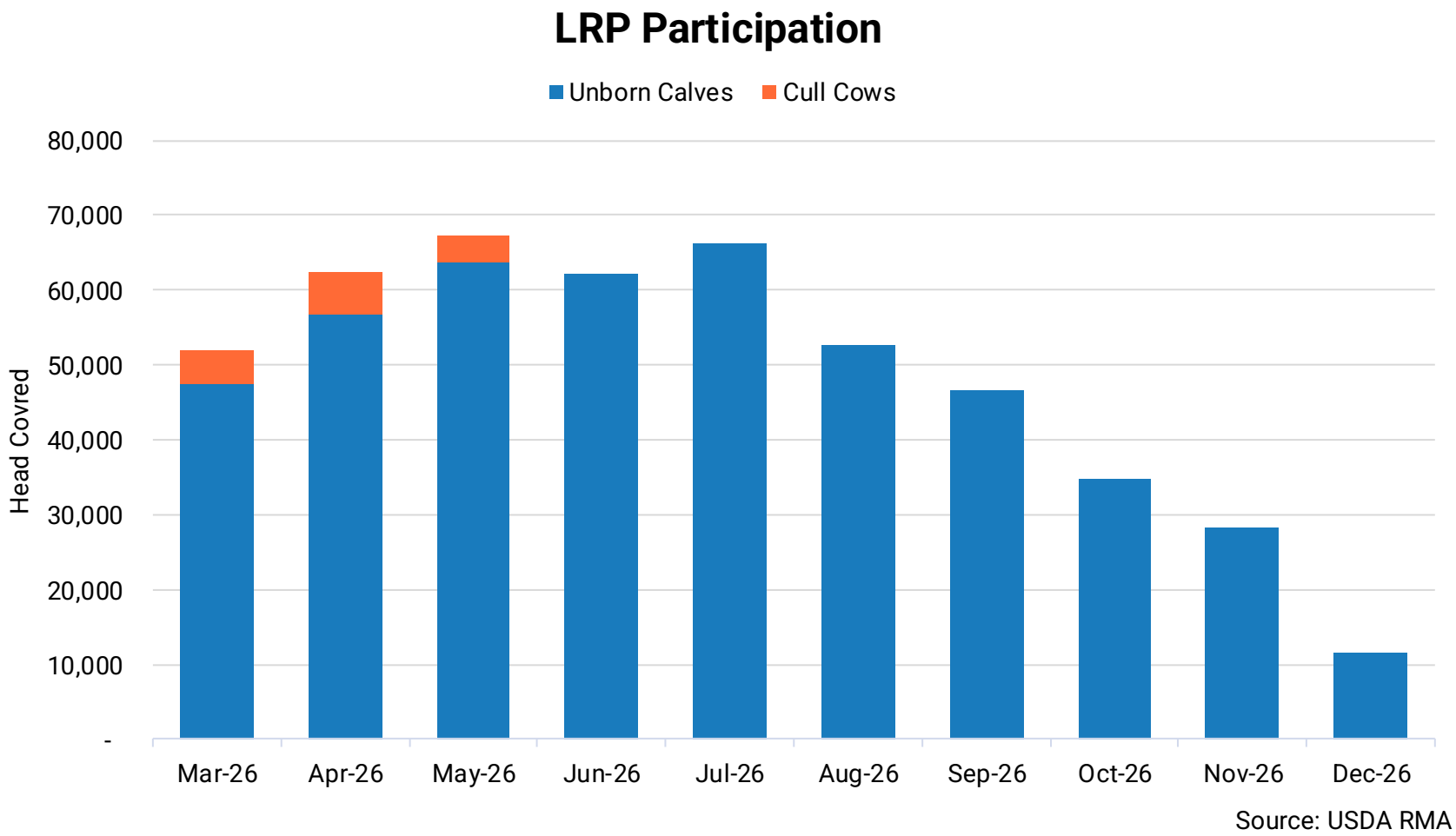
Disclaimer: HighGround Dairy is a division of HighGround Trading (HGT), an Introducing Broker (IB) registered under United States Laws. Nothing contained herein shall be construed as a recommendation to buy or sell commodity futures or options on futures. This communication is intended for the sole use of the intended recipient. Futures and options trading involves substantial risk and is not suitable for all investors.



DRP Participation



LRP Participation



Source: USDA RMA

HIGH PLAINS
DAIRY CONFERENCE

Dairy Outlook Series:

A panel conversation:
"Looking back while looking forward."

Moderated by Rick Naerebout, CEO IDA



High Plains Dairy Conference:
20 years providing science and information to dairy producers of the High Plains

DAIRY MANAGEMENT INC.™

Driving Dairy Sales Now and Into the Future via Innovation, Science & Technology

Paul Ziemnisky
Emil Nashed

March 3, 2026

External Headwinds Last Ten Years



DMI DAIRY MANAGEMENT INC.

Real Dairy Withstood a Decade of ~$20B Investment in Alternatives

The move away from animal products and towards plant-based protein is the 'number one game changing trend of the future.' *- Eric Schmidt, 2016, former Executive Chairman of Google/Alphabet*



Influencers

- ✓ Bezos (Amazon)
- ✓ Gates (Msoft)
- ✓ Schultz (Sbucks)
- ✓ Schmidt (Google)



Celebrities

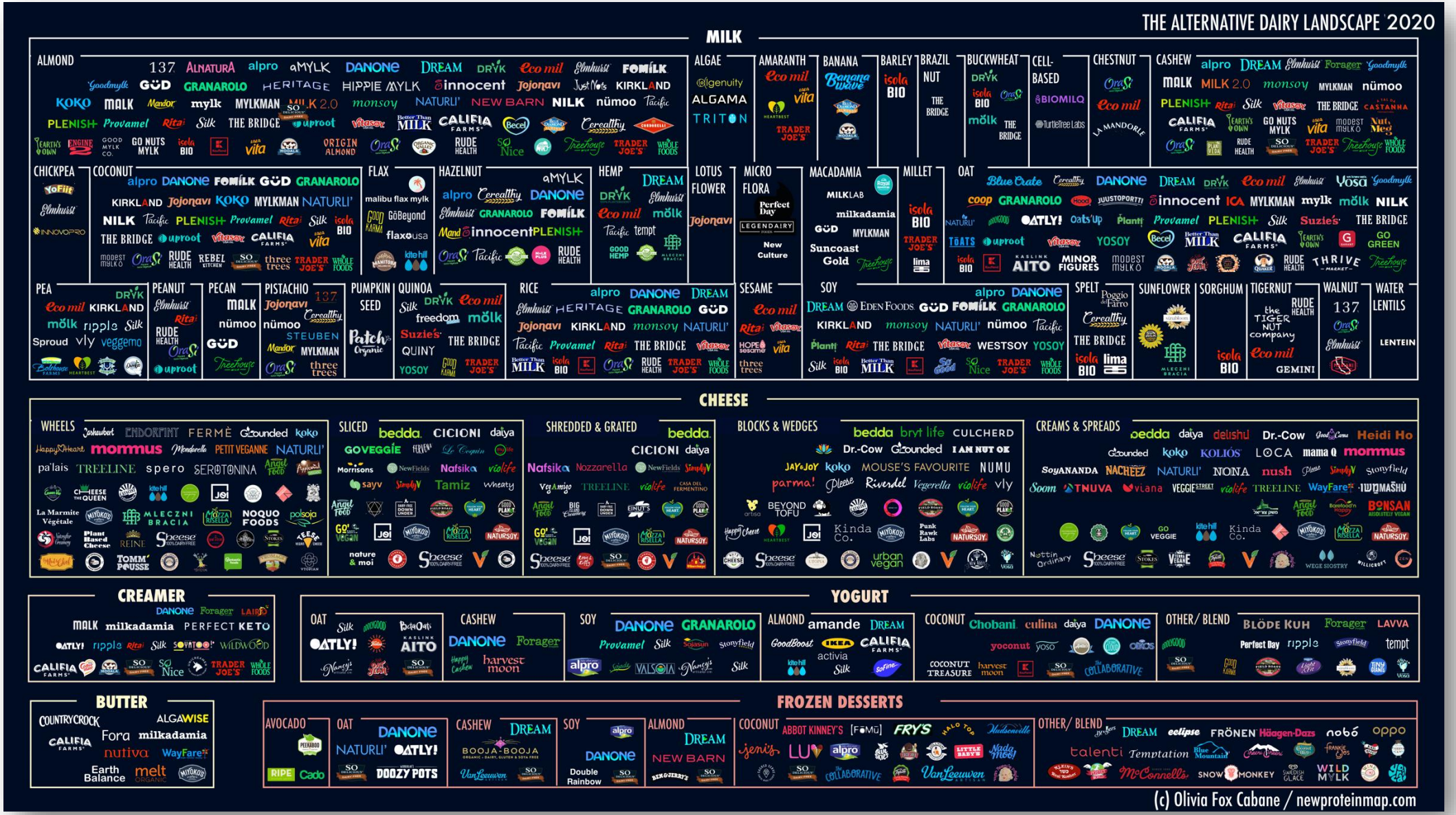
- ✓ Paltrow
- ✓ Oprah
- ✓ DeCaprio
- ✓ Jay Z
- ✓ Serena Williams



Funders

- ✓ Investment Banks
- ✓ PE
- ✓ VC
- ✓ Global Investors

Alternative Dairy Map: 2020

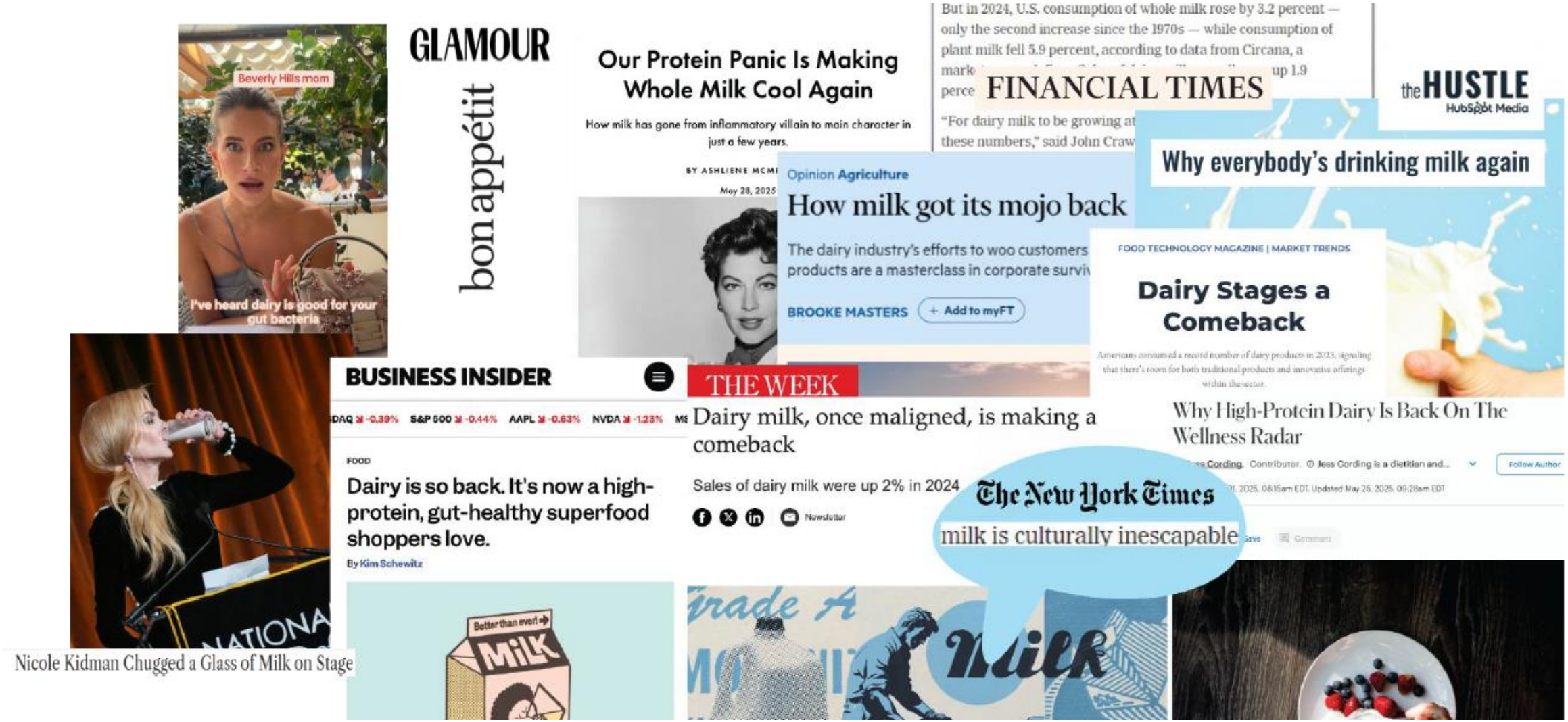


Tailwinds Now and Consumer Momentum



DMI DAIRY MANAGEMENT INC.

Major Media Outlets Herald Dairy's Renaissance



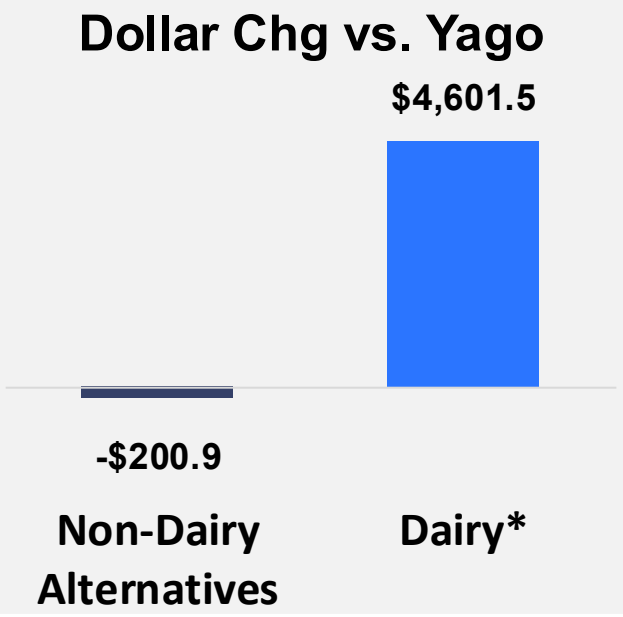
Nicole Kidman Chugged a Glass of Milk on Stage

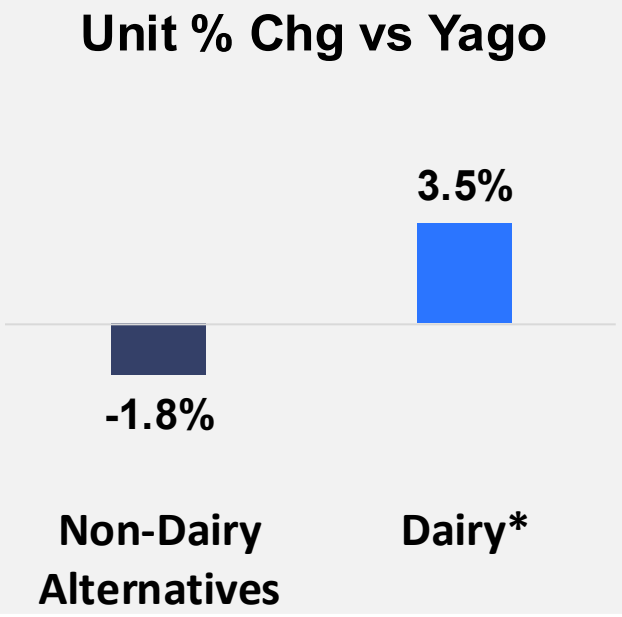
We are Winning Again

SIZE



GROWTH





Source: Circana MULO+ with convenience; 52 wks ending 7-13-25
** Dairy excludes frozen novelties and ice cream products*

DMI DAIRY MANAGEMENT INC.

Nearly all categories grew at retail in 2025

TOTAL U.S. RETAIL VOLUME % CHANGE VS YEAR AGO

2024 and 2025 Volume Growth vs. Previous Year

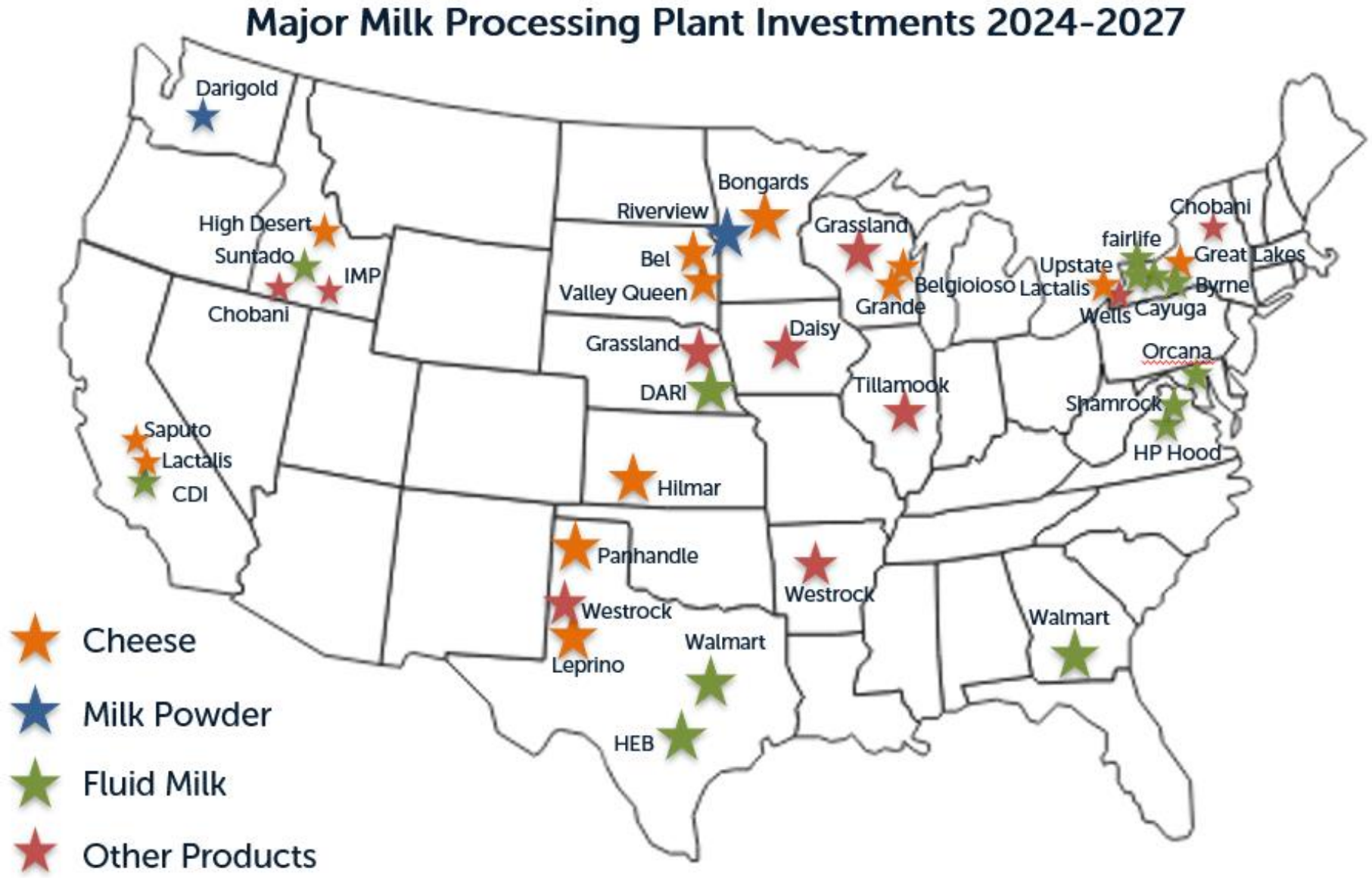
		COTTAGE CHEESE	PROTEIN	YOGURT		WHIPPING CREAM	BUTTER
% volume chg vs yago	’23-’24	12.5%	9.5%	7.6%	6.0%	8.8%	1.8%
	’24-’25	14.3%	10.8%	8.8%	7.6%	3.4%	1.8%

		CHEESE & MEAT			SOUR CREAM		ICE CREAM
% volume chg vs yago	’23-’24	-7.3%	1.9%	1.2%	1.9%	-0.3%	1.0%
	’24-’25	1.3%	1.0%	0.5%	0.0%	-0.5%	-2.4%

Source: Circana MULO+ with convenience. Note: Butter includes butter blends, Ice Cream includes sherbet, Yogurt is dairy yogurt, Creams include half & half, reg/lt cream & dairy creamers, Cheese excludes imitation/vegan

DMI DAIRY MANAGEMENT INC.

Because of this Growth… +$12B Investment



DAIRY MANAGEMENT INC.



SCIENCE, TECHNOLOGY AND INNOVATION

DMI DAIRY MANAGEMENT INC.


B
A

Innovation Plan Outcomes

MORE



Incremental Sales

MORE



Commercialized Science

MORE



Outside Investment

MORE



Dairy Talent and R&D

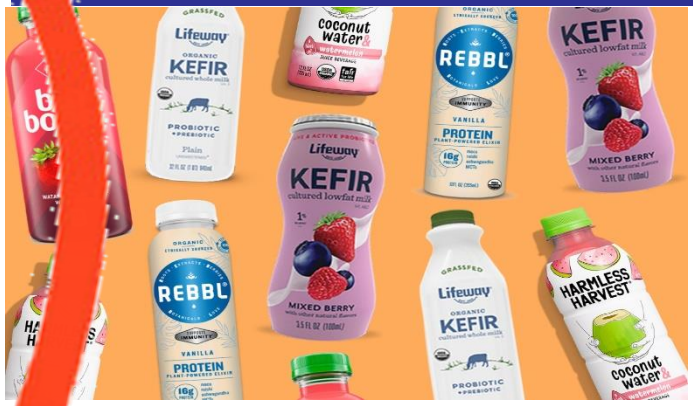
Unlocking Growth Platforms

Health & Wellness



$350B

Beverages



$100B

Food Service

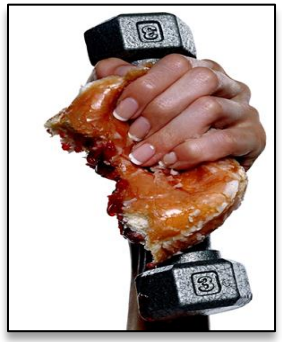
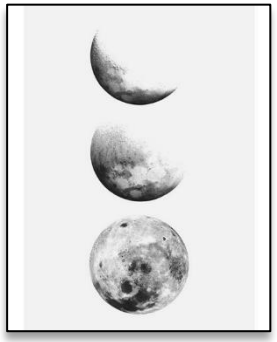


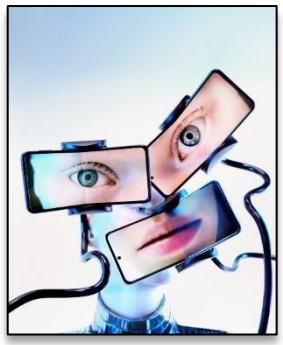
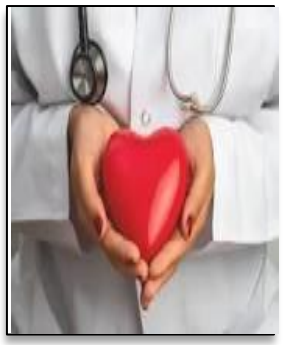
$240B

DMI DAIRY MANAGEMENT INC.

Identifying Top Health & Wellness Growth

Growth Potential Totaling $350B

ENERGY	PHYSICAL PERFORMANCE	SKIN HEALTH	MENTAL/ EMOTIONAL H&W	SLEEP	WEIGHT MANAGEMENT	BONE HEALTH
						
2028 Market Size $11B	$45B	$44B	$9B	$5B	$44B	$46B

ORAL HEALTH	VISION	HEART HEALTH	HAIR & NAIL HEALTH	DIGESTIVE HEALTH	HYDRATION	IMMUNITY
						
$12B	$2B	$23B	$15B	$30B	$49B	$6B

DMI DAIRY MANAGEMENT INC.

H&W Condition Size Including F&B and Non-F&B Projected for CY 2028 ($B)

Driving Growth Now & in the Future

Three Core Focus Areas will Deliver Impact

Unlock New Growth Platforms



Validate Disruptive Nutrition Science



Prove New Product Technology



Nutrition Research



Disruptive Nutrition Science

Broadening Dairy's Benefits



Dairy Science Efforts

Unlocking New Benefits to Power Consumer Wellness

Now



FIRST 1000 DAYS



BONE HEALTH



PERFORMANCE



GUT HEALTH

Future



CARDIO METABOLIC HEALTH



BETTER SLEEP



WEIGHT MANAGEMENT



COGNITION & STRESS

Driving Science Now

New Study Shows Butter Benefits vs Margarine/Oils

BUTTER > 1 teaspoon /day



- **Less** insulin resistance
- **Higher levels** of "good cholesterol (**HDL**)
- **Lower** triglycerides
- **Lower** risk of developing T2D

MARGARINE > 1.5 teaspoon /day



- **29% higher risk** of heart disease
- **41% higher risk** of T2D diabetes

NON-HYDROGENATED OILS



- **Higher** body weight
- **Higher levels** of "bad" cholesterol (**LDL**) by about 8 point

Driving Science Now: Arming the Industry with Science-Backed Messages

57 science-based messages



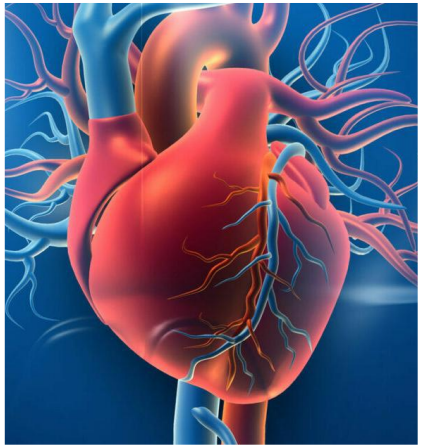
First 1000 Days:

Your baby's **brain doubles** in size in the first year! Cheese and yogurt are nutrient powerhouses providing **essential vitamins and minerals** for early **brain development**.



Grow and Perform:

Milk, cheese or yogurt's **high-quality protein** contains the essential **amino acids** needed for boosting **recovery** and **muscle growth** post-workout.



Health Heart and Weight:

Reducing your risk of heart disease is key to **long-term health**. Delicious milk, cheese and yogurt as part of a balanced diet, are **linked to a lower risk** of hypertension and cardiovascular disease.



Systems Super Charge:

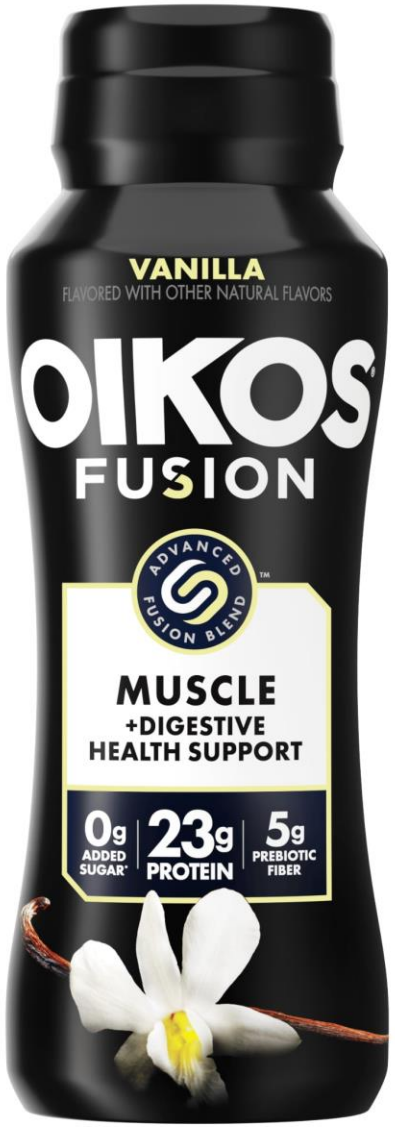
The **best defense is a good offense**. The **nutrients** in milk, cheese and yogurt help **support your immune system** and are **powerhouse** fuel for your overall wellness.

Taking Nutrition Research to Market: GLP Products

DANONE









DMI DAIRY MANAGEMENT INC.

DMI and Mayo Clinic- 3 Shared Pillars of Work



Scientific Research

+



Education & Outreach

+



Targeted Nutrition Technology Solutions

DMI DAIRY MANAGEMENT INC.


MAYO CLINIC

Education & Outreach

Over 44 Program Events to Demonstrate Protective Power of Dairy Foods to Health Professionals and Consumers



Mayo Clinic
Culinary Medicine
Selective



CV Podcast Series w/
Dr. Kyla Lara-
Breitinger, Tara
Schmidt & Jen Welper



NDC Webinar on
Culinary Nutrition for CVD
For Mayo Clinic
RDN Staff



NDC Webinar on
Dairy and CVD
for Mayo Clinic
RDN staff



Latin American Congress on
Dairy Nutrition



Pediatric Unit
MyPlate
Education





First 1,000 Days
Video Series

Nutrition News Update
Mayo Clinic Diet RD Tara
Schmidt and Katie Brown
Presentation on
Women's Wellness

Launching Now:
Mayo Clinic Press
Nutrition & Weight
Knowledge Hub
(4 articles, 5 videos, podcasts)

Product Science & Technology



Product Research & Development Essential to Yield Dairy Growth



Build & Develop R&D Talent



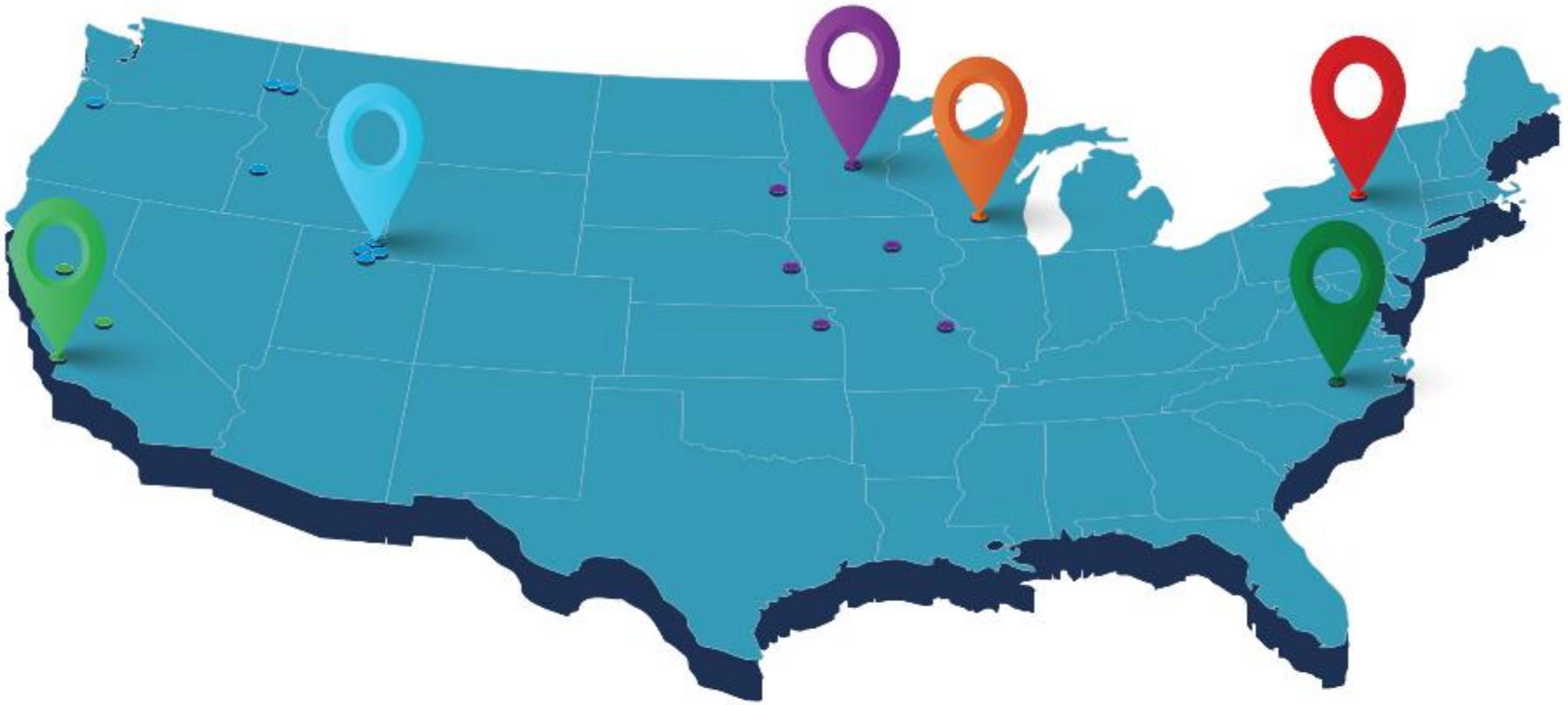
Leverage Technology to Unlock Growth Products and Address Industry Challenges



Enable & Accelerate Product Development & Commercialization

National Dairy Foods Research Centers

A network coordinated by DMI celebrating 35 years of partnership



CALIFORNIA DAIRY INNOVATION CENTER

WESTERN DAIRY CENTER

MIDWEST DAIRY CENTER

CENTER FOR DAIRY RESEARCH

NORTHEAST DAIRY FOODS RESEARCH CENTER

SOUTHEAST DAIRY FOODS RESEARCH CENTER

Six Centers

20+ Universities

140+ Experts

Four Innovation Labs

DMI Product Research and Development Website

Public Research



Public Research-Funding Opportunities

The goal of our public research program is to create scientific knowledge that results in the development of innovative dairy products and ingredients.

READ MORE >



Public Research: Active Projects

Discover breakthrough science supporting dairy foods' safety, quality, and innovation.

READ MORE >

Innovation Acceleration



Dairy Research Centers and Innovation Labs

Our research program works in partnership with the world-renowned National Dairy Foods Research Centers to provide a comprehensive array of resources for your innovation needs.

READ MORE >



Tools to Innovate

Discover an easy-to-use tool to help guide your next dairy innovation project, from key steps to assets that help bring ideas to life.

READ MORE >

Student Competition



New Product Competition

The Dairy Management Inc. New Product Competition is open to U.S. undergraduate and graduate students who develop and innovative with dairy to create new products.

READ MORE >

R&D Leading Discovery of Milk's Tree of Life

Family Tree of Bioactives and Benefits to Deliver Growth in Products

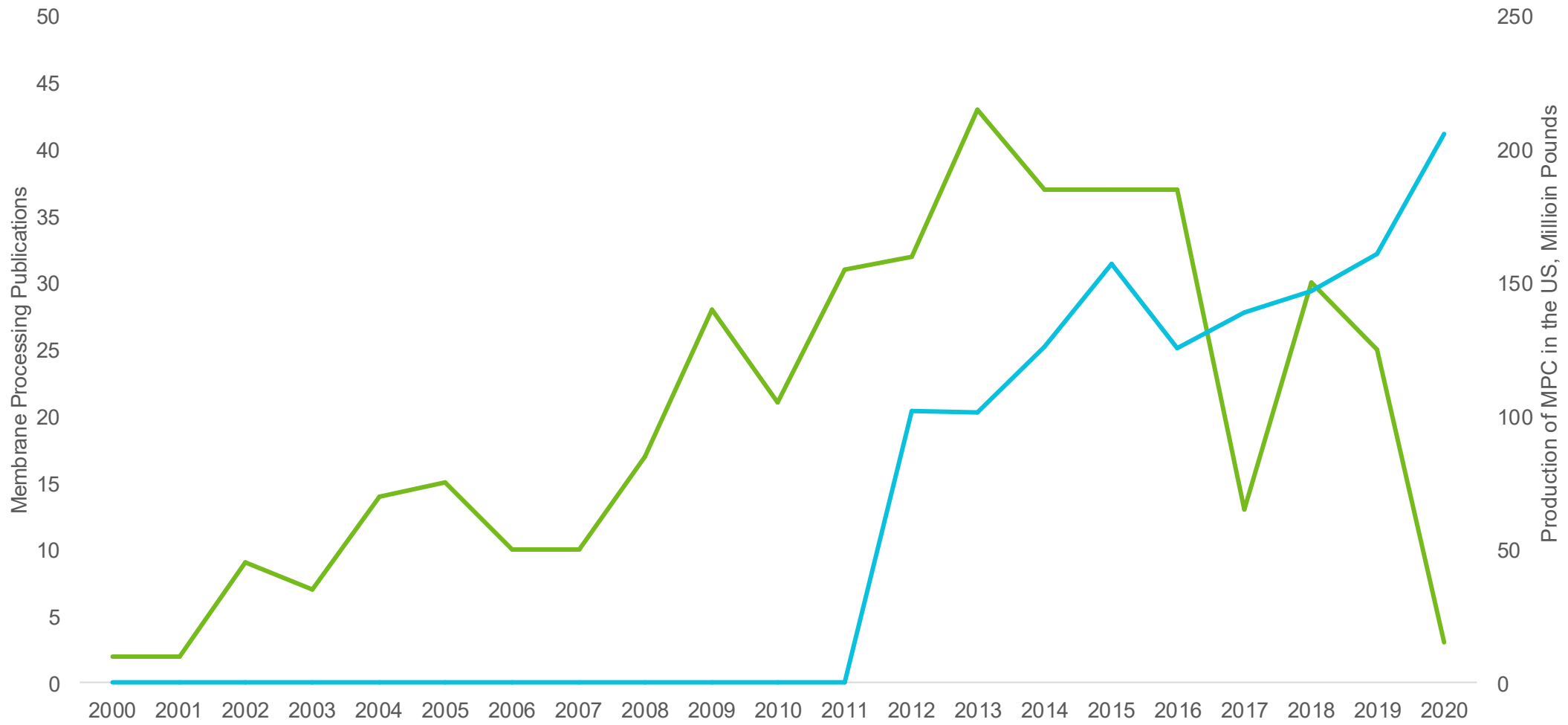




DMI DAIRY MANAGEMENT INC.

MPC Protein Case Study

Research Evidence & Publications Lead to Growth in US MPC



DMI DAIRY MANAGEMENT INC.

Protein R&D Leadership and Impacts











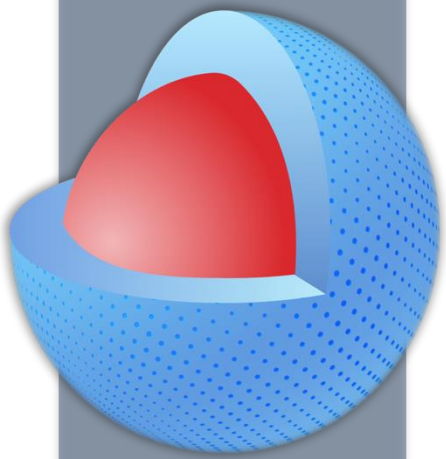




R&D Leading Technology

To Deliver Future Growth Using Magic of Milk Molecules

Lactoferrin Encapsulation



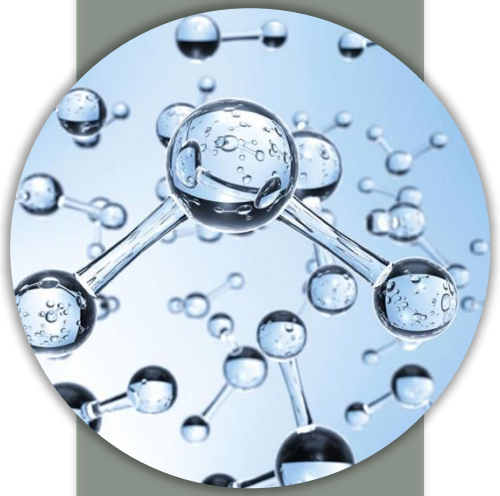
Immunity $6B

Filtration & Drying Milk Fat Globule Membrane



Cognition $9B

Fermentation Bioactive Peptides



Healthy Heart $23B

High Growth Platforms via Partners & Industry



DMI DAIRY MANAGEMENT INC.

Prioritized Growth Platforms

1. **Foodservice Beverages**



2. **Foodservice Cheese & Ingredients**



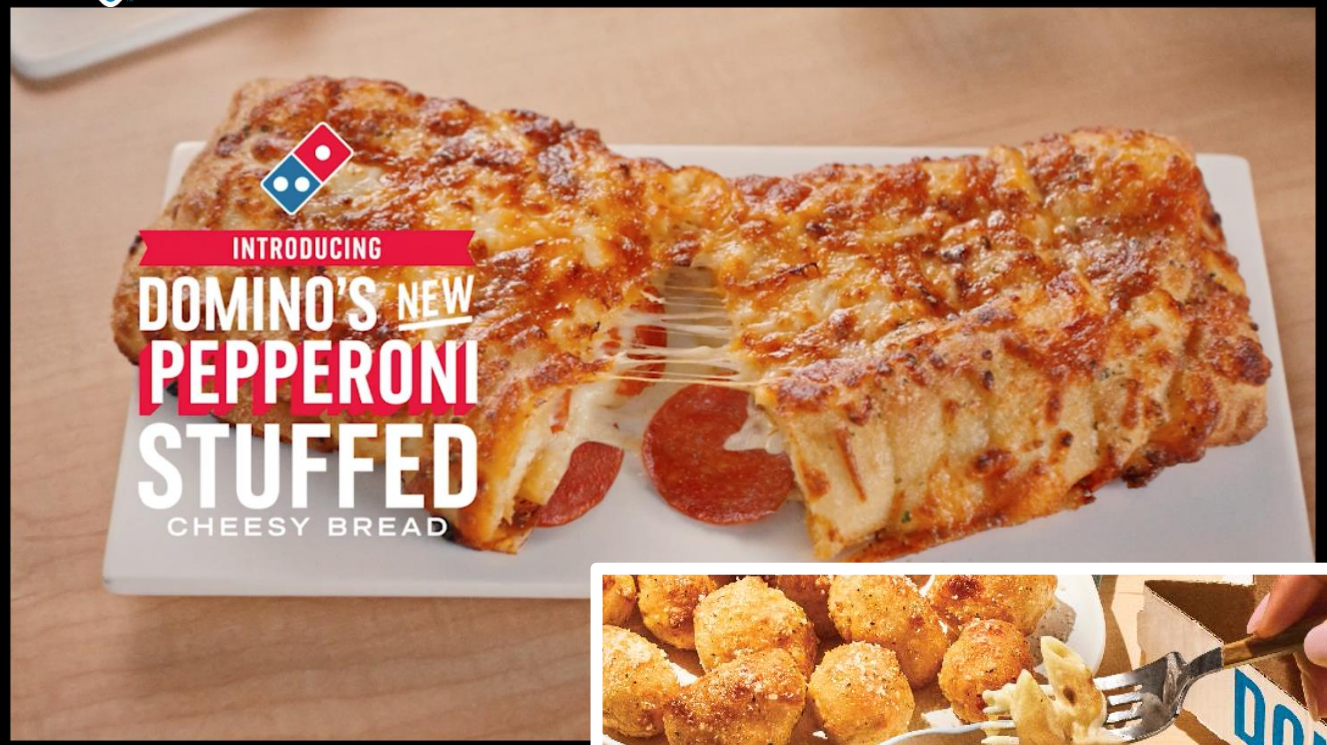
3. **Retail Cultured**



4. **Retail Beverages**



Domino's


INTRODUCING
DOMINO'S NEW
PEPPERONI
STUFFED
CHEESY BREAD


INTRODUCING
DOMINO'S
NEW YORK
STYLE PIZZA


DOMINO'S
100% Grated Parmesan Cheese
NEW 5-CHEESE MAC & CHEESE


INTRODUCING
• DOMINO'S® FIRST-EVER •
STUFFED
CRUST
PARMESAN STUFFED CRUST
GOLDEN AND PERFECTLY BAKED
WITH MELTY CHEESE IN EVERY BITE

McDonald's




McFlurry
McFlurry


McCafé




Happy National Cheeseburger Day
Get a free Double Cheeseburger with $1 minimum purchase*, today only.
As voted by fans, here's ur winner—on us.
Get the Deal
Maybe Later




Toasted Vanilla Frappé
Strawberry Watermelon Refresher
Sprite® Lunar Splash
Popping Tropic Refresher
Creamy Vanilla Cold Brew



McDonald's turning around, vol +7% Q4

BIG ARCH™

April 2026, 3 slices of cheese



McD's assessing positive October '25 test market to determine mid-2026 beverage platform launch



Taco Bell


LIMITED TIME
QUESOCRISP TACO™
CRISPY SHELL MADE OF 100% CHEDDAR CHEESE


NEW
CHEESY DIPPING BURRITOS
Steak with Nacho Cheese Sauce
$9.99 0000-000 cal
Seasoned Beef with Nacho Cheese Sauce
$9.99 0000-000 cal
Slow-Roasted Chicken with Nacho Cheese Sauce
$9.99 0000-000 cal
LOADED WITH STEAK, SLOW-ROASTED CHICKEN, OR SEASONED BEEF
SWAP NACHO CHEESE SAUCE FOR
SOUR CREAM OR CREAMY CHIPOTLE


NEW
CHURRO CHILLERS
SWEET AND CREAMY WITH A CHURRO CRUNCH
SWEET VANILLA
DULCE DE LECHE COFFEE
MEXICAN CHOCOLATE
WILD STRAWBERRY


NEW
STEAK & QUESO CRUNCHWRAP SLIDERS™
COMES WITH 2
NEW GREEN CHILE QUESO SAUCE
Set of 2 Steak & Queso Crunchwrap Sliders™
Served with Green Chile Queso Sauce
460 Cal
For a limited time only, while supplies last. Prices exclude tax.


LIVE MÁS CAFÉ

Driving the Future Now

Foodservice Beverages



Dirty Sodas



Specialty Coffee



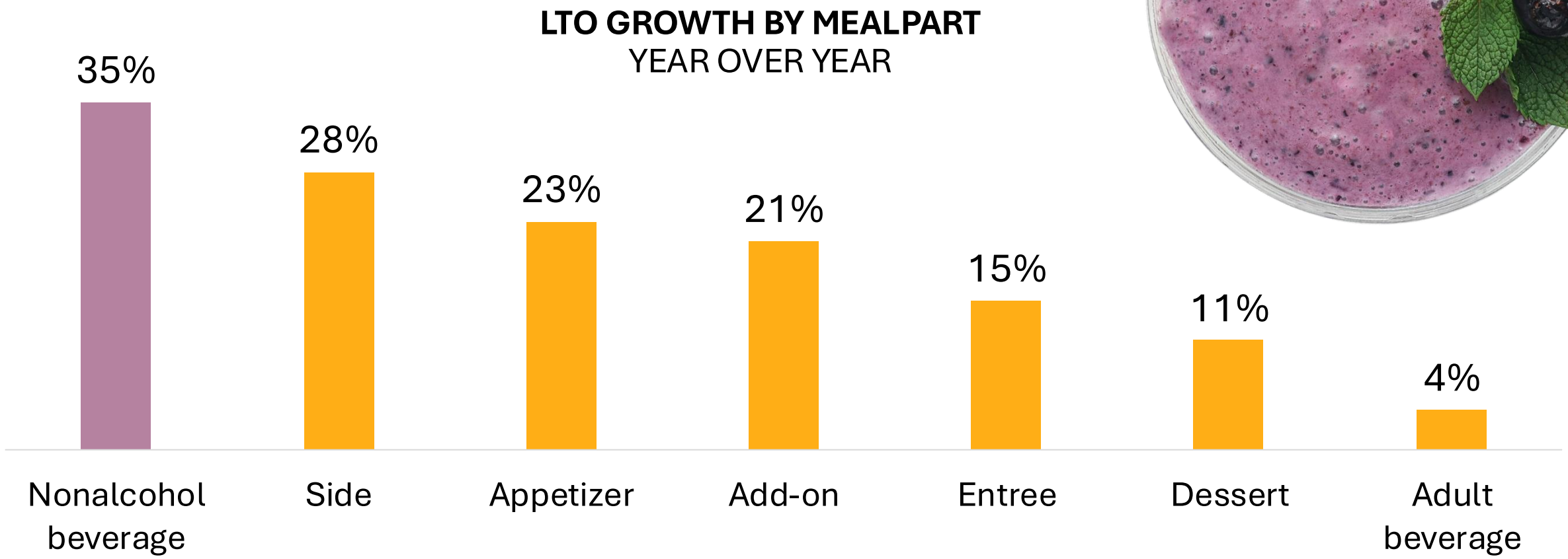
Refreshers



Functional Beverages

Beverages are the Innovation Playground





Swig: In-Market Example of Dirty Soda Margins



16-ounce, regular soda

$1.75

+ Flavoring
+ Cream



16 ounce, “Dirty Little Secret”
Dr Pepper + Coconut syrup + Pineapple flavor + Vanilla Cream
$3.25

Price difference =
$1.50

Assuming minimal product cost (less than 25 cents)

Resulting in higher ring, increased margin, and differentiation

DMI DAIRY MANAGEMENT INC.

Driving the Future Now

Foodservice Brand Engagement













































DMI DAIRY MANAGEMENT INC.

What's New in Market

DMI Helps to Accelerate Dunkin's Protein Beverage Launch by ~18 Months



4 new beverage in 2026 at Taco Bell



DMI DAIRY MANAGEMENT INC.

What's New in Market



Peet's Coffee

Peet's Coffee, a JDE Peet's subsidiary, added a line of protein smoothies to its Vitality menu. The smoothies feature banana puree and whey protein, in such varieties as cold brew (16 grams of protein), matcha peach (19 grams of protein) and strawberry (18 grams of protein).

Peet's also has partnered with Táche, a pistachio milk manufacturer, to debut two pistachio-based beverages. The collaboration includes the pistachio rose latte and the pistachio matcha latte.



Chick-fil-A

Chick-fil-A is expanding its beverage platform with two permanent additions. The company's frosted sodas blend Chick-fil-A's icedream dessert with the soda of a customer's choice, while floats layer the icedream dessert and soda.

What's New in Market

"(Beverage) customization alone is a billion-dollar business, unlocking incremental value and driving higher attach," she said. "Cold foam is now one of our largest modifiers and represents one-third of our $1 billion customization business. And customers can now make 90% of their drinks a protein drink with an upsell to protein milk or protein cold foam."



Starbucks' introduction of protein lattes and protein cold foam in Sept. 2025 has been a great incremental driver.



Jack in the Box launching matcha beverages nationwide, as part of a "more beverage-forward approach to innovation" focused on evolving with consumer tastes and where trends are headed, especially with younger Millennials and Gen Z.

Driving the Future Now

Retail Brand Engagement









































What's New in Market







What's New in Market







Retail Yogurt

Lactalis Innovation















DMI DAIRY MANAGEMENT INC.

Inspiring Growth in Butter Concepts















Driving the Future Now

Retail Cultured



Muscle & Gut Health

Spoonable Yogurt with Fiber



Overnight Recovery

Greek Yogurt Shot with Collagen, Creatine & Calcium



Bone

Crispy Cottage Cheese Chips with Protein & Calcium



Sleep Quality

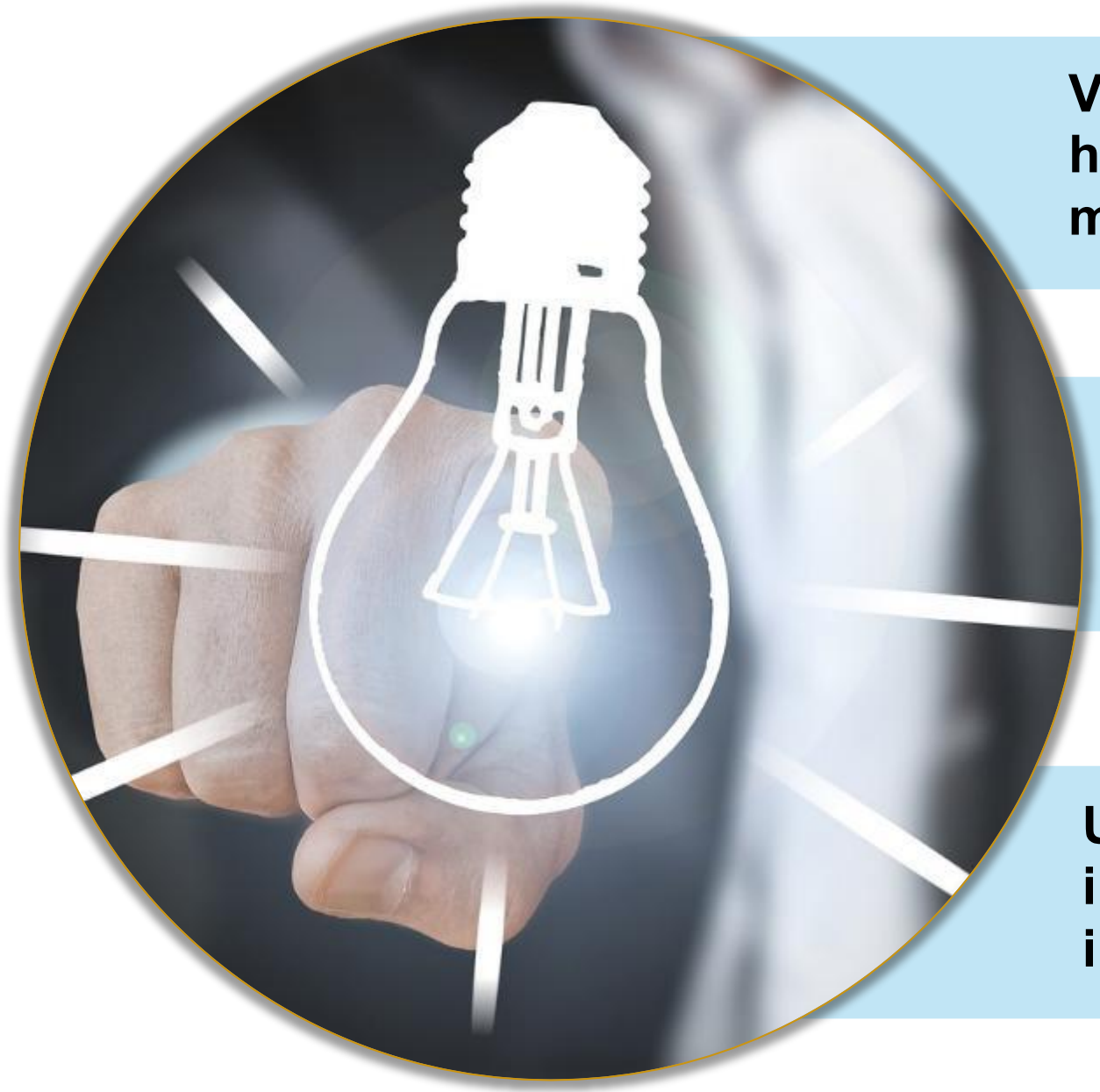
Spoonable Yogurt with Tryptophan & Magnesium

Inspiring the Future of Dairy at Retail via Disruptive Formats

Milk & Cream	Yogurt & Yogurt Drinks	Cheese	RTD	Cottage Cheese	Other Formats
					

DMI DAIRY MANAGEMENT INC.

Key Takeaways



Validating disruptive nutrition science for health benefits and to unleash new marketing claims and messaging

Proving technology to create value-added products for domestic and export markets and retail and foodservice channels

Unlocking new growth platforms for industry will result in bigger growth impact in Foodservice and Retail

High Plains Dairy Conference

Amarillo, Texas

March 4, 2026

Charlie Garrison

THE GARRISON GROUP

Ag Labor Reform

- A “Must Have” for the U.S. dairy industry
- Helps keep food affordable for Americans
- Provides labor certainty for producers, workers
- Federal legislation is required

THE GARRISON GROUP

Ag Labor Reform

- Some History
  - 1986 Legalization
  - Late 1990's 3- and 10-year bars
  - 2002 "AgJOBS"
  - 2013 S 744 "Gang of 8" Bill
  - 2017 "Goodlatte Bill"
  - 2019 "Farm Workforce Modernization Act"

THE GARRISON GROUP

Ag Labor Reform

- 1986 Legalization
  - Green Cards for undocumented immigrants
    - Many left ag for a better-paying job
  - Temporary worker program for seasonal agriculture
    - H-2A
  - Program for nonseasonal agriculture was to follow
    - Still waiting after 40 years

THE GARRISON GROUP

Ag Labor Reform

- 3- and 10-year Bars on Admission
  - Entering the country without inspection is a civil violation
    - 3-year bar on readmission
  - Entering more than once and/or staying longer than one year makes it a felony
    - 10-year bar on readmission
- A major hurdle for U.S. dairy workers

THE GARRISON GROUP

Ag Labor Reform

- AgJOBS Bill
  - A “Blue Card” for agricultural workers
  - ‘Disaggregation’ of jobs for worker visas
    - Changed the pay structure
    - More complicated visa program

THE GARRISON GROUP

Ag Labor Reform

- S 744 “Gang of 8” U.S. Senate Bill
  - Comprehensive
  - Passed the Senate with 68 bipartisan votes
  - Agriculture provisions negotiated between employers and the UFW
    - Passed committee, floor with no Ag changes
  - House Speaker declined to take up the Senate bill

THE GARRISON GROUP

Ag Labor Reform

- The “Goodlatte Bill”
  - Named for then-chairman of House Judiciary Committee
  - Included a waiver of the bar on admissibility
    - Only for worker entering H-2A
    - Included a departure requirement to qualify
    - Did not include immediate family

THE GARRISON GROUP

Ag Labor Reform

- Farm Workforce Modernization Act
  - Has passed the House twice
  - Bipartisan negotiations from the start
  - Democrats, Republicans
  - Ag employers, the UFW

  - Title I: The current workforce
  - Title 2: H-2A Improvements
  - Title 3: Mandatory E-Verify

THE GARRISON GROUP

Ag Labor Reform

- Farm Workforce Modernization Act
  - Title I: The current workforce
    - Adjustment of status for vetted current workers
    - "Certified Agricultural Worker" (CAW)
      - Future work requirement in Ag
    - Green Card eligibility timing based on length of previous work in agriculture
    - Includes immediate family

THE GARRISON GROUP

Ag Labor Reform

- Farm Workforce Modernization Act
  - Title 2: H-2A Improvements
  - Streamlined application, processing
  - Wage freeze and study
    - Would have codified the AEWR
    - Disaggregated wages
  - Two programs
    - Seasonal – no cap
    - Non-seasonal: cap that could adjust

THE GARRISON GROUP

Ag Labor Reform

- Farm Workforce Modernization Act
  - Title 3: Mandatory E-Verify
    - No requirement for Ag until Congress provides a program for legal workers
    - Persuasive talking point with some in Congress
      - Shuts off the “jobs magnet”

THE GARRISON GROUP

Ag Labor Reform

- Farm Workforce Modernization Act
  - Passed the House twice (2019, 2021)
    - Democrats had the majority
    - Bill needed to reflect that
  - Did not move in the Senate
    - 60 votes required to pass
    - Changes to get there didn’t happen

THE GARRISON GROUP

Ag Labor Reform

- Where are we now?
- Needs for dairy haven't changed:
  - Current workforce
    - Adjustment of status
      - Non-disruptive process
      - Include immediate family
  - Access to legal workers in the future
    - Nonseasonal work included

THE GARRISON GROUP

Ag Labor Reform

- The current workforce
  - Trained, experienced
  - Came to the U.S. for the economic opportunity
  - Many here for a decade or more
  - Many with immediate family residing with them
  - Many with citizen spouses, children
  - DACA?
  - Workers now afraid to go to the grocery store, church

THE GARRISON GROUP

Ag Labor Reform

- H-2A Improvements
  - Remove seasonal job requirement
  - Increase the 10-month work limit
  - Simplify application process
  - Make wage structure competitive
  - No new employer liabilities
  - No cap on visa numbers

THE GARRISON GROUP

Ag Labor Reform

- Mandatory E-Verify
  - Is interior enforcement, not border security
  - For new hires only
  - Cannot happen until current workers can adjust legal status
  - Will prevent same situation in 10 years
  - Valuable selling point in Congress

THE GARRISON GROUP

Ag Labor Reform

- Food Processing
  - Doesn't fit the definition of agriculture
  - Involves more unions in negotiations
  - Dependent on immigrant labor
  - Year-round work
  - Many current workers are recent immigrants
    - Result of Biden Executive Orders
  - DHS wants them to self-deport now

THE GARRISON GROUP

Ag Labor Reform

- Where Are We Now?
- Several bills in Congress
  - FWMA reintroduced with few changes
  - "DIGNITY" Act
    - Comprehensive
    - Current workers only (deferring on H-2A)
  - H-2A bill
    - Caps program at 400k visas
    - H-2A workers in a union would not count against the cap

THE GARRISON GROUP

Ag Labor Reform

- House Agriculture Committee Bill
- Still being drafted
- Based on Committee Working Group on Ag Labor (2024)
  - Bipartisan
  - Mostly H-2A program reforms
  - Judiciary Committee has jurisdiction

THE GARRISON GROUP

Ag Labor Reform

- House Agriculture Committee Bill
  - Remove the seasonal requirement for the job
  - Define period of admission for the employee
  - Define “temporary” as up to 11½ months
  - Worker can stay for up to three years

THE GARRISON GROUP

Ag Labor Reform

- House Agriculture Committee Bill
  - Removes requirement that eligible work is defined as “on a farm by a farmer”
    - Cooperatives would now qualify for H-2A
  - Codifies wage methodology in Trump Administration Interim Final Rule
    - Would no longer rely on USDA Farm Labor Survey for wage data

THE GARRISON GROUP

Ag Labor Reform

- House Agriculture Committee Bill
  - A waiver of the 3- and 10-year bars on admission for Ag workers
    - The ballgame for dairy
  - How will it work?
    - Put existing workers into H-2A
      - Agencies already pressed by program growth
    - Departure requirement?

THE GARRISON GROUP

Ag Labor Reform

- House Agriculture Committee Bill
  - Working Group recommendations were bipartisan – will that still be the case?
  - Judiciary Committee has jurisdiction over immigration issues
  - Will Speaker Johnson want a bill to proceed?
  - How much bipartisan support in the full House?
  - And then there's the Senate

THE GARRISON GROUP

Ag Labor Reform

- The Politics of Immigration Reform
  - Republicans have the majority now in Senate, House
    - Republican divisions on immigration
    - Outcome of November midterms?
    - Both parties see immigration as a winning issue
    - Anti-immigration groups
  - What would the President sign?

THE GARRISON GROUP

Ag Labor Reform

- The Politics of Immigration Reform
  - Potential for Executive Orders
    - Definition of “temporary”
    - Definition of “work”
    - Wage structure
    - Transportation costs
    - Housing inspections
    - DACA was an EO

THE GARRISON GROUP

High Plains Dairy Conference March 4, 2026

cgarrison@garrisongroup.com

THE GARRISON GROUP

Dairy Labor Panel:

From Hiring to High Performance. What works in dairy workforce training?

A panel moderated by Ryan DeWit, Twin Circle Dairy

High Plains Dairy Conference:
20 years providing science and information to dairy producers of the High Plains

HIGH PLAINS
DAIRY CONFERENCE

Jorge Delgado
Alltech People +
Training and Talent Development for Dairy Workers



High Plains Dairy Conference:
20 years providing science and information to dairy producers of the High Plains

3 Teaching pillars

- **Relevancy: why**
- **No anonymity: participation**
- **Measurement: understanding**

1 •Relevancy: wh-y-o

Why do you do what you do?

Familia



Alltech®

Picture courtesy of Jorge Delgado



2 No anonymity: participation

Mark 6:34,37

Understanding






ESTE MAT
8586

Alltech®
Benton Dairy
Rutina de Ordeño
Powered by Knowby


ESTE MATERIAL SE BASA EN EL TRABAJO RESPALDADO POR USDA / NIFA BAJO EL NÚMERO DE PREMIO 2018-70027-28586
USDA National Institute of Food and Agriculture
U.S. DEPARTMENT OF AGRICULTURE
EXTENSION
Alltech

Alltech
ON-FARM SUPPORT

Recolección y prepar
para cultivo

Notas para evitar la recontaminación de la punta de las tetas, limpie primero las tetas del lado más lejano de la ubre y luego las tetas en el lado cercano de la ubre. Muestree lo más rápidamente posible, comenzando con las tetas en el lado cercano de la ubre seguidas por las tetas en el lado lejano de la ubre.

Problemas comunes encontrados durante la recolección y el transporte al laboratorio:

1. Las ubres y tetas no se limpian adecuadamente
2. Los números de identificación en los contenedores no son legibles o han sido borrados
3. Orientación numérica (por ejemplo, 18 o 81)
4. Formularios no debidamente rellenados
5. Muestras no transportadas al laboratorio en 24 horas.
6. Muestras no refrigeradas durante el transporte.
7. Envases de muestra rotos o con fugas durante el transporte.

BIOPLEX®
Minerales para fertili

Alltech
SOPORTE ON-FARM

Suministros necesarios:
- Frascos de recolección estéri
- plástico desechables
- Guantes de nitrilo o de látex
- Gasas o bolas de algodón empapadas en alcohol
- Un nevera portátil pequeñ enfriar las muestras después recolección
- Un marcador permanente

5

Durante 20 segundos, fro cuidadosamente y vigorosame extremo del pezón con una bo algodón o una gasa humedecida 80% de alcohol etílico o isopropí una gasa separada para cada teta cada extremo de la teta hasta qu este completamente limpia y s

Mueva las Vacas

Mueva las vacas de manera tranquila y calmada. Si maltrata, asusta o apura a las vacas, el proceso de liberación de leche puede verse alterado.
¡Busque y reporte vacas enfermas!

Manos li
transfe
mastitis
para min

Limpie y Seq

Con movimientos circular descendentes, remueva suaver tierra y el desinfectante. De vue toalla y limpie la punta de las

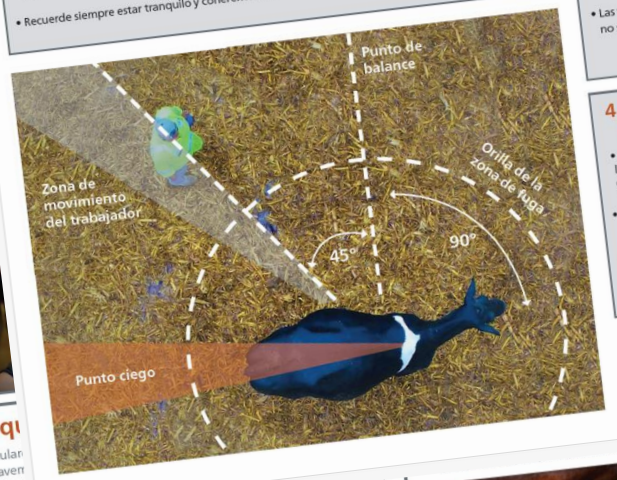
Aprende más hoy en Alltech.com/on-farm-support

Alltech
SOPORTE ON-FARM

5 Reglas Simples para Mov

1. Conozca la Zona de Fuga

- Las vacas son animales de presa y reaccionan cuando especies potencialmente depredadoras se acercan a ellas. Entender cómo ellas reaccionan cuando se les acercan puede ayudar a crear una manera libre de estrés para mover vacas desde los corrales a la sala de ordeño.
- Recuerde siempre estar tranquilo y coherente al acercarse y mover las vacas.



2. Vigile su Paso

- Siempre mueva las vacas al ritmo de ellas. Un indicativo de esto es cuando la vaca mantiene su cabeza hacia abajo para ver dónde está caminando. Las vacas que caminan con las cabezas levantadas están agitadas.
- Las vacas se mueven en orden de rango y no se adelantan entre sí.

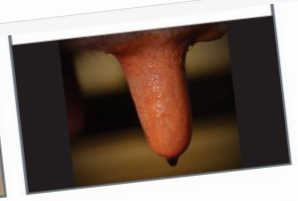
4. Remueva todos los Obstáculos

- Recuerde mantener los corrales de espera y los pasillos limpios y secos. Esto ayuda a evitar resbalones y ayuda a mantener la integridad de los cascos.
- Asegúrese de que no haya obstáculos tales como protuberancias, orificios o crestas que puedan causar lesiones.
- Deje siempre espacio extra para evitar aglomeraciones. Esto permite que las vacas se muevan y se eviten entre ellas si es necesario.

Aprenda más ahora

Alltech.com/on-farm-support
©2018. Alltech, Inc





Alltech.com/on-farm-support AlltechNaturally @Alltech
©2018. Alltech, Inc. All Rights Reserved. US_DA_OnF_po1.2

Alltech
SOPORTE ON-FARM

Alltech
ON-FARM SUPPORT

Etapas del parto


Observaciones


Aislamiento

1. Observaciones

- Se requieren observaciones periódicas para determinar el progreso del parto, y cuándo y cómo proporcionar asistencia o buscar ayuda de un veterinario.
- Siga el progreso del parto en una hoja de registro.
- Asegúrese de que el personal actualice a otros en los cambios de turno.

2. Aislamiento

Un comportamiento variable como el aislamiento ocurrirá en la mayoría de las vacas. Las vacas mostrarán algunos cambios en el comportamiento hasta que comience el proceso del parto: malestar, inquietud, etc.

3. Parto





Etapa 1: Dilatación

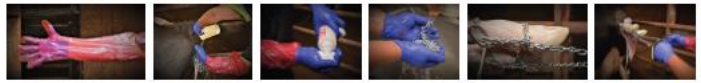
Esta etapa, que dura de 6-8 horas en promedio (puede ser un par de horas más en novillas), comienza con la dilatación y contracciones iniciales del parto. La vaca puede mostrar signos de malestar al patear su vientre y volverse inquieta debido a las contracciones. Algunos signos clínicos en esta etapa son: cola levantada, descarga sanguinolenta, descarga de líquidos. Sólo observe a la vaca y su progreso.

Etapa 2

En esta etapa, que dura de 1-2 horas en promedio para las vacas y de 2-4 horas en promedio para las novillas, el cérvix está completamente dilatado, la vaca tal vez se acuesta, las contracciones aumentarán y las contracciones abdominales son obvias. El inicio de esta etapa comienza cuando el becerro pasa el cérvix y entra en el canal de nacimiento con una bolsa de agua visible en frente del becerro. Esta etapa finaliza con el nacimiento del becerro.

Etapa 3

En esta etapa la placenta o las membranas fetales son eliminadas. Esta etapa dura hasta 24 horas. Si han pasado mas de 24 horas se considera como membranas fetales retenidas (RP).



Si asiste:

- Lave la vulva y el área perineal con jabón desinfectante antes de asistir. Rapita siempre si la vaca defeca.
- Utilice guantes limpios, descartables, de manga larga.
- Determine la presentación, la posición y la postura del feto.
- Corrija la presentación antes de realizar una extracción forzada.
- Utilice abundante lubricante para asistir al parto.
- Utilice cadenas y equipos obstétricos limpios y desinfectados.
- Utilice una colocación apropiada de la cadena con un doble nudo, la cadena en la parte superior de las patas.
- Toda tracción ejercida sobre el becerro debe coincidir con la madre cuando tenga una contracción y cuando empuje.
- Por favor sea paciente.
- Si no hay progreso dentro de ½ hora, llama para pedir ayuda.

Cuándo asistir:

- Si no hay progreso normal en la etapa 2.
- Si el becerro no ha nacido en 65 minutos después de la aparición del saco amniótico o después de que las patas se hayan visto fuera de la vulva.
- Cuando una postura anormal es evidente.
- En presentaciones al revés.



BIOPLEX® SEL-PLEX®
Minerales para fertilidad, salud y rendimiento.

Alltech

Alltech.com/on-farm-support AlltechNaturally @Alltech
© Alltech, Inc. All Rights Reserved. US_DA_OnF_po7.1

Thanks

jdelgado@alltech.com
612-210-0020

Jorge M. Estrada, CEO
Leadership Coaching International, inc

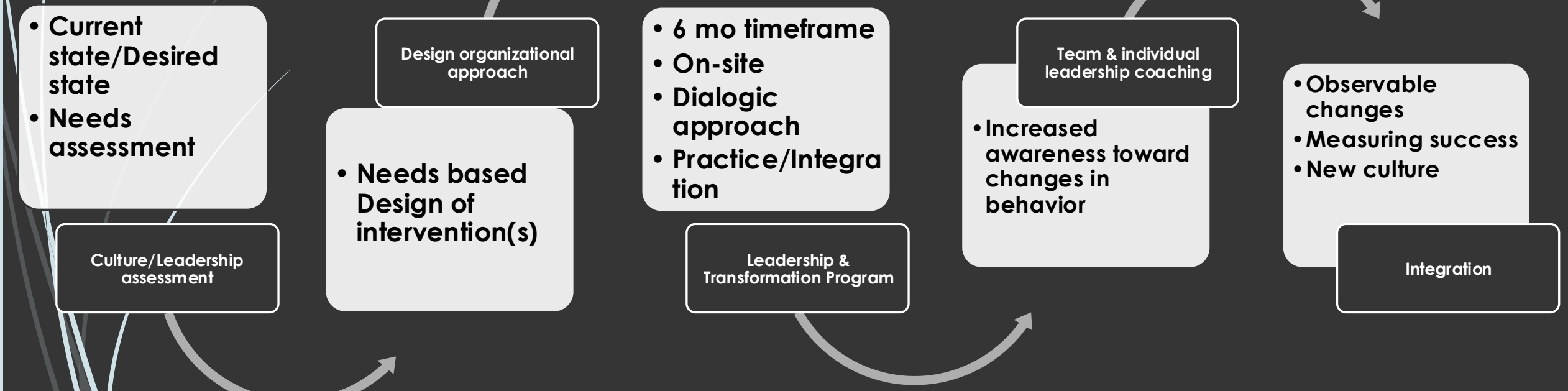


ORGANIZATIONAL DEVELOPMENT FOR DAIRIES:

- **Large systems thinking**
- **Dialogic approach**
- **Organizational design**
- **Group and individual dynamics on dairies**
- **Organizational behavior**
- **Organizational transformation and change**
- **Executive & leadership coaching**

High Plains Dairy Conference:
20 years providing science and information to dairy producers of the High Plains

Organizational Development for Dairies



HIGH PLAINS
DAIRY CONFERENCE

Tom Wall, The Dairy Coach™
PeopleCor



Dairy Labor Panel:

From hiring to high performance – What works in dairy workforce training.

High Plains Dairy Conference:
20 years providing science and information to dairy producers of the High Plains

THE DAIRY COACH COR-4



CLARIFY



COMMUNICATE



CONNECT



RECOGNIZE


RESULTS
HABITS
CLARITY
DISCIPLINE
ACCOUNTABILITY

Questions

High Plains Dairy Conference:
20 years providing science and information to dairy producers of the High Plains

Dairy Labor Panel:

From Hiring to High Performance. What works in dairy workforce training?

A panel moderated by Ryan DeWit, Twin Circle Dairy

High Plains Dairy Conference:
20 years providing science and information to dairy producers of the High Plains

HIGH PLAINS
DAIRY CONFERENCE

Jorge Delgado
Alltech People +
Training and Talent Development for Dairy Workers



High Plains Dairy Conference:
20 years providing science and information to dairy producers of the High Plains

3 Teaching pillars

- **Relevancy: why**
- **No anonymity: participation**
- **Measurement: understanding**

1 •Relevancy: wh-y-o

Why do you do what you do?

Familia



Alltech®

Picture courtesy of Jorge Delgado



2 No anonymity: participation

Mark 6:34,37

Understanding






ESTE MAT
8586

Alltech®
Benton Dairy
Rutina de Ordeño
Powered by Knowby


ESTE MATERIAL SE BASA EN EL TRABAJO RESPALDADO POR USDA / NIFA BAJO EL NÚMERO DE PREMIO 2018-70027-28586
USDA National Institute of Food and Agriculture
U.S. DEPARTMENT OF AGRICULTURE
EXTENSION
Alltech

Alltech
ON-FARM SUPPORT

Recolección y prepar
para cultivo

Notas para evitar la recontaminación de la punta de las tetas, limpie primero las tetas del lado más lejano de la ubre y luego las tetas en el lado cercano de la ubre. Muestree lo más rápidamente posible, comenzando con las tetas en el lado cercano de la ubre seguidas por las tetas en el lado lejano de la ubre.

Problemas comunes encontrados durante la recolección y el transporte al laboratorio:

1. Las ubres y tetas no se limpian adecuadamente
2. Los números de identificación en los contenedores no son legibles o han sido borrados
3. Orientación numérica (por ejemplo, 18 o 81)
4. Formularios no debidamente rellenados
5. Muestras no transportadas al laboratorio en 24 horas.
6. Muestras no refrigeradas durante el transporte.
7. Envases de muestra rotos o con fugas durante el transporte.

BIOPLEX®
Minerales para fertili

Alltech
SOPORTE ON-FARM

Suministros necesarios:
- Frascos de recolección estéri
- plástico desechables
- Guantes de nitrilo o de látex
- Gasas o bolas de algodón empapadas en alcohol
- Un nevera portátil pequeñ enfriar las muestras después recolección
- Un marcador permanente

5

Durante 20 segundos, fro cuidadosamente y vigorosame extremo del pezón con una bo algodón o una gasa humedecida 80% de alcohol etílico o isopropí una gasa separada para cada teta cada extremo de la teta hasta qu este completamente limpia y s

Mueva las Vacas

Mueva las vacas de manera tranquila y calmada. Si maltrata, asusta o apura a las vacas, el proceso de liberación de leche puede verse alterado.
¡Busque y reporte vacas enfermas!

Manos li
transfe
mastitis
para min

Limpie y Seq

Con movimientos circular descendentes, remueva suaver tierra y el desinfectante. De vue toalla y limpie la punta de las

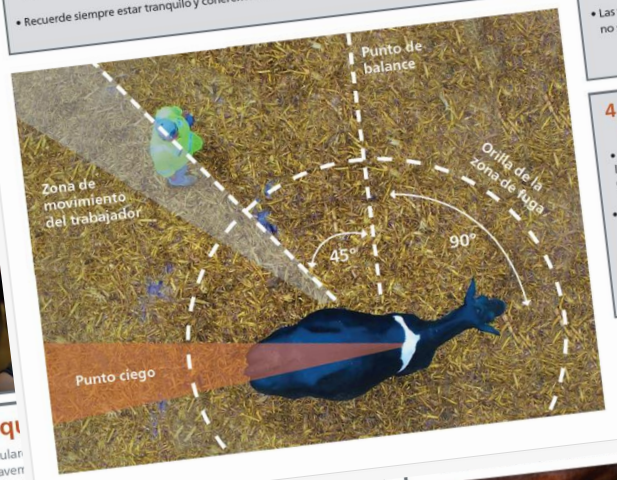
Aprende más hoy en Alltech.com/on-farm-support

Alltech
SOPORTE ON-FARM

5 Reglas Simples para Mov

1. Conozca la Zona de Fuga

- Las vacas son animales de presa y reaccionan cuando especies potencialmente depredadoras se acercan a ellas. Entender cómo ellas reaccionan cuando se les acercan puede ayudar a crear una manera libre de estrés para mover vacas desde los corrales a la sala de ordeño.
- Recuerde siempre estar tranquilo y coherente al acercarse y mover las vacas.



2. Vigile su Paso

- Siempre mueva las vacas al ritmo de ellas. Un indicativo de esto es cuando la vaca mantiene su cabeza hacia abajo para ver dónde está caminando. Las vacas que caminan con las cabezas levantadas están agitadas.
- Las vacas se mueven en orden de rango y no se adelantan entre sí.

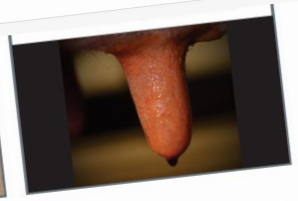
4. Remueva todos los Obstáculos

- Recuerde mantener los corrales de espera y los pasillos limpios y secos. Esto ayuda a evitar resbalones y ayuda a mantener la integridad de los cascos.
- Asegúrese de que no haya obstáculos tales como protuberancias, orificios o crestas que puedan causar lesiones.
- Deje siempre espacio extra para evitar aglomeraciones. Esto permite que las vacas se muevan y se eviten entre ellas si es necesario.

Aprenda más ahora

Alltech.com/on-farm-support
©2018. Alltech, Inc





Alltech.com/on-farm-support AlltechNaturally @Alltech
©2018. Alltech, Inc. All Rights Reserved. US_DA_OnF_po1.2

Alltech
SOPORTE ON-FARM

Alltech
ON-FARM SUPPORT

Etapas del parto


Observaciones


Aislamiento

1. Observaciones

- Se requieren observaciones periódicas para determinar el progreso del parto, y cuándo y cómo proporcionar asistencia o buscar ayuda de un veterinario.
- Siga el progreso del parto en una hoja de registro.
- Asegúrese de que el personal actualice a otros en los cambios de turno.

2. Aislamiento

Un comportamiento variable como el aislamiento ocurrirá en la mayoría de las vacas. Las vacas mostrarán algunos cambios en el comportamiento hasta que comience el proceso del parto: malestar, inquietud, etc.

3. Parto





Etapa 1: Dilatación

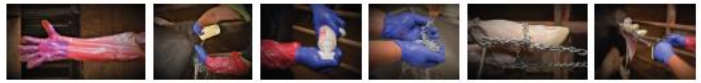
Esta etapa, que dura de 6-8 horas en promedio (puede ser un par de horas más en novillas), comienza con la dilatación y contracciones iniciales del parto. La vaca puede mostrar signos de malestar al patear su vientre y volverse inquieta debido a las contracciones. Algunos signos clínicos en esta etapa son: cola levantada, descarga sanguinolenta, descarga de líquidos. Sólo observe a la vaca y su progreso.

Etapa 2

En esta etapa, que dura de 1-2 horas en promedio para las vacas y de 2-4 horas en promedio para las novillas, el cérvix está completamente dilatado, la vaca tal vez se acuesta, las contracciones aumentarán y las contracciones abdominales son obvias. El inicio de esta etapa comienza cuando el becerro pasa el cérvix y entra en el canal de nacimiento con una bolsa de agua visible en frente del becerro. Esta etapa finaliza con el nacimiento del becerro.

Etapa 3

En esta etapa la placenta o las membranas fetales son eliminadas. Esta etapa dura hasta 24 horas. Si han pasado mas de 24 horas se considera como membranas fetales retenidas (RP).



Si asiste:

- Lave la vulva y el área perineal con jabón desinfectante antes de asistir. Rapita siempre si la vaca defeca.
- Utilice guantes limpios, descartables, de manga larga.
- Determine la presentación, la posición y la postura del feto.
- Corrija la presentación antes de realizar una extracción forzada.
- Utilice abundante lubricante para asistir al parto.
- Utilice cadenas y equipos obstétricos limpios y desinfectados.
- Utilice una colocación apropiada de la cadena con un doble nudo, la cadena en la parte superior de las patas.
- Toda tracción ejercida sobre el becerro debe coincidir con la madre cuando tenga una contracción y cuando empuje.
- Por favor sea paciente.
- Si no hay progreso dentro de ½ hora, llama para pedir ayuda.

Cuándo asistir:

- Si no hay progreso normal en la etapa 2.
- Si el becerro no ha nacido en 65 minutos después de la aparición del saco amniótico o después de que las patas se hayan visto fuera de la vulva.
- Cuando una postura anormal es evidente.
- En presentaciones al revés.



BIOPLEX® SEL-PLEX®
Minerales para fertilidad, salud y rendimiento.

Alltech

Alltech.com/on-farm-support AlltechNaturally @Alltech
© Alltech, Inc. All Rights Reserved. US_DA_OnF_po7.1

Thanks

jdelgado@alltech.com
612-210-0020

Jorge M. Estrada, CEO
Leadership Coaching International, inc

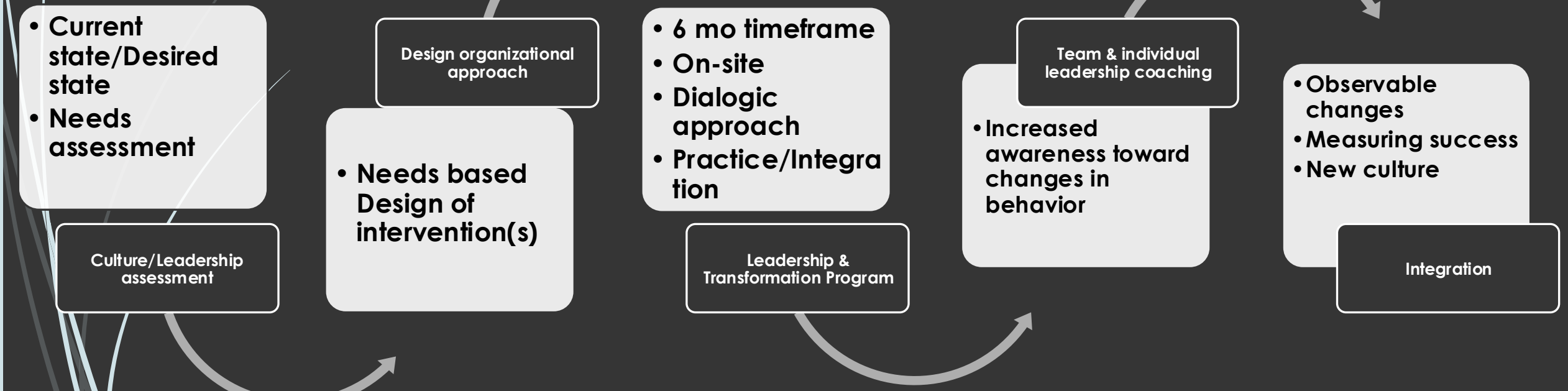


ORGANIZATIONAL DEVELOPMENT FOR DAIRIES:

- **Large systems thinking**
- **Dialogic approach**
- **Organizational design**
- **Group and individual dynamics on dairies**
- **Organizational behavior**
- **Organizational transformation and change**
- **Executive & leadership coaching**

High Plains Dairy Conference:
20 years providing science and information to dairy producers of the High Plains

Organizational Development for Dairies



HIGH PLAINS
DAIRY CONFERENCE

Tom Wall, The Dairy Coach™
PeopleCor



Dairy Labor Panel:

From hiring to high performance – What works in dairy workforce training.

High Plains Dairy Conference:
20 years providing science and information to dairy producers of the High Plains

THE DAIRY COACH COR-4



CLARIFY



COMMUNICATE



CONNECT



RECOGNIZE


RESULTS
HABITS
CLARITY
DISCIPLINE
ACCOUNTABILITY

Questions

High Plains Dairy Conference:
20 years providing science and information to dairy producers of the High Plains



Seeing Is Managing

The Promise and Pitfalls of Camera Technology on Dairies

Jeffrey Bewley, PhD, PAS

Executive Director of Genetic Programs and Innovation

Holstein USA, Inc.

U.S. Registered Holsteins

FOR MAXIMUM PROFIT

HOLSTEIN ASSOCIATION USA, INC.


20 Years of Technology Work
>50 Technologies

Artificial intelligence is revolutionizing the world and the dairy industry




Computer Vision Technology
is advancing rapidly

Computer Vision: Defined

Computer vision is a field of artificial intelligence that trains computers to interpret and understand visual information from images and videos



2D RGB

Standard cameras
Color images



3D Depth

Time of Flight
Body dimensions



Thermal/IR

Heat signatures
Fever detection



Multi-Camera AI

Array systems
360° coverage

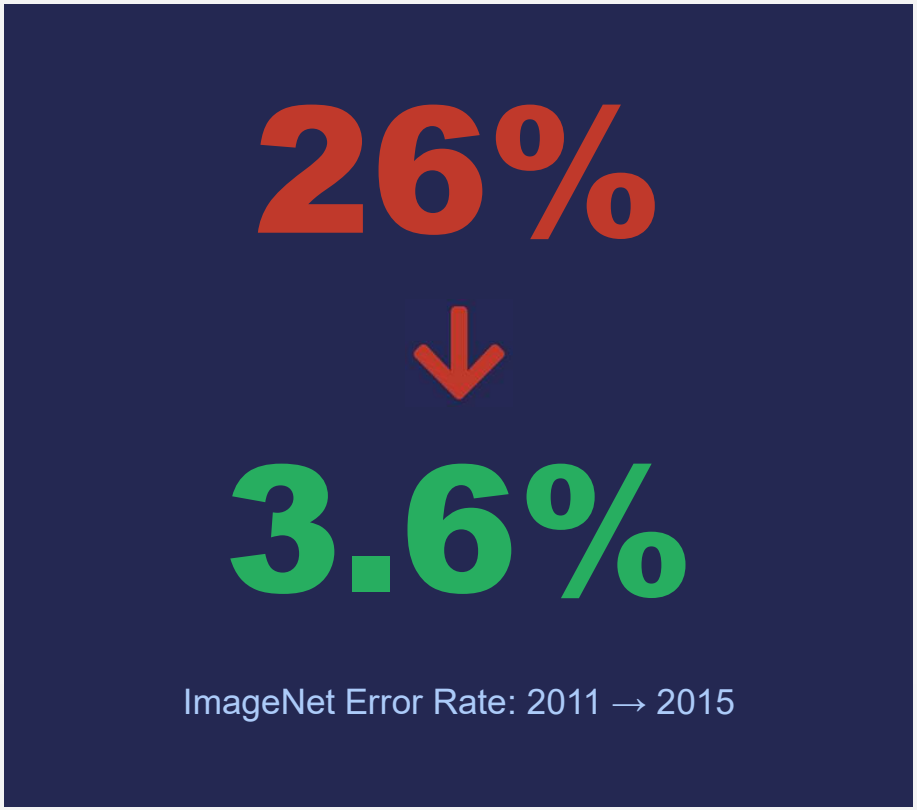
How Computer Vision Works



1	2	3	4	5
Capture	**Preprocess**	**Feature Extraction**	**Classification**	**Action**
Camera records image/video	Clean, resize, normalize	AI identifies patterns	Algorithm makes a decision	Alert sent to farmer/system

This entire pipeline can now run in real-time on inexpensive computers

The Breakthrough Moment: 2012



AlexNet (2012) proved that deep neural networks could see

Within 3 years, AI surpassed human-level accuracy at recognizing objects in photos

This single breakthrough unlocked everything that came after — including cameras on dairies

YOLO: You Only Look Once

Traditional CV

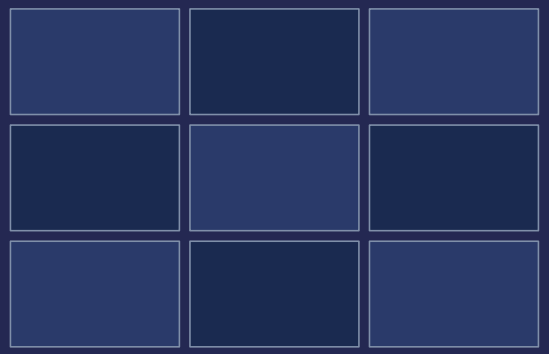
Step 1: Find objects
Step 2: Classify each one
Step 3: Repeat for every box

SLOW

YOLO

One pass: Detect + classify everything at the same time!

FAST

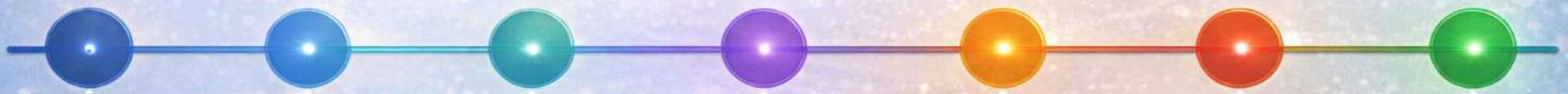


Grid divides image

Why YOLO Matters for Dairies:

- Processes 30+ frames per second
- Runs on affordable edge hardware
- Detects multiple cows simultaneously
- Works in real-time barn conditions

A Decade of Breakthroughs



2012
AlexNet
Deep Learning

2014
VGGNet
Visual Geometry Group Network
Image Recognition

2015
ResNet + YOLO
(You Only Look Once)
Residual Networks + You Only Look Once

2017
Transformers
Scalable Artificial Intelligence

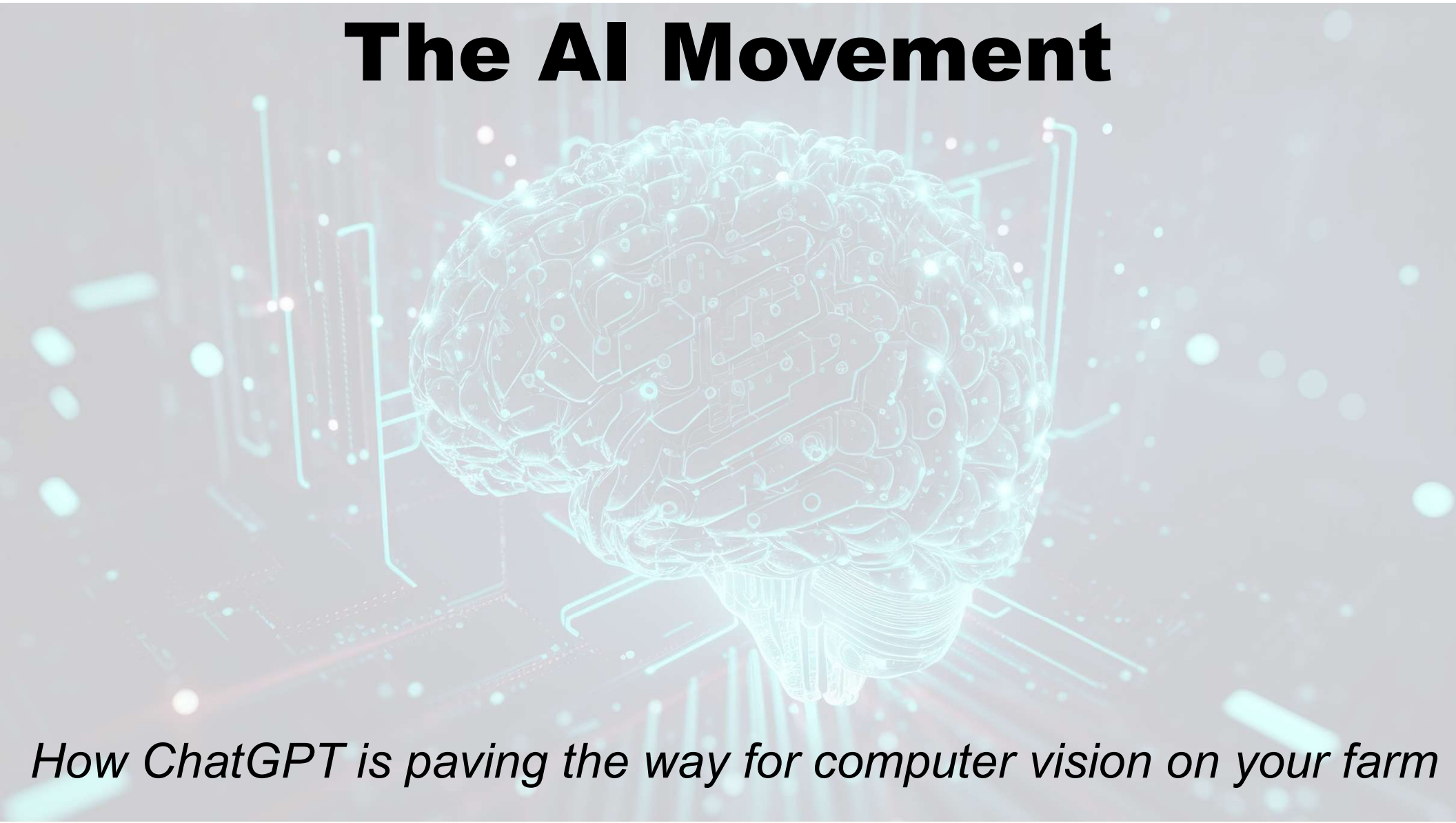
2020
Edge Computing
On-Farm AI Processing

2023
GPT-4 Vision + Segment Anything Model (SAM)
Multimodal Artificial Intelligence

2025
LLM + Computer Vision Fusion (Projected)
Advanced Artificial Intelligence

Each breakthrough made cameras cheaper, faster, and smarter

The AI Movement



How ChatGPT is paving the way for computer vision on your farm

The AI Explosion: ChatGPT By the Numbers

800M

Global users (Dec 2025)

300M

Weekly active users

$200B

Global AI investment 2025

36.7%

Deep learning market

Sources: Fortune Business Insights, Wikipedia, IntuitionLabs 2025

The ChatGPT → Computer Vision Connection

ChatGPT (Language)

- Reads text, predicts next word
- Learns patterns from billions of pages
- Gets smarter with more data
- Went from clunky to amazing in 3 yrs

Computer Vision (Images)

- Reads pixels, predicts what's there
- Learns patterns from millions of images
- Gets smarter with more cow data
- Rapidly improving accuracy each year

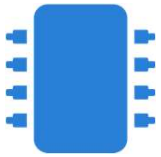
Same Engine, Different Application

The Transformer architecture that powers ChatGPT is the SAME technology now powering the best computer vision systems on farms

Rapid Iteration	GPT-3 → GPT-4 → GPT-5	YOLO v1 → v5 → v11
Accuracy Gains	Struggled with math, now excels	Struggled in barns, now reliable
Cost Reduction	Cost dropped 97% in 2 years	Camera hardware costs halved
Specialization	Custom GPTs for your business	Custom models for your farm

The Tidal Wave Effect

Every dollar invested in ChatGPT-style AI lifts ALL AI — including farm vision



Better Hardware

NVIDIA GPUs built for LLMs also accelerate computer vision. Edge AI chips (Jetson, Coral) got cheaper because of massive AI demand.



Smarter Algorithms

Transformer breakthroughs from language models directly transfer to vision models. GPT-4V proved AI can reason about images.



More Investment

$200B global AI investment in 2025. Venture capital flowing into ag-tech CV startups at record levels.



Talent Pipeline

More AI researchers than ever. Many now applying their skills to agriculture and livestock problems.

ChatGPT's Journey IS Camera Tech's Journey

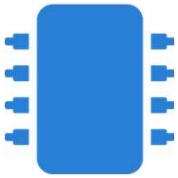
	ChatGPT	Camera Vision on Dairies
Novelty	Dec 2022: "This chatbot is cool!" 1M users in 5 days	2019-2021: "Neat demo" University prototypes only
Useful	2023: Students, writers adopt it 100M users in 60 days	2022-2023: Progressive farms piloting First commercial systems
Essential	2024-2025: 92% of Fortune 500 800M weekly users	2025-2026: Proven ROI on farms Multiple vendor options
Invisible	2026+: Built into every tool You use it without thinking	2028+: Standard equipment Like TMR mixers or AMS

Why Now? The Perfect Storm



AI Got Smart

Deep learning accuracy surpassed humans in object detection



Hardware Got Cheap

Inexpensive edge computers run real-time AI on-farm



Labor Got Scarce

Dairy workforce shortage demands automation solutions



Data Got Valuable

Farm data integration and cloud platforms finally possible


What Cameras
See on Dairies Today
From lameness to behavior — practical applications already in the field

Start Simple: *Using Off-the-Shelf Cameras on Dairies*





Why Start Simple? — *Before AI, **before** automation — just visibility.*

- ***Calving** pen monitoring*
- ***Equipment** & facility security*
- ***Equipment** & facility security*
- ***After-hours** barn checks*
- ***Hospital** & fresh cow observation*
- ***Employee** safety monitoring*

1. Calving Pens

- ✓ *Watch close-up cows 24/7*
- ✓ *Reduce pen checks*
- ✓ *Respond faster to problems*
- ✓ *View remotely from home*

2. Security & Risk Management

- ✓ *Deter theft & vandalism*
- ✓ *Monitor visitor access*
- ✓ *Document incidents*
- ✓ *Lower liability*

3. Fresh & Hospital Pens

- ✓ *Observe eating & rising*
- ✓ *Spot down cows early*
- ✓ *Monitor post-treatment*

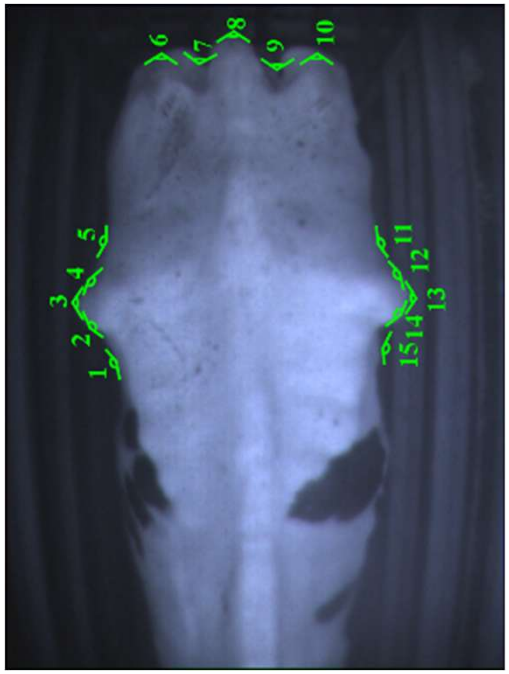
Why This Works

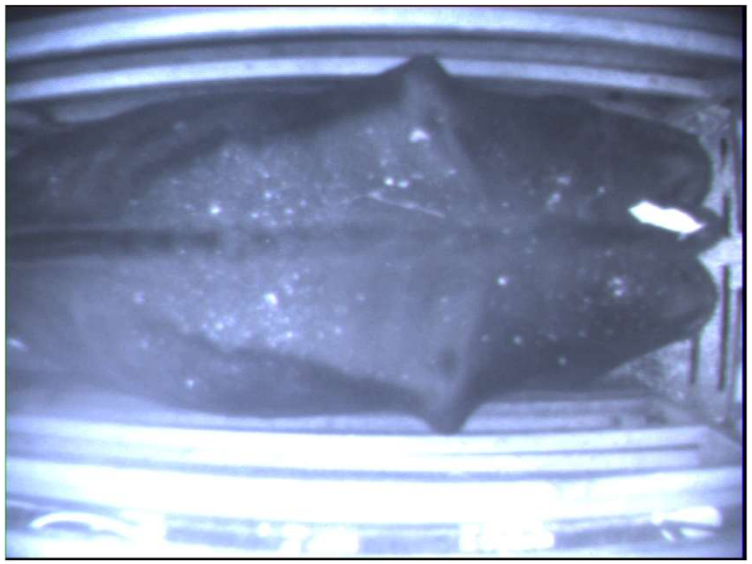
- ✓ Low cost, easy setup
- ✓ Scalable & flexible
- ✓ No AI required
- ✓ Immediate ROI

"You don't need advanced analytics to benefit from cameras.

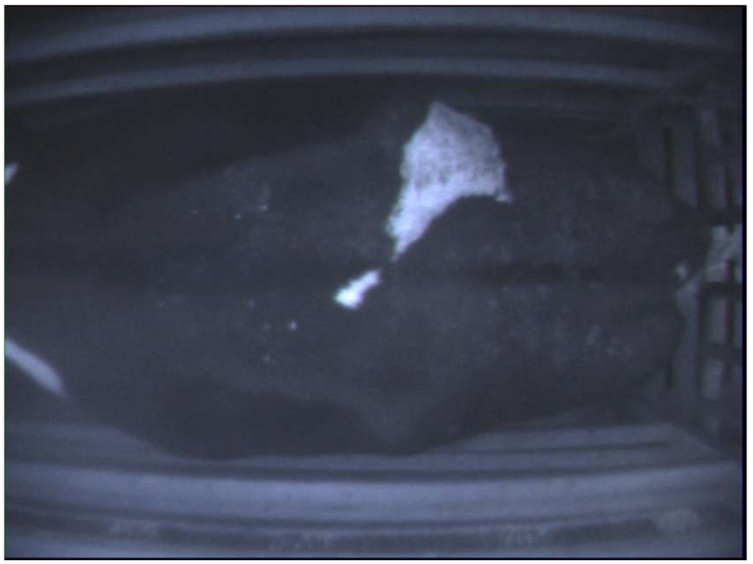
Seeing is managing."

BCS Example: Applying Geometry





BCS	**2.50**
Predicted BCS	**2.63**
Posterior Hook Angle	**150.0°**
Hook Angle	**116.6°**



BCS	**3.50**
Predicted BCS	**3.32**
Posterior Hook Angle	**172.1°**
Hook Angle	**153.5°**

Body Condition Scoring by Camera

3D cameras measure body shape to estimate BCS automatically

Research shows $r^2 = 0.80+$ correlation with expert scorers

Monitors every cow at every milking — not just periodic checks

Detects BCS loss trends 2-3 weeks earlier than visual scoring

Commercial: DeLaval BCS, Nedap, InnoCow, 3DIT

ROI: 3D cameras can return 200-500% annually at ~$1/cow/month

Computers and Electronics in Agriculture 148 (2018) 226–236

Contents lists available at ScienceDirect

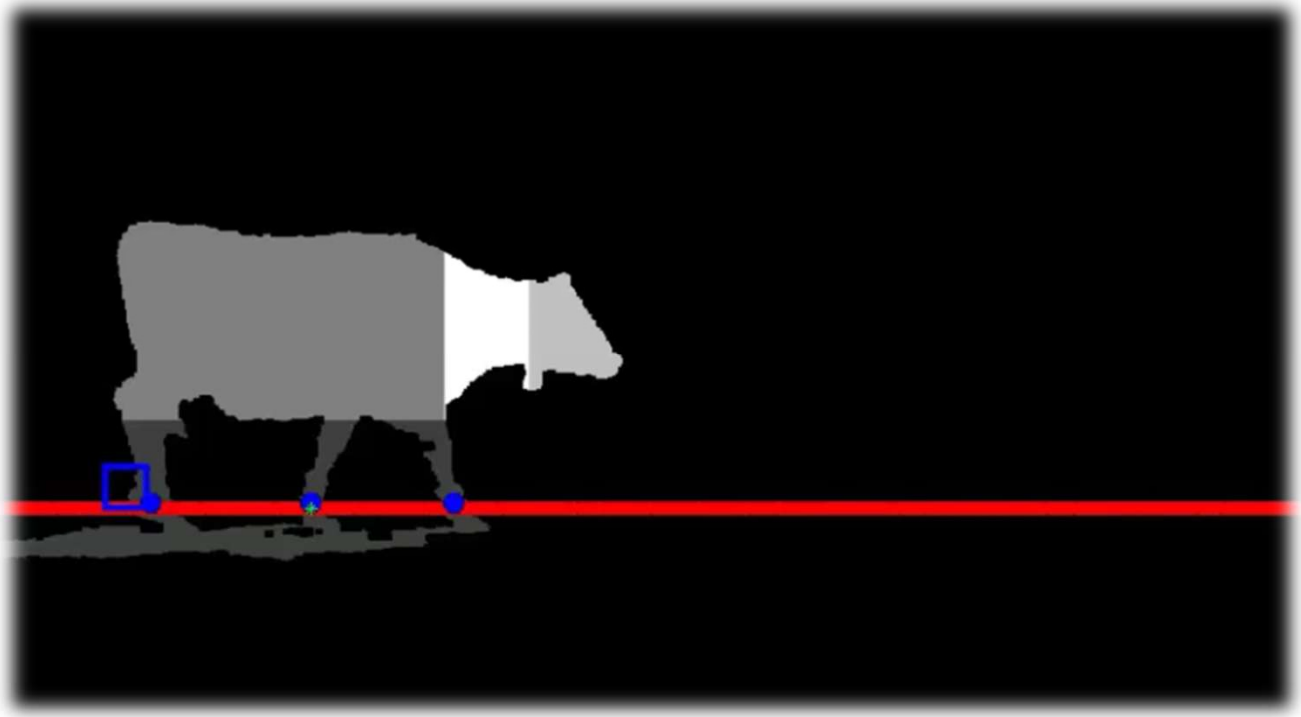
Computers and Electronics in Agriculture

journal homepage: www.elsevier.com/locate/compag

Original papers

Automatic lameness detection in dairy cattle based on leg swing analysis with an image processing technique

K. Zhao[a,b], J.M. Bewley[c], D. He[a,d,e,*], X. Jin[b]

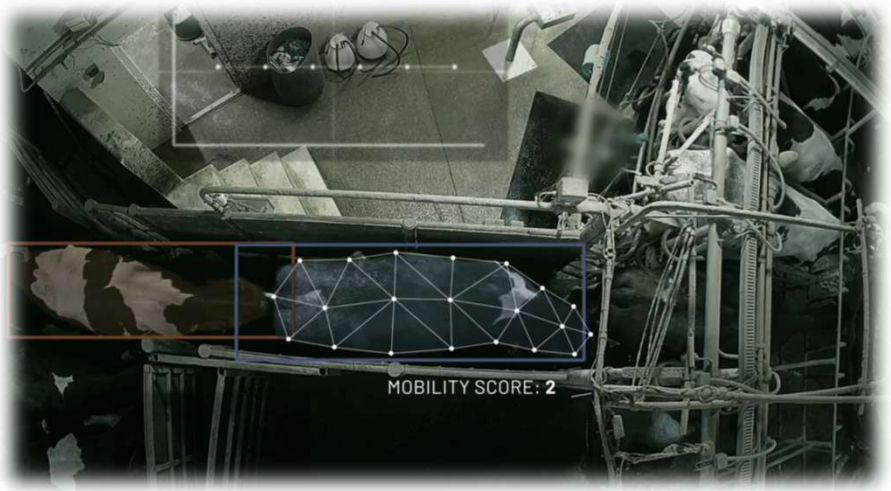


CV Lameness Detection: How It Works

1. Camera captures cow walking
2. AI extracts body landmarks (pose estimation)
3. Gait symmetry analyzed frame-by-frame
4. Locomotion features extracted
5. Locomotion score assigned
6. Alert sent if score ≥ X

Commercial systems: CattleEye, Nedap SmartSight, BovicAIR

Locomotion and Body Condition Scoring



CATTLE EYE





nedap



RFID

1. ID

The cow is identified passing through the milking parlor entrance, exit, race lane or sort gate – using Nedap's proven SmartID or possibly by integrating your existing parlor ID.



2. SmartSight camera

The top-view 3D camera (PoE) scans her body and movement patterns at each milking, every day. It's capable of scoring 1000+ cows per hour, without interrupting cow flow.





3. AI-powered software

Camera observations are turned into locomotion data and insights through AI-powered software. Data is processed on-farm without storage, so your privacy is covered.



4. Insights in Nedap Now

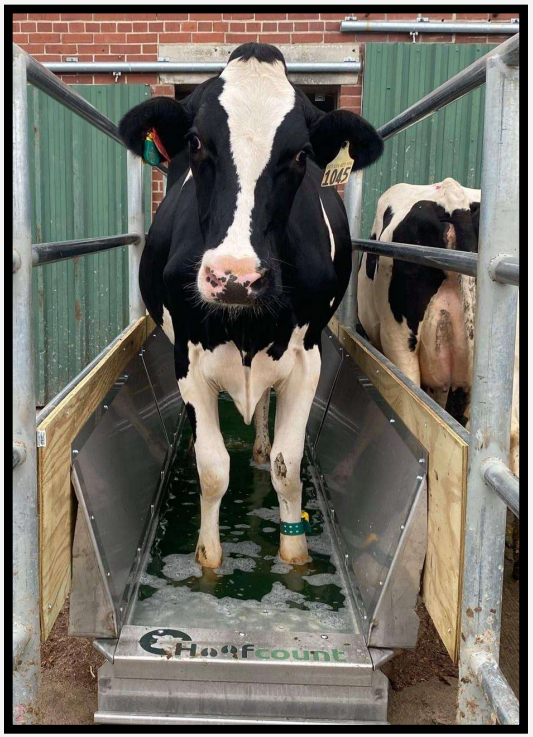
Lameness checks, recovery insights and locomotion scores are presented in a user-friendly way within Nedap Now. Accessible anytime, anywhere via PC, smartphone and the Nedap Now app.

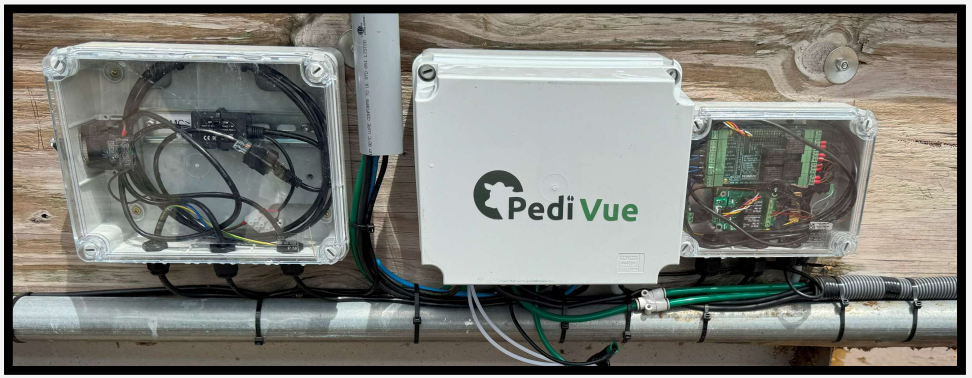

Digital Dermatitis Detection (Dopfer)

PediVue

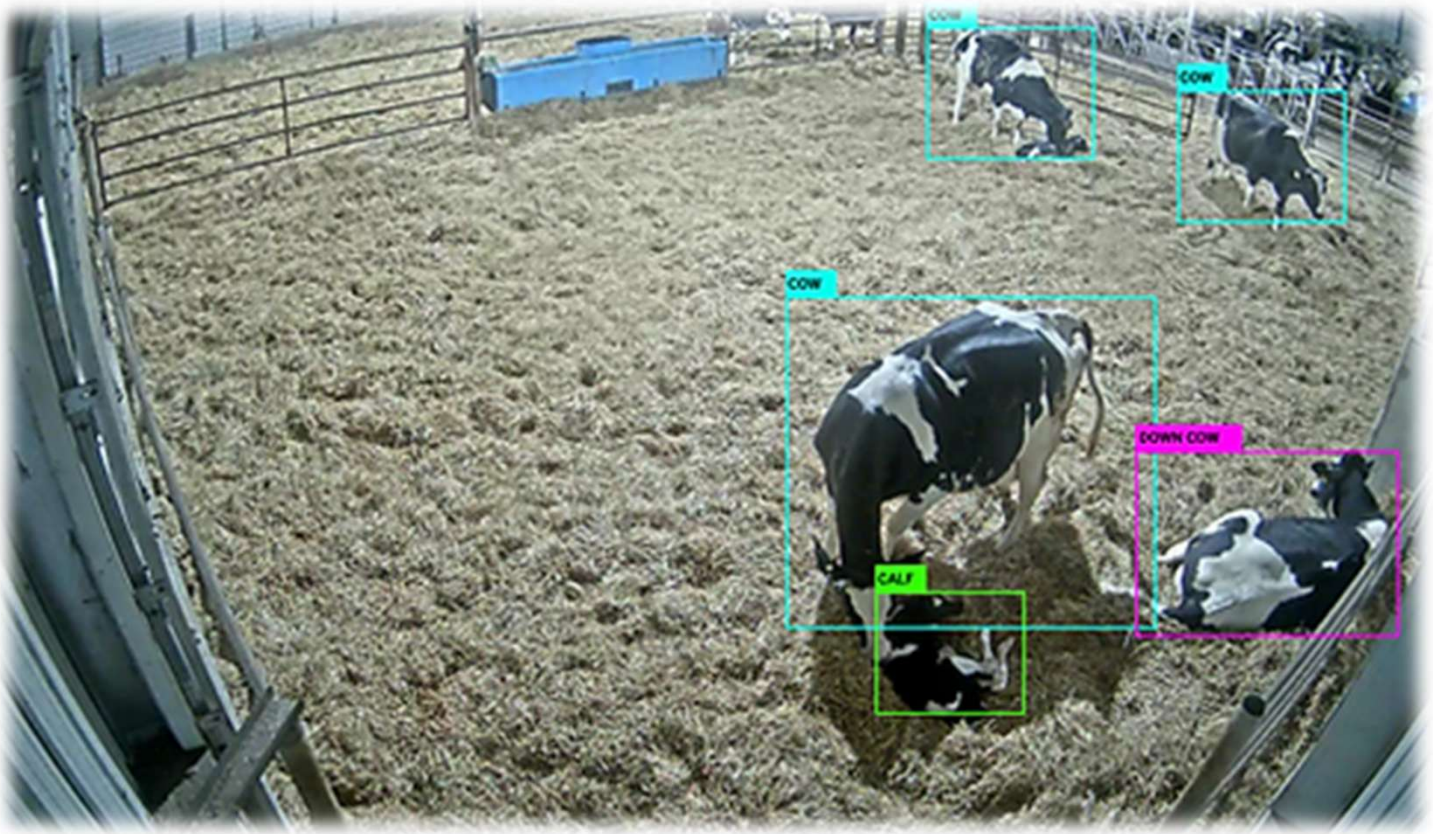
- Lameness detection device detecting early signs of digital dermatitis
- High speed camera located at the exit of the footbath
- Helps identify lameness sooner







BOVICA²IR



Cattle Care

Missed Post Dip Event

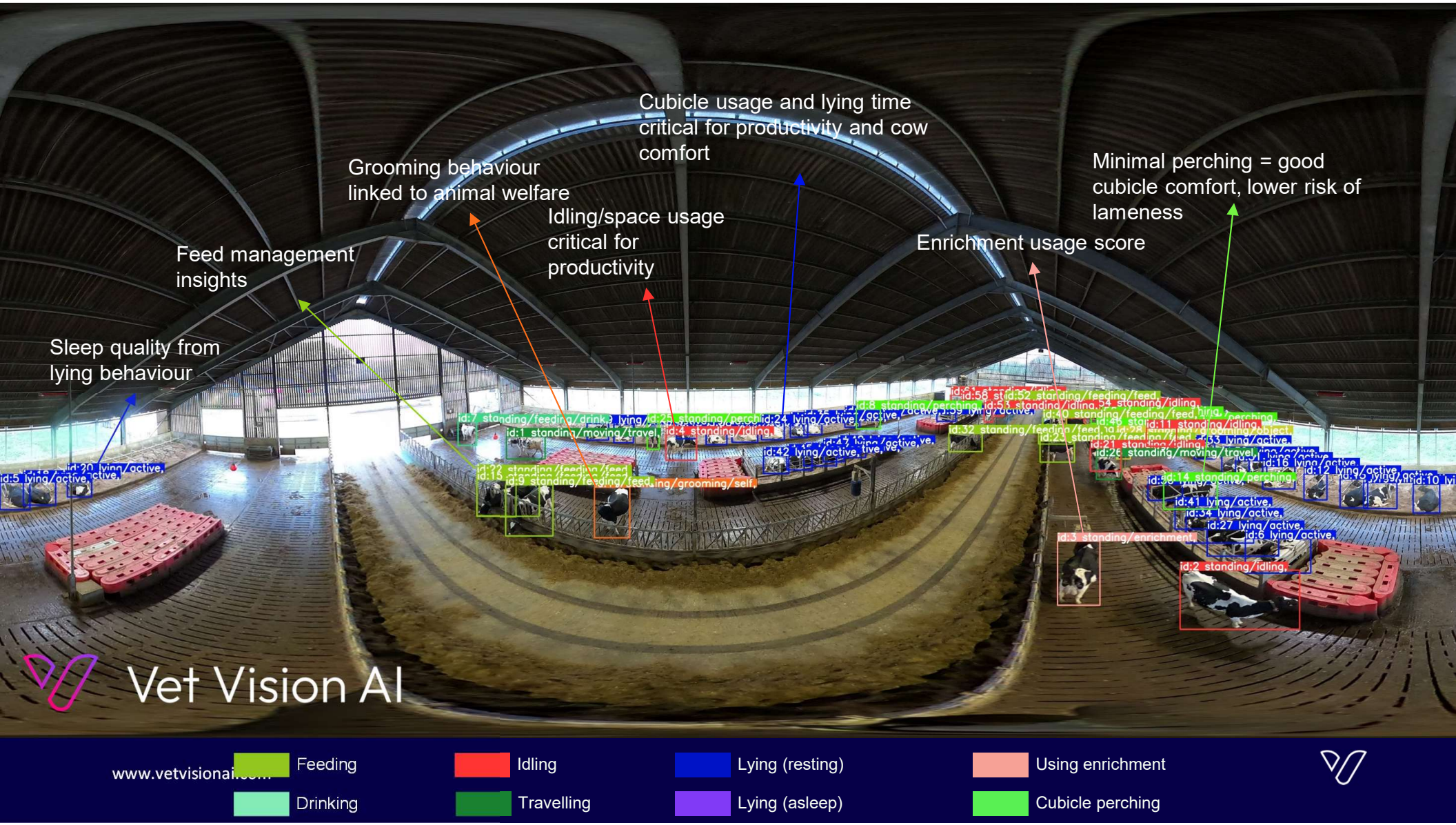


Phone Time



Behavior Monitoring: Seeing the Whole Picture

Lying time & bouts	Comfort, lameness, illness
Feeding time & visits	Intake, acidosis, social stress
Standing idle	Heat stress, discomfort
Social interactions	Hierarchy, competition, bullying
Rumination posture	Digestive health indicators

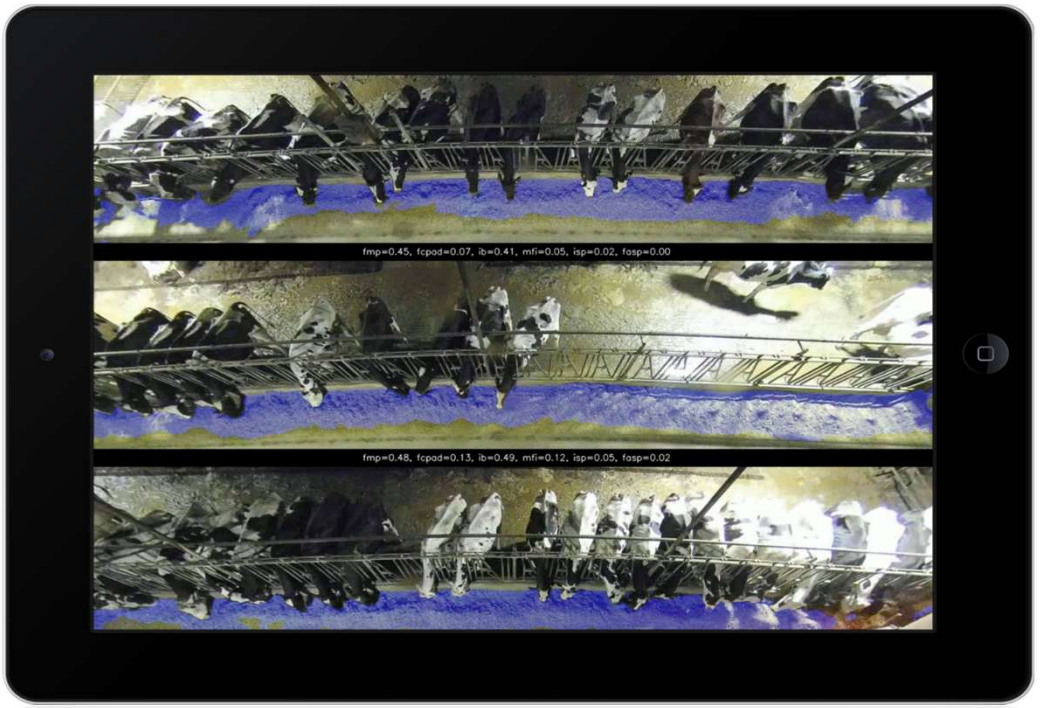

Cubicle usage and lying time critical for productivity and cow comfort
Grooming behaviour linked to animal welfare
Idling/space usage critical for productivity
Minimal perching = good cubicle comfort, lower risk of lameness
Feed management insights
Enrichment usage score
Sleep quality from lying behaviour
Vet Vision AI
www.vetvisionai.com
Feeding
Idling
Lying (resting)
Using enrichment
Drinking
Travelling
Lying (asleep)
Cubicle perching

Monitoring cow behavior by pen 24/7



Monitoring feed availability and determining when feed events happen

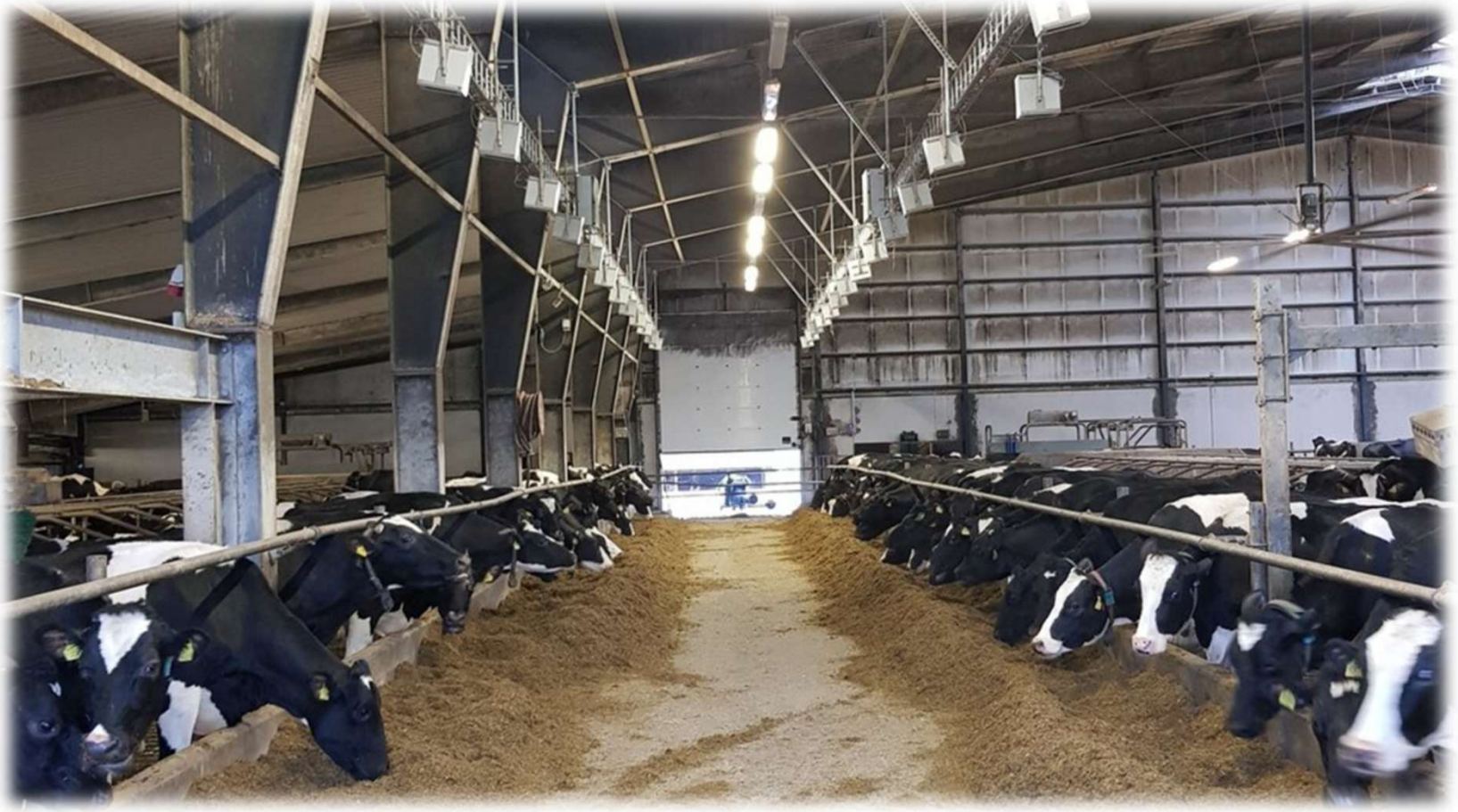
Before a feed delivery



After a feed delivery

Cattle Feed Intake System (CFIT)

VIKINGGENETICS
innovative breeding



iCHASE

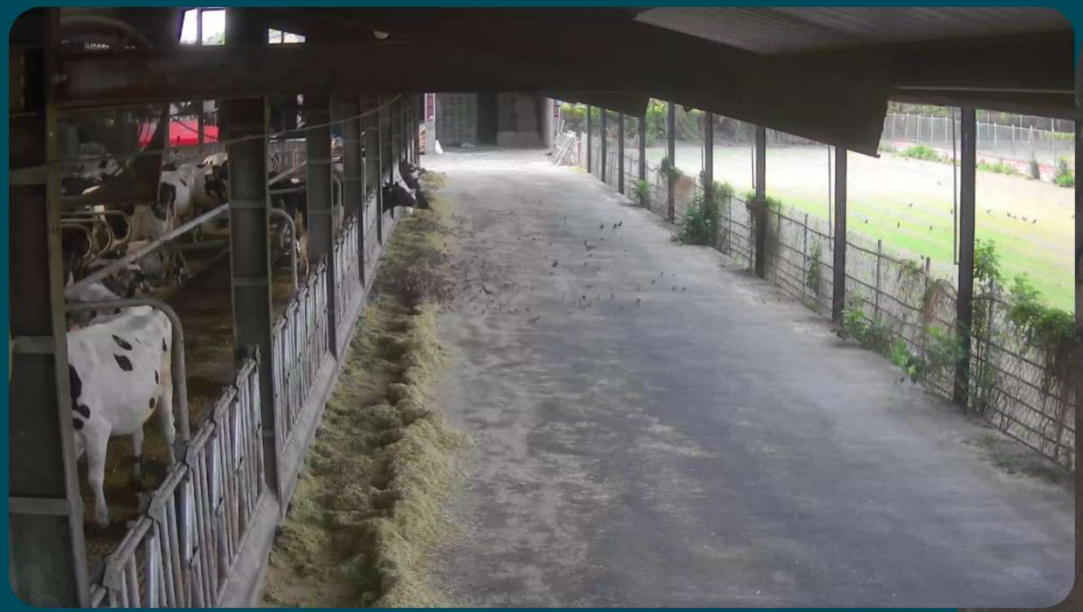
Bird Detection → Activate Laser Beam



AI camera with guided laser beam

iCHASE

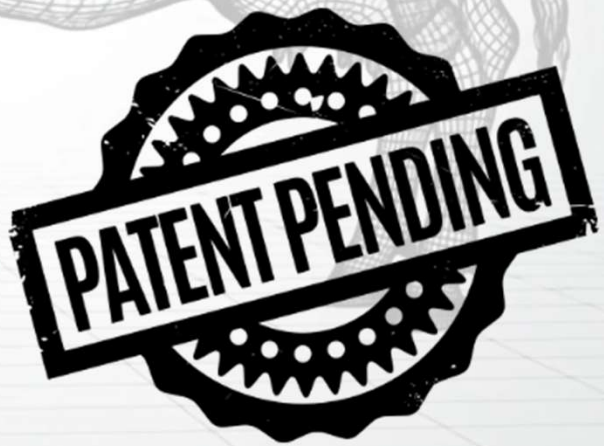
Bird Detection → Activate Laser Beam



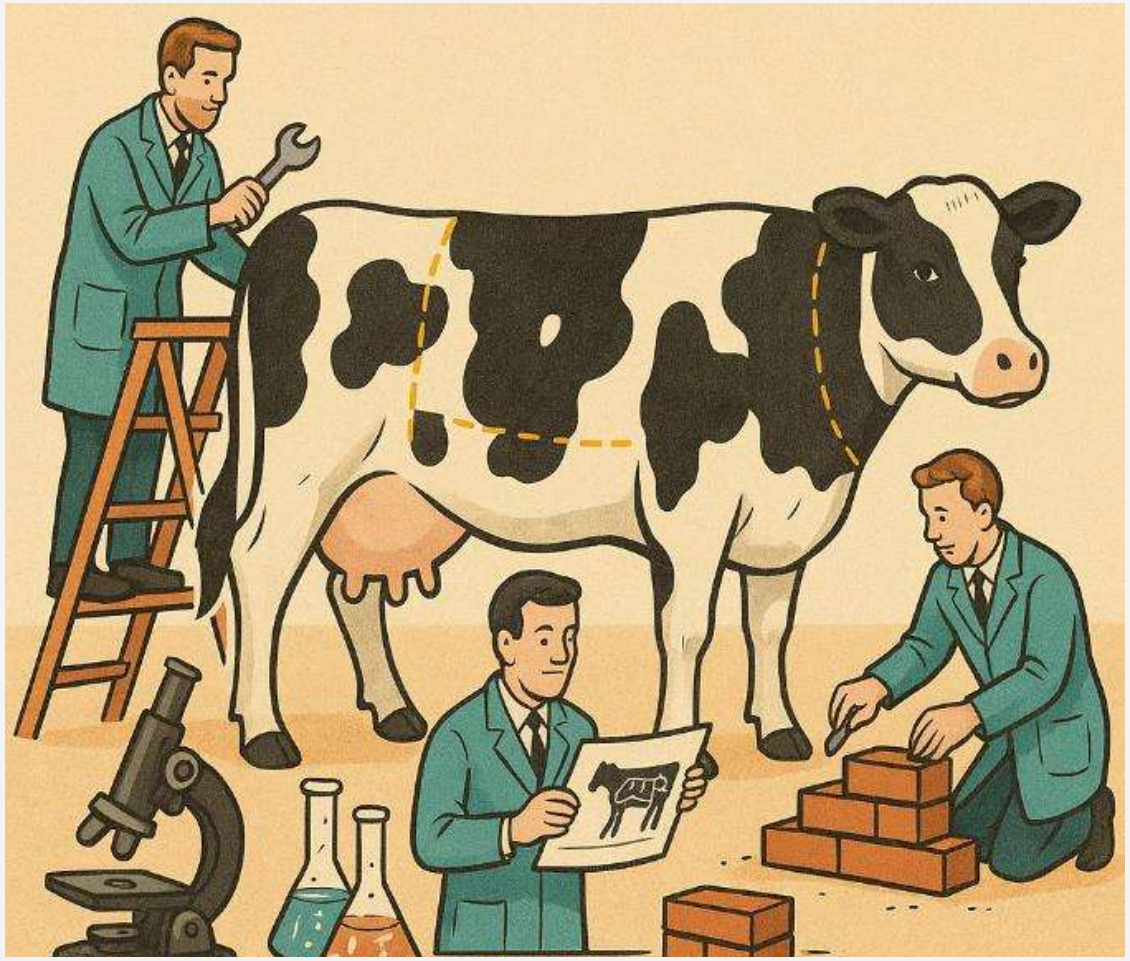


Holstein Association USA has developed an **innovative technological solution** designed to advance cattle **conformation evaluation** into a revolutionary new era





Building a Better Cow



HOLSTEIN ASSOCIATION USA

26 Traits Measured

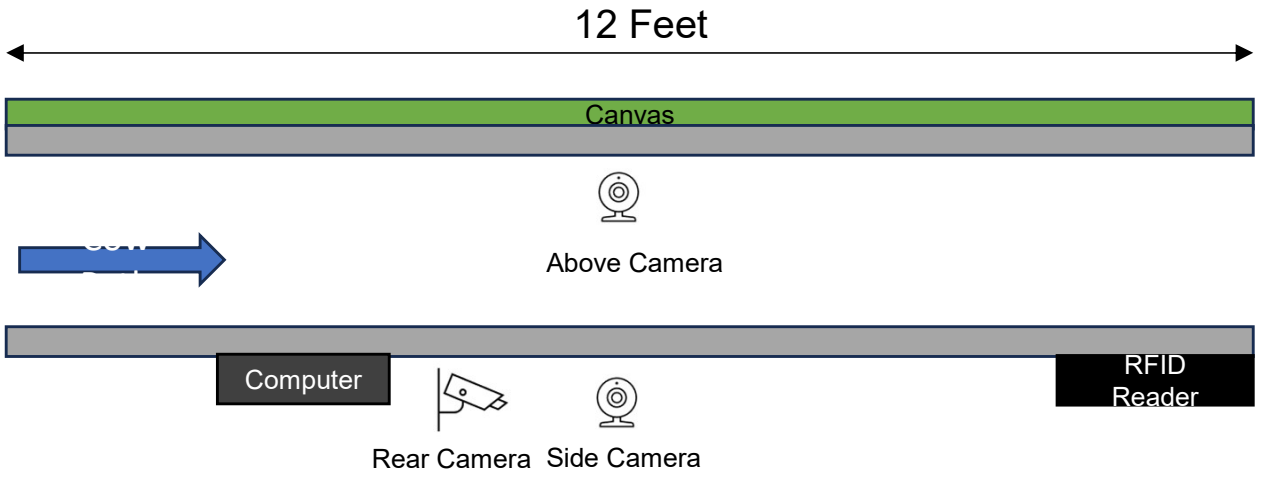
3D Imaging Technology

0 Disruption

365 Days — Data Availability

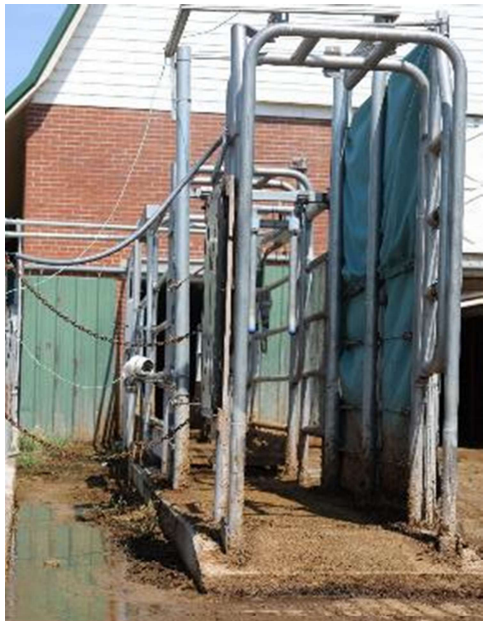
ALL Cows and Lactations

System Setup

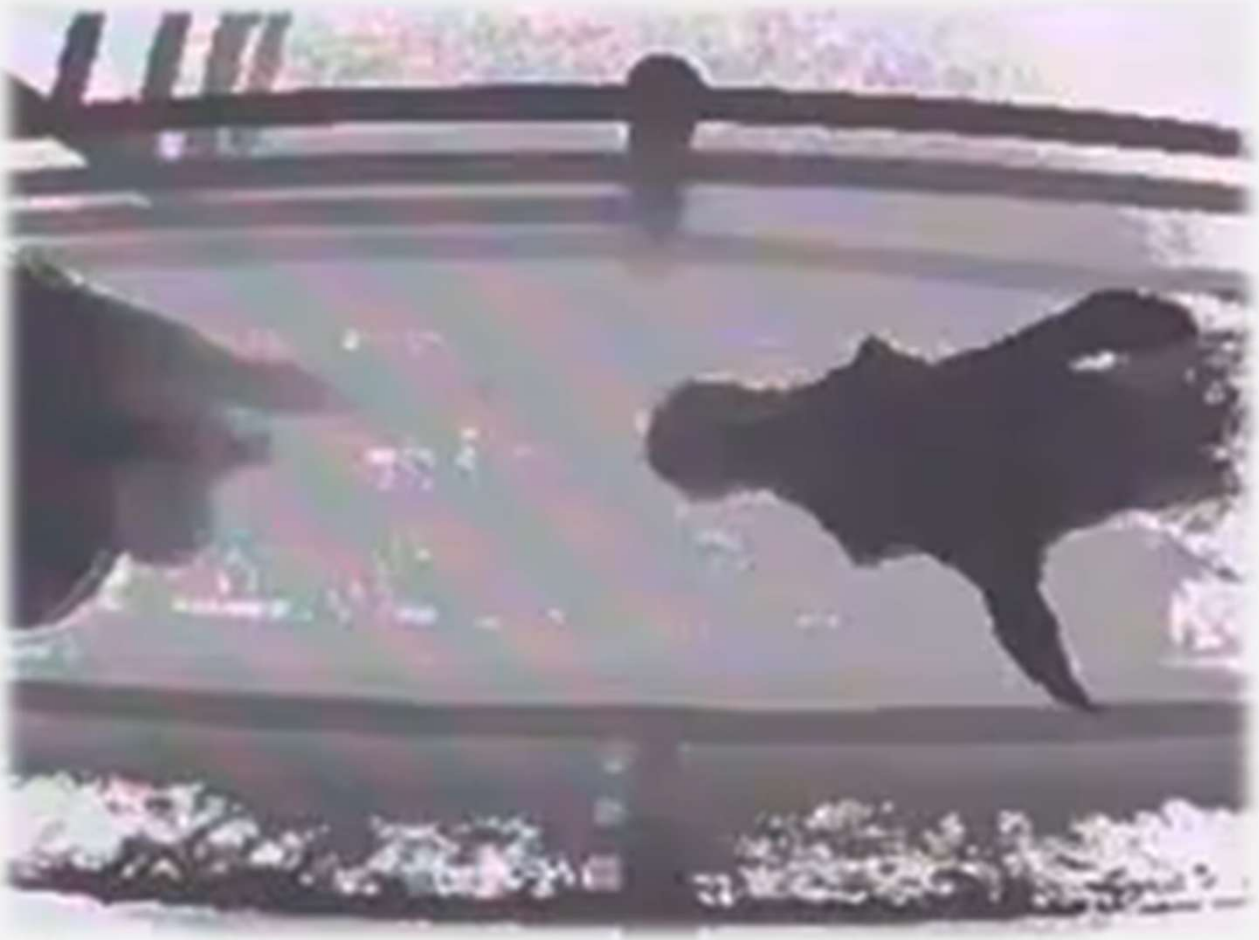








Smooth cow flow





Current Traits

Body

- BCS
- Stature
- Body Depth
- Chest Width
- Rump Angle
- Rump Width
- Rib Openness
- Wither Angle
- Spring of Rib

Feet & Legs

- Foot Angle
- Tracking Up
- Rear Hoof Distance
- Swinging Out
- Rear Legs
  - Side View
  - Rear View

Udder

- Udder Tilt
- Udder Depth
- Rear Udder Height
- Rear Udder Width
- Udder Cleft
- Fore Udder Attachment
- Front Teat Length
- Teat Diameter
- Teat Placement
  - Front Teats
  - Rear Teats
  - Side View

U.S. Registered Holsteins
FOR MAXIMUM PROFIT

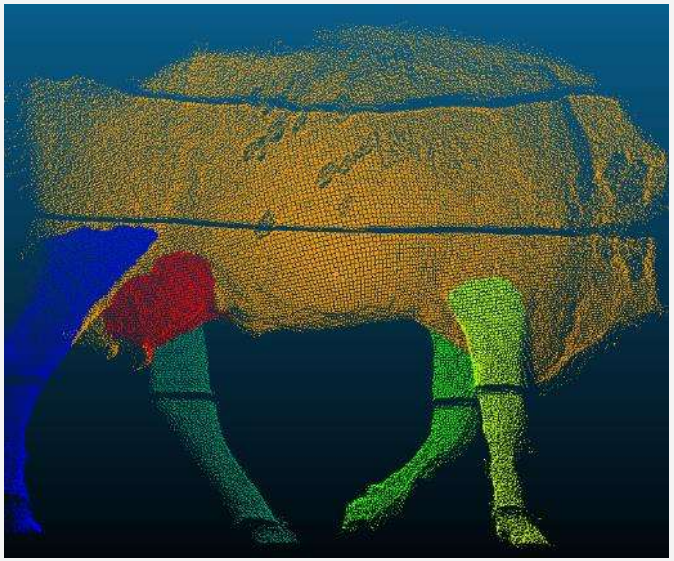
Build a Better Cow

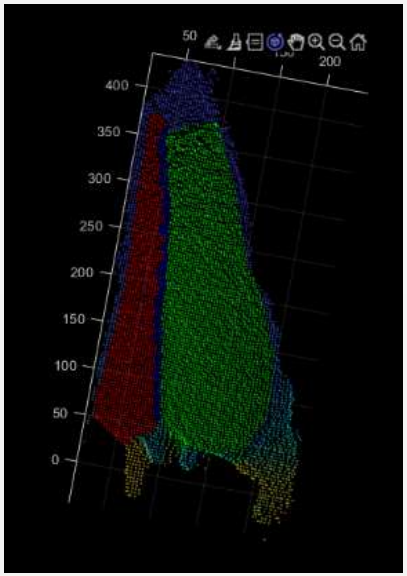
Image Capture
Daily 3D imaging during regular parlor exit

AI Analysis
Deep learning techniques process images

Trait Calculation
Geometric principles measure traits objectively

Report Delivery
Spreadsheet format for easy integration





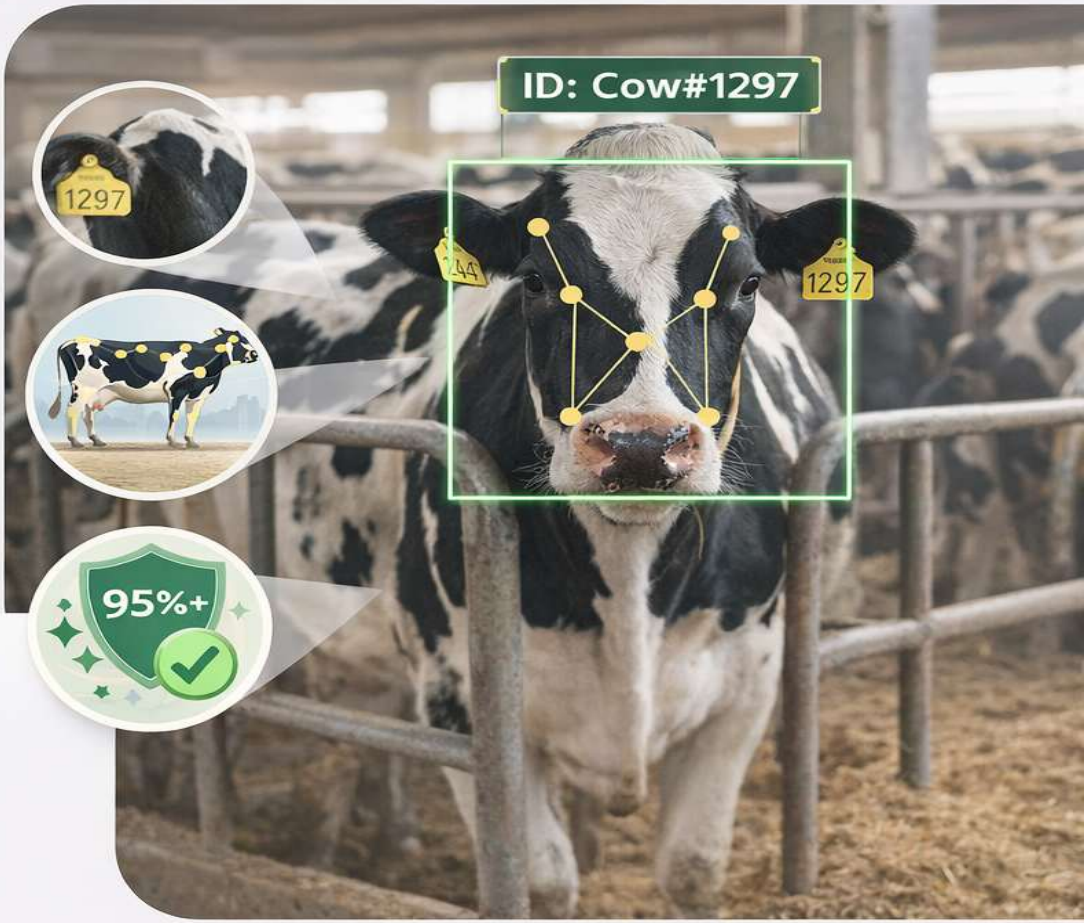
Animal Identification by Camera

Moving beyond ear tags and RFID

- Coat pattern recognition: Like facial recognition for cows — each Holstein pattern is unique
- Keypoint detection: 14-17 body landmarks tracked per frame (Dórea Lab, JDS 2025)
- OCR ear tag reading: Camera reads ear tag numbers automatically
- Accuracy: 95%+ individual ID in research settings

Challenge: Lighting changes, dirty coats, crowded pens





Lessons from Other Industries

Automotive



Automotive

Tesla Autopilot replaces radar with 8 cameras. Taught the world vision-only can work at scale.

Retail



amazon

Amazon Go is ending. It used 100s of cameras but showed simpler setups are better.

Healthcare



Healthcare

AI reads X-rays and pathology slides. FDA approved 500+ medical devices at 95%+ accuracy.

Manufacturing



Manufacturing

Quality inspectors catch defects cameras spot better. Achieved 99.9% accuracy on assembly lines.

Vision AI Across Agriculture

Swine

- eYeNamic overhead cameras
- piglet counting
- welfare auditing, tail biting detection
- thermal fever detection



Poultry

- Bird distribution, feather scoring
- mortality detection, egg counting
- broiler weight estimation



Equine

- Gait analysis for lameness, body condition
- movement tracking in paddocks



Aquaculture

- Fish counting, feeding behavior
- biomass estimation, disease spotting

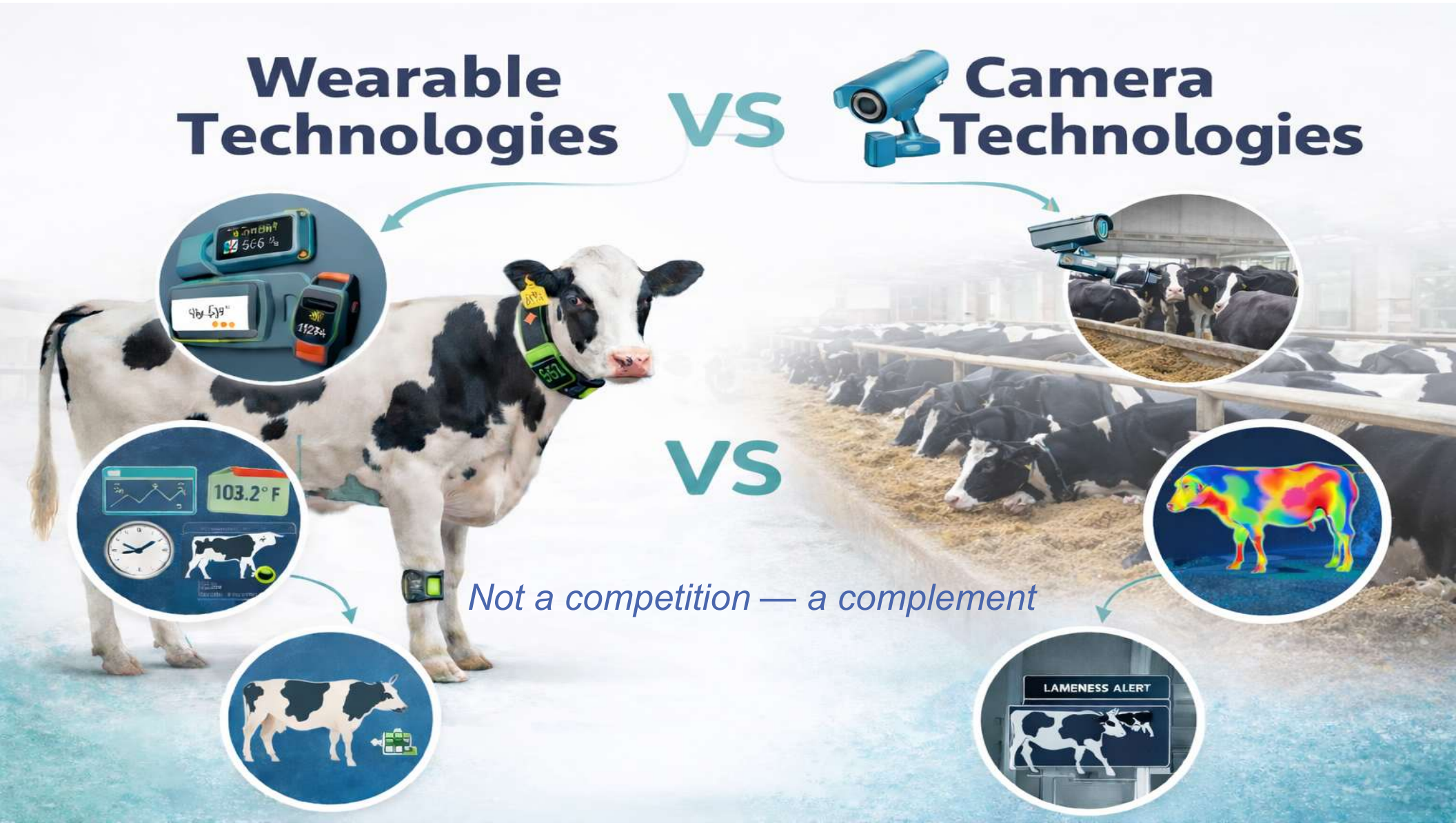


Crops

- Drone imaging, precision spraying
- weed detection, yield estimation — **AgroVisionNet**



Wearable Technologies VS Camera Technologies



Wearables vs. Cameras: Head to Head

Dimension	Wearables	Cameras
Installation	Per-animal (collar/tag)	Per-location (barn/alley)
Scalability	Cost scales with herd size	Cost scales with # locations
Data Type	Activity, rumination, temp	Gait, posture, BCS, behavior
Maintenance	Battery, lost/broken tags	Lens cleaning, connectivity
Individual ID	Built in (tag = cow)	Requires AI recognition
Proven ROI	20+ years of validation	Emerging, fewer long-term studies

Best strategy: Use BOTH — wearables for individual physiology, cameras for movement & environment

What Wearable Adoption Taught Us

2/3 of dairy farms now use at least one monitoring technology

Health monitoring collars and ear tags are the most widely adopted innovations

Adoption lessons that apply to cameras:

- Simple, clear ROI drove adoption — heat detection paying for itself in 6 months
- Integration with existing herd management software was critical
- Farmer-to-farmer word of mouth was the #1 driver of adoption
- Technology that required behavior change was adopted slower

Source: 2025 Farm Journal State of the Dairy Industry



Pitfalls & Infrastructure:
Camera Systems on Dairies

The challenges nobody puts in the marketing brochure



Physical Problems

- Dust / Manure Splatter
- Condensation / Humidity
- Corrosion / Ammonia Exposure
- Lighting Variability
- Occlusion / Cow Crowding

System Problems

- WiFi Dead Zones
- Bandwidth Overload
- Power Outages / Signal Loss
- Data Storage Limits
- Calibration Drift / False Positives





Camera systems are **not plug-and-play**.

Camera Cleaning





The Rural Broadband Problem

Camera AI generates massive data. A single 4K camera stream = 10-20 Mbps.
Many rural farms have < 25 Mbps total.

Edge Computing

Process data ON the camera/local device. Only send alerts to cloud.

Starlink

Satellite internet: 50-200 Mbps. Game-changer for rural farms.

Private 5G

Emerging option for large operations. High bandwidth, low latency.

TV Whitespace

Unused TV frequencies for rural broadband. FCC pilot programs.

The Data Problem Nobody Talks About

Camera hardware is only 20% of the challenge. Data is the other 80%.

Garbage In, Garbage Out	AI trained on clean university data often fails on real farms. Dust, shadows, overlapping cows, and wet floors all confuse the model.
Not Enough Cow Data	ChatGPT trained on trillions of words. Most cow CV models train on fewer than 100K images. The data gap is enormous.
Your Farm ≠ Their Farm	A model trained on sand-bedded freestalls may fail on compost bedding. Breed, lighting, and climate all matter.
Who Labels the Data?	Every AI needs human-labeled training data. Locomotion scoring is subjective — even experts disagree 30% of the time.

Your Team IS the Technology

The #1 predictor of precision technology success on farms isn't the technology.
It's the PEOPLE using it.



The Champion

One person who owns the data, checks alerts daily, and holds the team accountable. Without a champion, every system fails.

The Skeptic

Healthy skepticism prevents blind faith in false alerts. Encourage questions like "Is the camera right?"



The Responder

Who acts when the camera flags a lame cow? Clear SOPs turn alerts into action. No SOP = expensive noise.

Are You Camera-Ready? Infrastructure Checklist

Complete this checklist BEFORE calling a vendor.

Internet Speed	**25+ Mbps download**	*Edge computing can reduce this to 5 Mbps*
Power at Cameras	**Dedicated circuits in barn**	*PoE cameras simplify wiring*
Herd Mgmt Software	**Active PCDART / DairyComp / BoviSync**	*Camera data is useless without integration*
Tech Champion	**At least one staff 'champion'**	*Willing to check dashboards daily*
Defined Problem	**Specific, measurable goal**	*e.g., 'Reduce lameness from 30% to 15%'*
Ongoing Budget	**$1-3/cow/month**	*Includes software, updates, & support*

The Big Question

"Should I invest in camera technology on my dairy?"

The answer depends on YOUR operation, YOUR goals, and YOUR resources.

INVEST NOW	You have a specific, quantifiable problem that cameras solve (lameness, BCS monitoring). You have reliable internet and staff who will use the data.
INVEST SOON	You're planning a barn renovation or expansion. Building camera infrastructure in from the start saves 50%+ vs. retrofit.
WAIT & WATCH	You don't have a clear problem to solve, your internet is unreliable, or your team isn't ready. Focus on wearables first.

The Bottom Line

- Camera technology is NOT a "someday" thing — it's happening NOW
- The same AI revolution driving ChatGPT is driving farm vision
- Start with ONE problem, ONE camera, ONE pen
- Your people matter more than your hardware
- Ask hard questions. Demand validation data. Measure ROI.

The producers who move strategically NOW will have the advantage





Never Lose Sight of the Cow

Technology should serve the animal.
The best camera system in the world is worthless if nobody acts on the data.



Jeffrey Bewley, PhD, PAS
jbewley@holstein.com
1-859-699-2998

WKU SmartHolstein Lab

www.smartholstein.com

U.S. Registered Holsteins
FOR MAXIMUM PROFIT
HOLSTEIN ASSOCIATION USA, INC.

Like us on facebook

FOLLOW US ON Instagram

Beef on Dairy Panel:

Beyond the boom:
Beef on Dairy's next chapter in 2026

A panel moderated by Joe Dalton, Ph.D, Un. of Idaho

High Plains Dairy Conference:
20 years providing science and information to dairy producers of the High Plains

Laphe LaRoe Director of Operations Smith Cattle & TCFA Chair



- Beef on Dairy Panel. Beyond the boom: Beef on Dairy's next chapter in 2026

- **<u>Focus for this Presentation and Panel discussion:</u>**
  - 1 How BOD have changed the inventory in feedyards
  - 2 Partnerships/Relationships
  - 3 Sire/Dam importance
  - 4 Risks looking ahead

High Plains Dairy Conference:
20 years providing science and information to dairy producers of the High Plains

Beef on Dairy Panel. Beyond the Boom: Beef on Dairy's Next Chapter in 2026



Laphe LaRoe
Director of Operations, Smith Cattle Company
Chairman, Texas Cattle Feeders Association
March 4, 2026

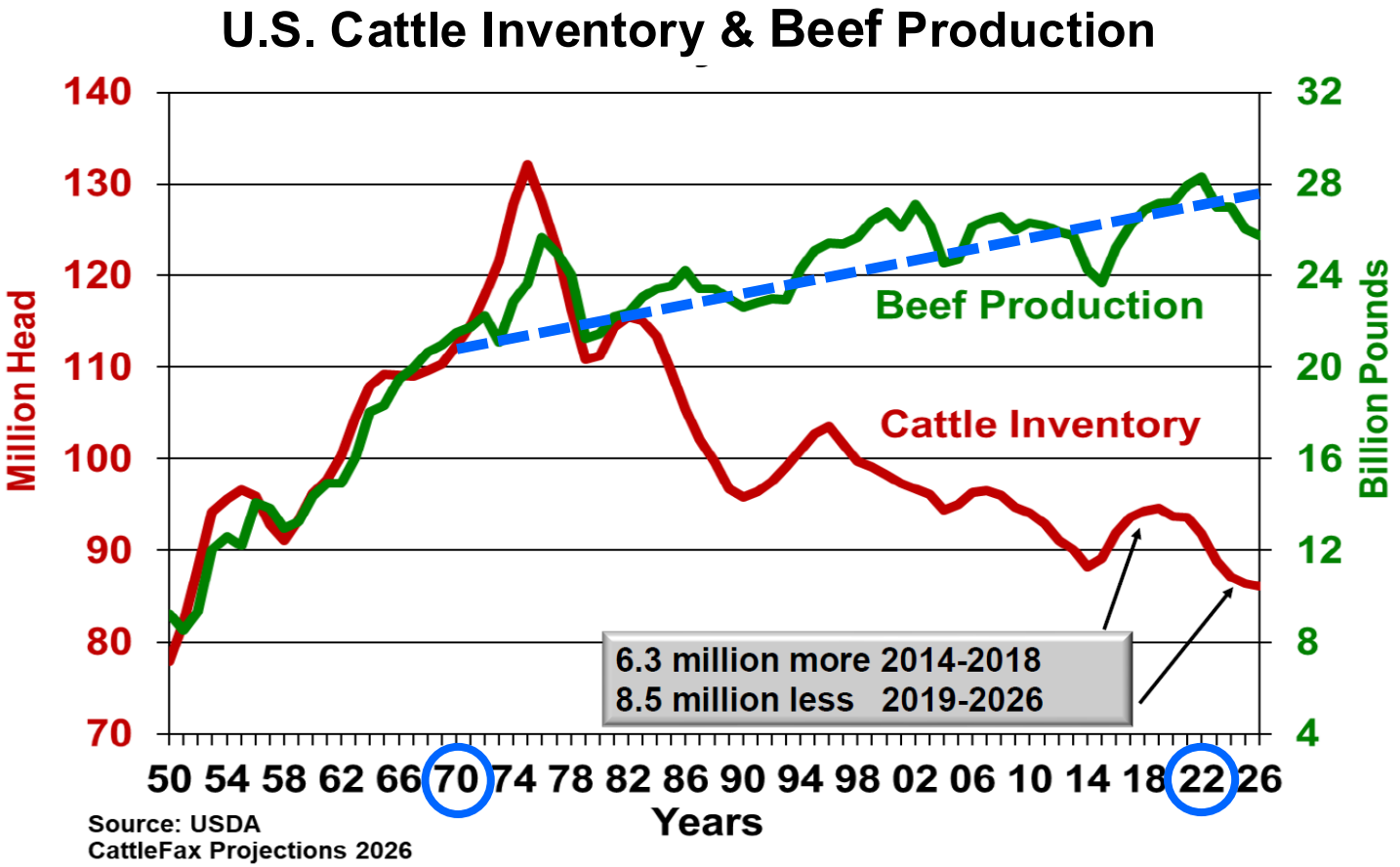
Texas Cattle Feeders Association

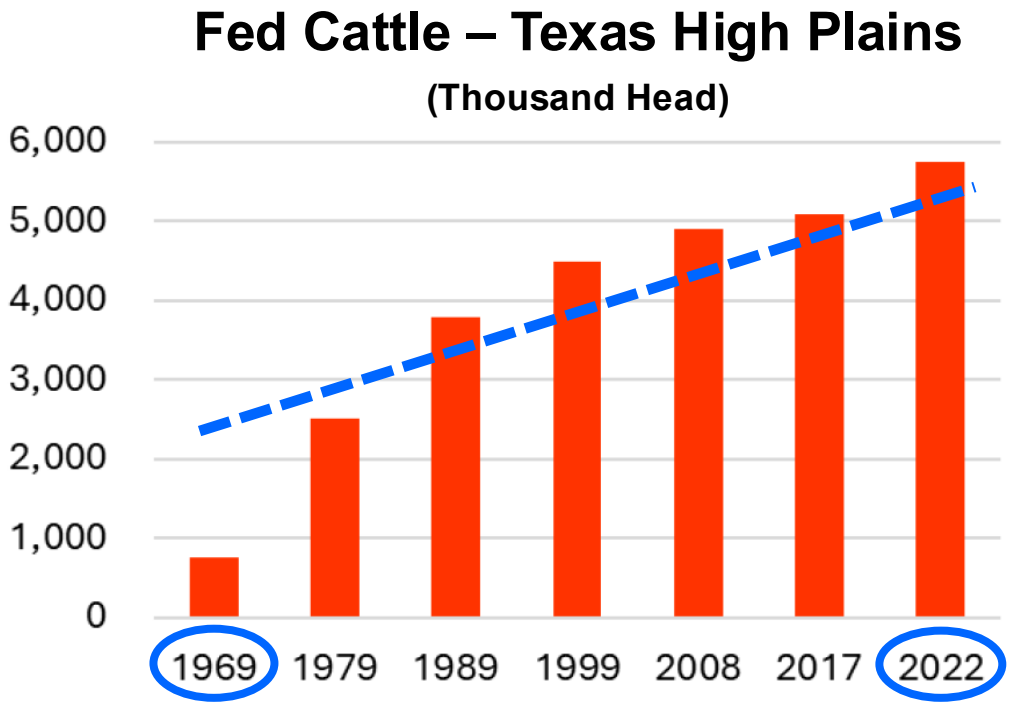
CATTLE FEEDING COUNTRY

- Texas, Oklahoma and New Mexico
- Over 25% of the nation's fed cattle
- $22 Billion total economic impact
- $17.9 Billion annual fed cattle sales
- $13.8 Billion buying feeder cattle
- $13 Billion buying feed commodities
- $150 Million payroll
- 2,500 direct employees



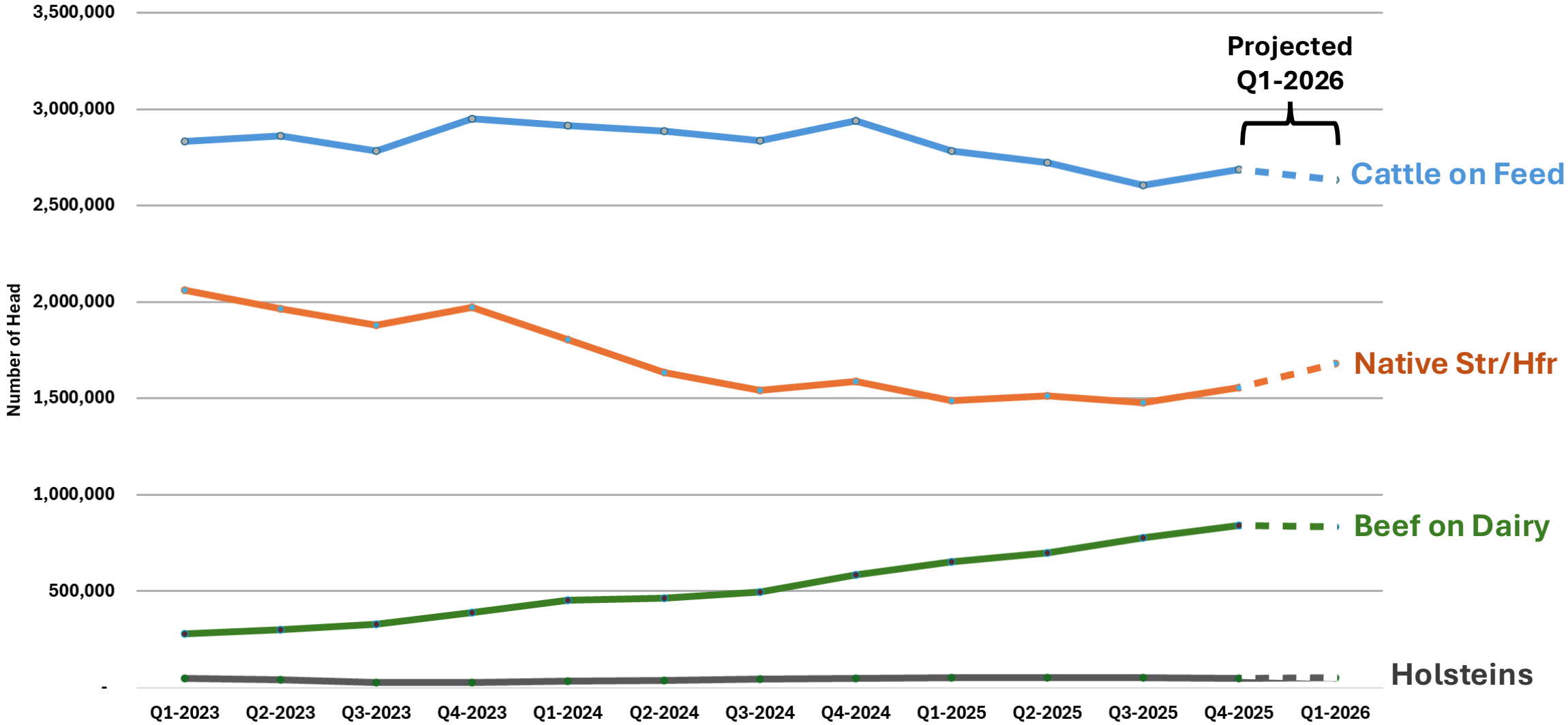
MORE WITH LESS





Source: Impact of Agribusiness in the High Plains Trade Area

CATTLE ON FEED – TEXAS



CMS LIVESTOCK AUCTION

CMS CATTLE MARKETING SERVICES, INC

DELBERT HOLLIS

PRESIDENT, FOUNDER - CMS LIVESTOCK AUCTION



LIVESTOCK TRADING PERSPECTIVE

- MARKET BxD ACCEPTANCE
- GENETIC DRIVEN PRICES
- VERIFIED VS MIXED GENETICS

cattlemarketingservices.com

CMS Livestock Auction	Jan 2025 - Feb 2026
Holstein Dams vs. non-Holstein Dams	$ 26.17
Angus Sires vs. Limousin and Simmental Sires	$ 14.27
Charolais Sires vs. Limousin and Simmental Sires	$ ($10.69)
Steers vs. Heifers	$ 31.61
Headcount Price Advantage	$ 0.02
NHTC vs. non-NHTC	$ 10.28

*Price difference shown in $/CWT

R-squared	0.968
Total Lots	561
Total Head	107,280
Av. Weight	511 lbs.

Jon D. Robison, Ph.D.



- **Owner – JDR Livestock Management Services, Inc. – 1984 to present**
  - Ph. D. in Animal Physiology – University of Arizona, 1984
  - Partner, Horizon Consulting Service, LLC, 2014 to 2024
  - Professor (Professor Emeritus) CSUFresno, 1996 to 2014
  - Managing Partner 2 Commercial Feedlots, 1987 to 1996
  - Nevada State Dairy Specialist, 1984 to 1987
  - Livestock Manager, Shamrock Dairy, Tucson, 1981 to 1984
  - Partner, Custom Calf Raising, Cow/Calf and Feedlot Operation, 1965 to 1976

High Plains Dairy Conference:
20 years providing science and information to dairy producers of the High Plains

Lauren Kimble, MS

Select Sires, Inc.
Manager of ProfitSOURCE Supply Chains



- **Panel on Beef on Dairy**
  Beyond the boom: Beef on Dairy's next chapter in 2026

  - **<u>Focus for this Presentation and Panel discussion:</u>**
    - Beef Supply & Demand
    - Genetics & Market Signals
    - Economically Influential Traits
    - Supply Chain Influence

High Plains Dairy Conference:
20 years providing science and information to dairy producers of the High Plains

SELECT SIRES INC.

ProfitSOURCE®

Beef on Dairy Genetic Implications

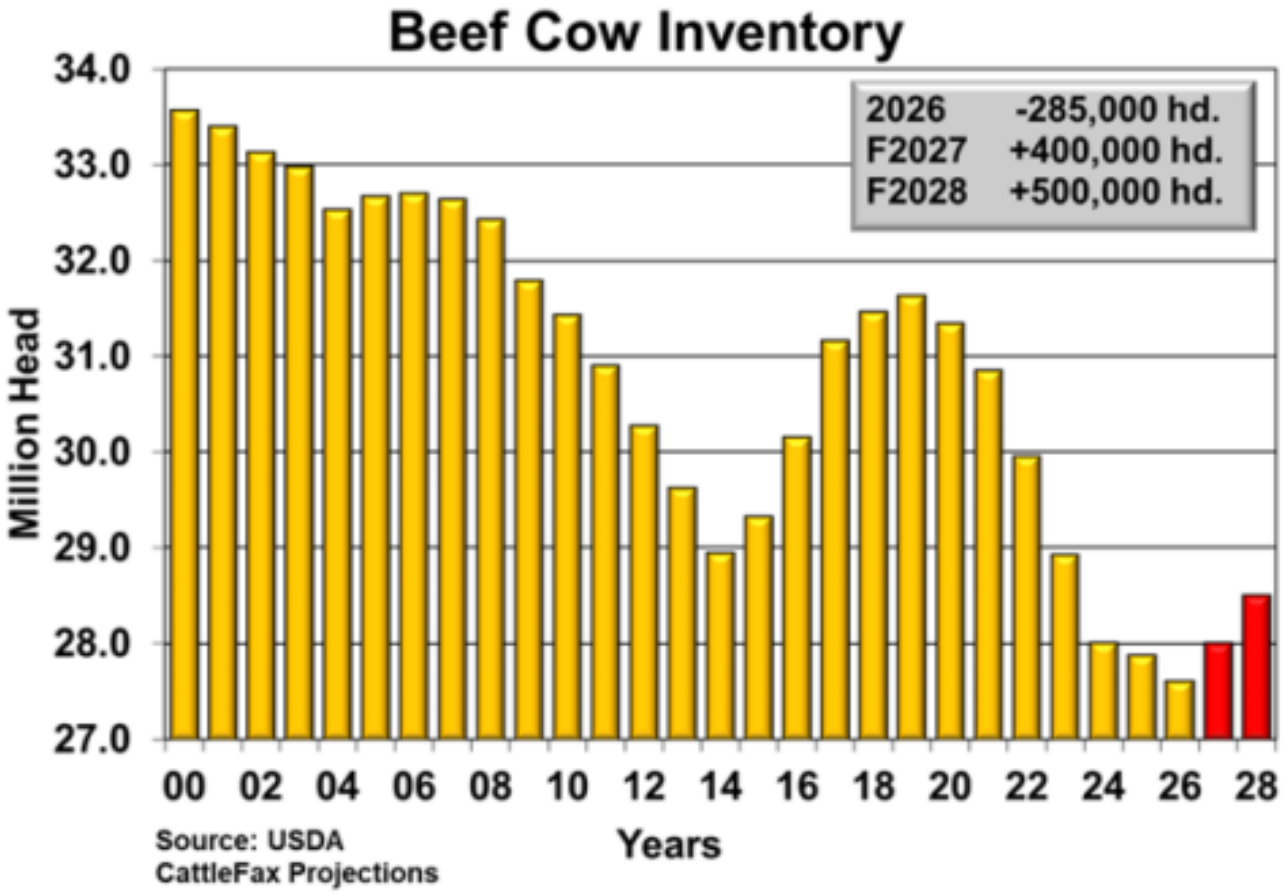






Lauren Kimble
ProfitSOURCE Manager
Select Sires Inc.

Beef Herd Driving Market Dynamics



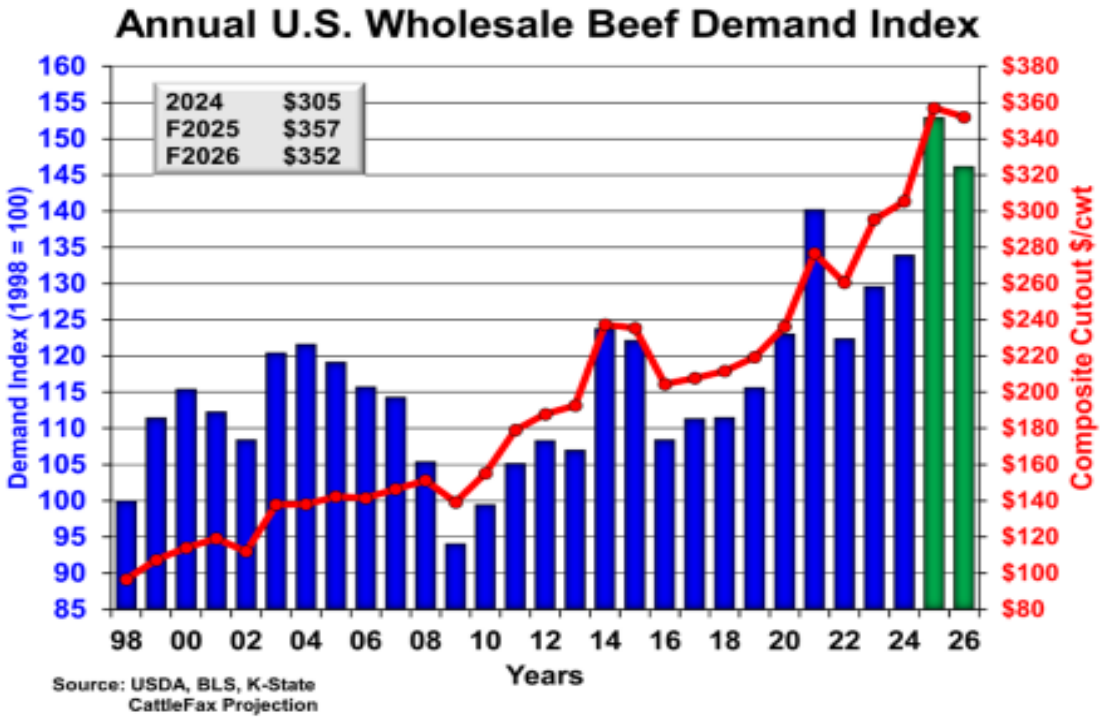
Current State: Scarcity supply premium

- All cattle commanding high prices – quality spreads condensed
- Retention decisions influenced by short-term margins

Outlook: Increased supply, more price dispersion

- Genetic differentiation may be the key to maintaining optimal market access

What Beef on Dairy "Gets Right"



Increased quality performance over time has boosted consumer demand and loyalty for beef.

Increased Quality and Grade Performance
- Higher Choice and Prime percentages
- Strong marbling expression

Carcass and Product Consistency
- Uniform carcasses
- Tighter yield/quality distribution
- Reduced variability for packers and retailers
- Year-round market supply

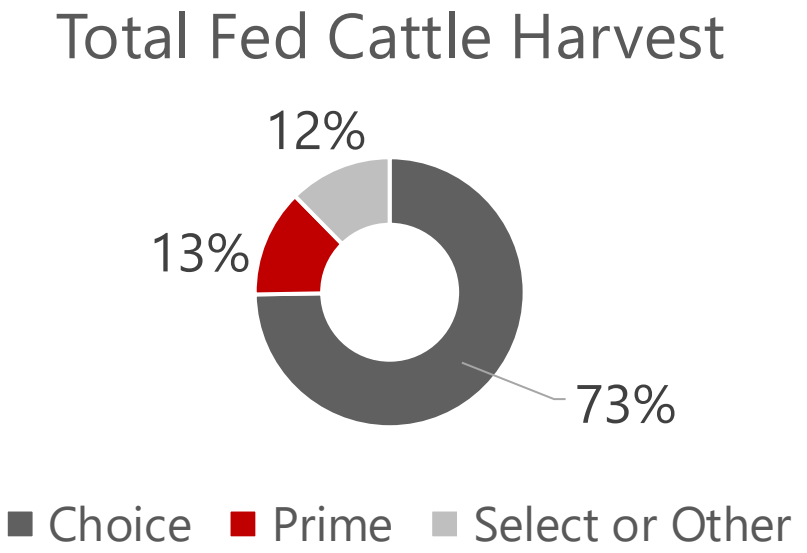
Growth Performance and Efficiency

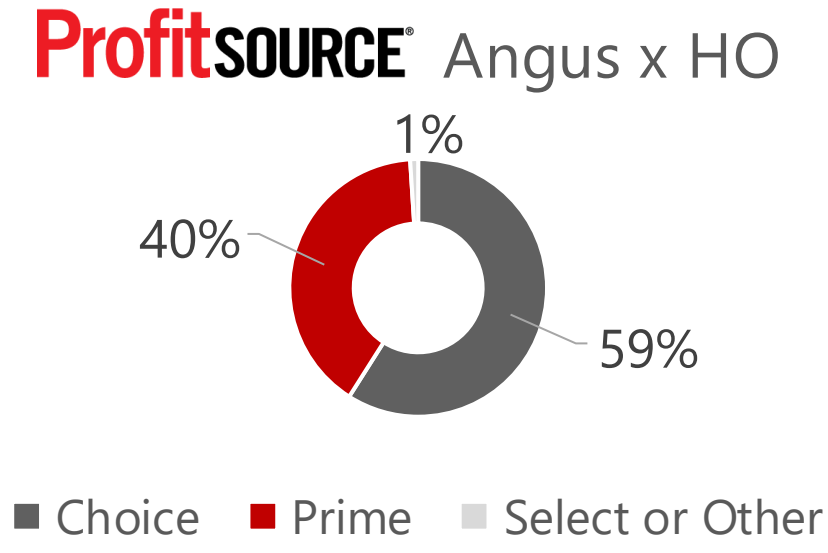


"Genetics create potential. Systems capture value."
– *Troy Marshall, American Angus Association*

INTEGRITY ◆ DEDICATION ◆ RESPECT ◆ INNOVATION

Consistency Reduces Risk, Quality Drives Demand





"I care deeply about consistency…variability is the enemy…"

– *Sidney Abbot, OT Feedyard & Research Center*

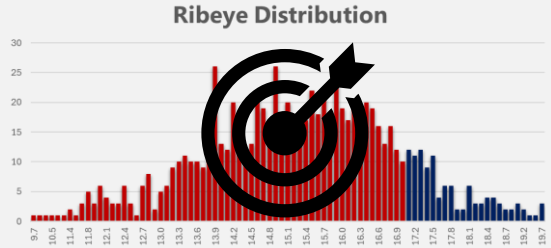


Marbling is moderately to highly heritable, ~45%

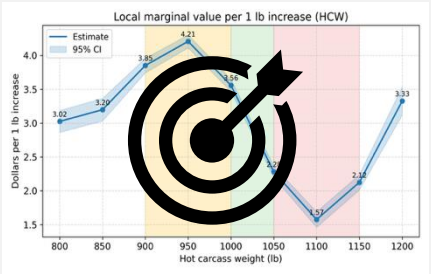


Hitting Moving Targets

Targeting Certified Angus Beef Specs



Managing CW Marketing Decisions



RMY System Developments

Yield Grading Outdated: Time to Modernize

Introduced in 1965, the USDA Yield Grade system has not been updated since its release even though cattle and technologies have drastically changed.

By Angie Stump Denton · March 27, 2025 08:17 AM

EVERY ISSUE HAS ITS MOMENT

And this is it for yield grade and red meat yield.

by Lindsay Graber Runft

Evolving the Conversation Around Red Meat Yield

NCBA • AUGUST 28, 2025



"We have a system that doesn't tell us accurately what we should be producing."

– *Dr. Dale Woerner, Texas Tech*

Genetics As Brand Equity

Genetic selection and identification can:

- ✓ Bring repeat demand
- ✓ Unlock access to coordinated supply chains
- ✓ Increase open market sale price

Video Sale Analysis

Genetic designation on sale listing	$ per head, standardized 450 lbs.	$ per head difference
ProfitSOURCE Program	**$1966.37****	**0**
No Genetic Program	$1913.40	- $52.97

Statistical analysis of CMS and Overland results.

For a load of 105 head sold, that difference equals **$5,562** when not using the program lineup…

…Selling 105 every month? **That's $66,744 left on the table that year by not using tailored program genetics.**

***Avg. 2023 to 2025*
Now over $2,472 per head!

Questions

High Plains Dairy Conference:
20 years providing science and information to dairy producers of the High Plains

Practical Truths About Sorghum Silage

John Paul Heavyside

General Manager, DFA Farm Services
Dairy Farmers of America



THIS MARK MATTERS. DFA Dairy Farmers of America

Meet your panelists



Jordan Bell, PhD

Associate Professor
Texas A&M AgriLife
Extension Agronomist



Douglas Duhatschek, DVM, PhD

Technical Services Manager
Parnell Pharmaceuticals



Lyndon Luckasson

OEM Business Director
Scherer Inc.



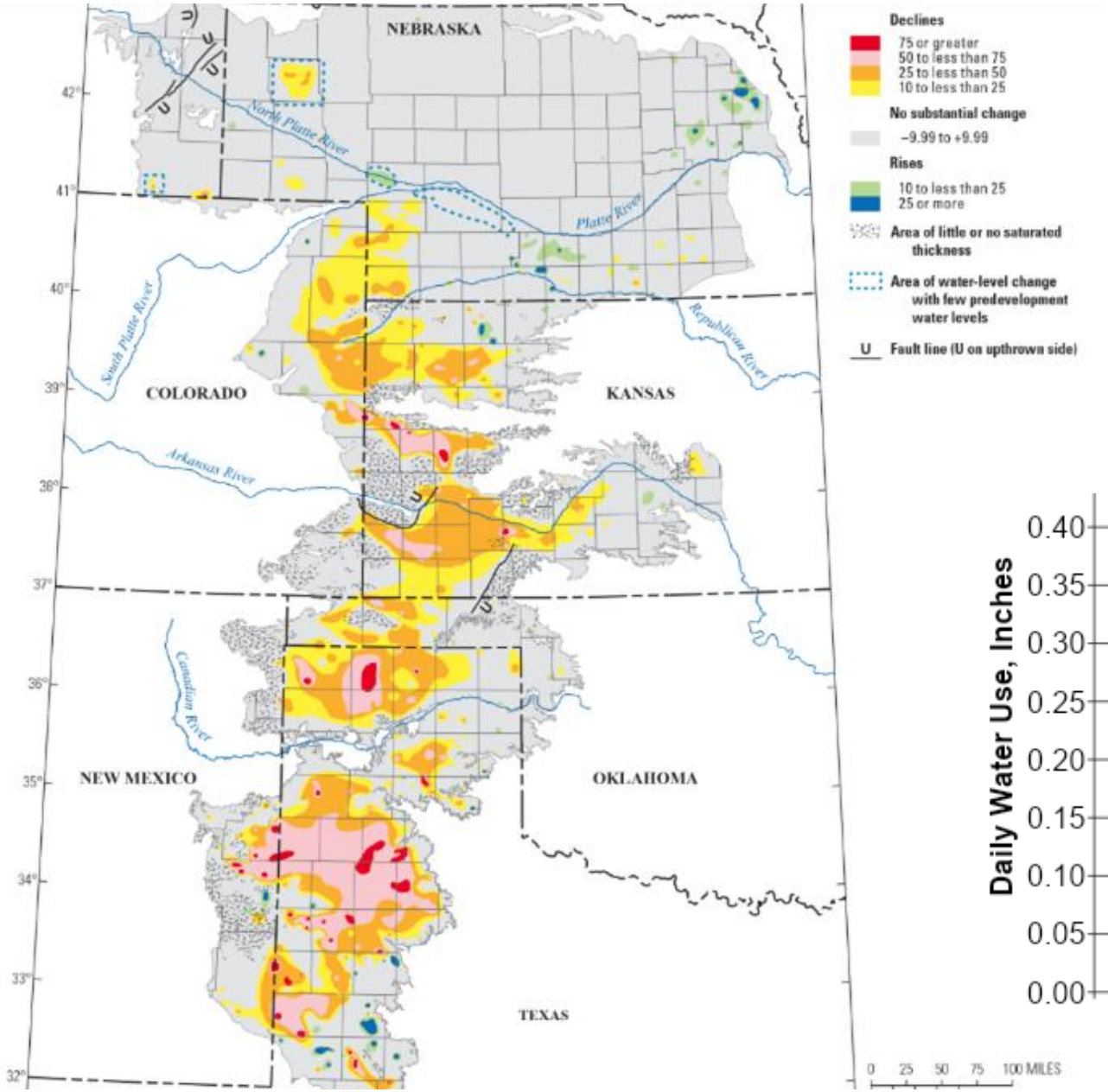
Braden Gibson

Manager
Gibson Farms

The case for sorghum

Jordan Bell, PhD

Percent Change in Saturated Thickness from Predevelopment to 2019



120 acres

500 gpm capacity

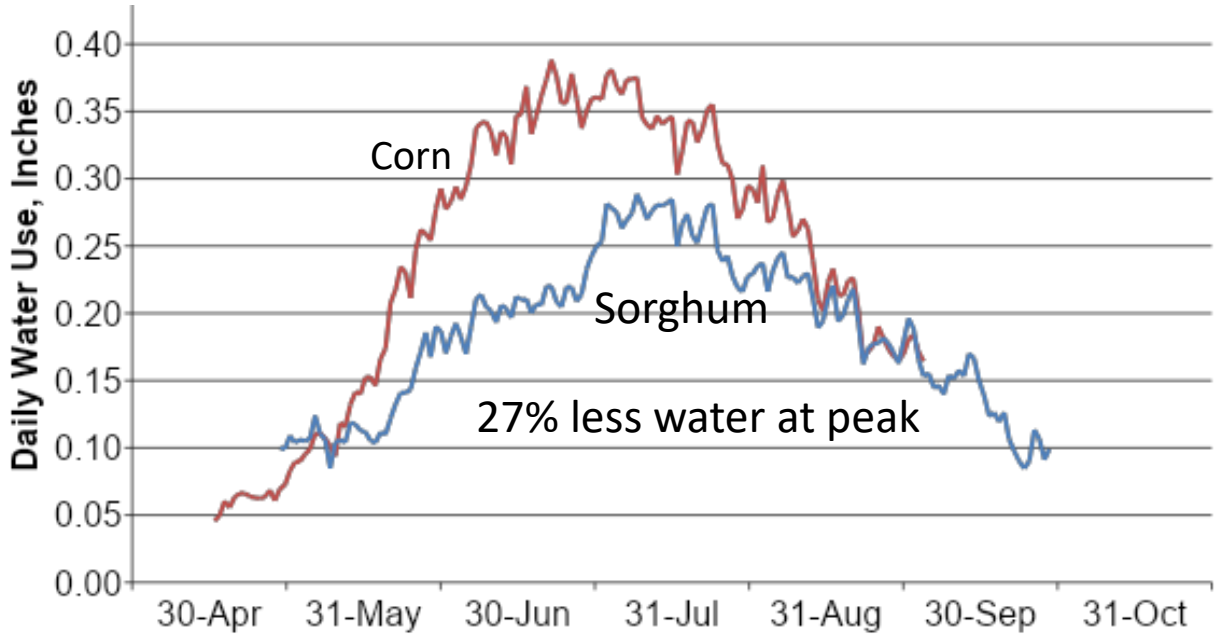
0.22 inch/day

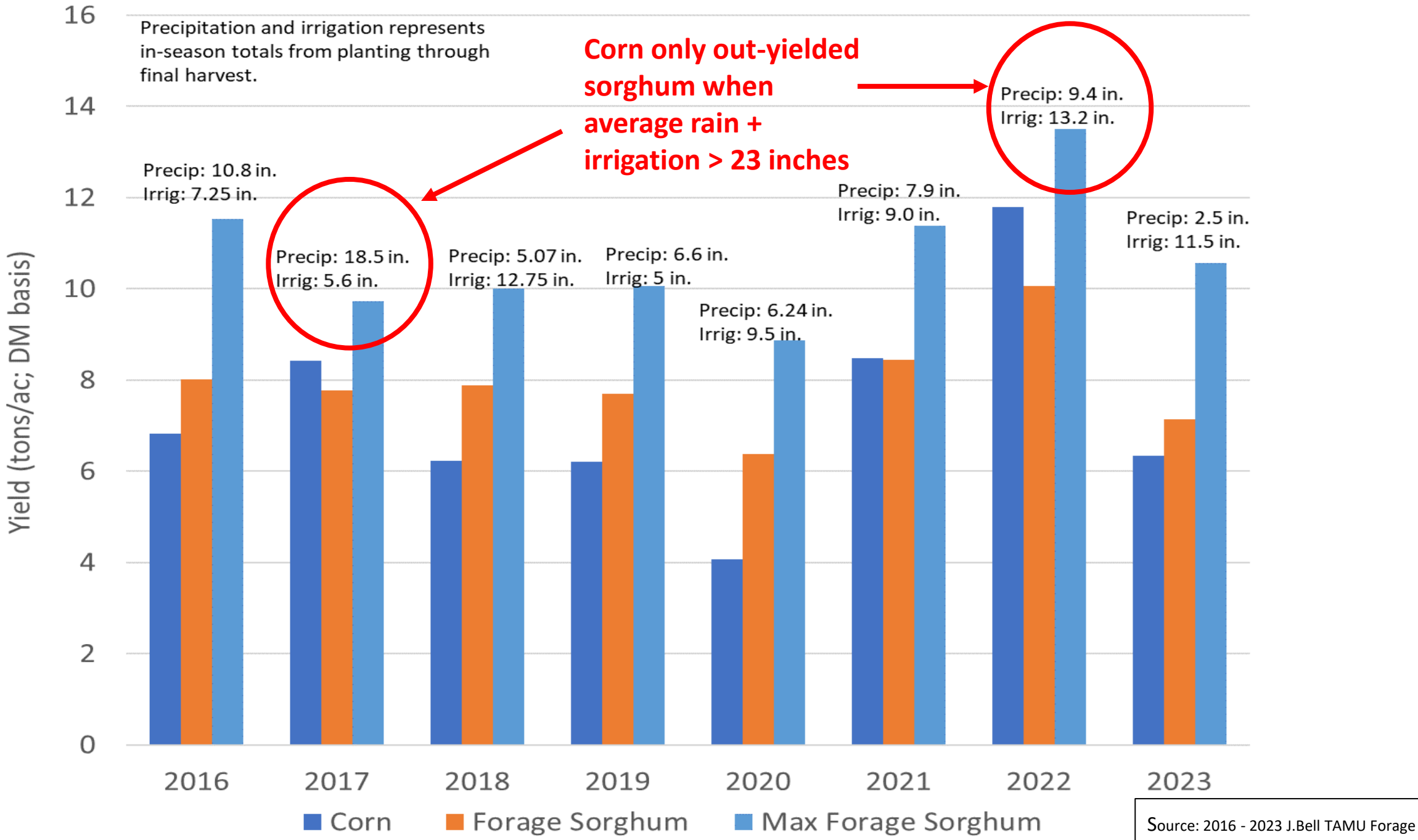
1.0 inch/4.5 days

250 gpm capacity

0.11 inch/day

1.0 inch/9 days





Source: 2016 - 2023 J.Bell TAMU Forage Sorghum Trial Summaries

Drought Damaged Corn Silage

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

Message to producers: If there is a risk for drought damaged corn, consider forage sorghums.

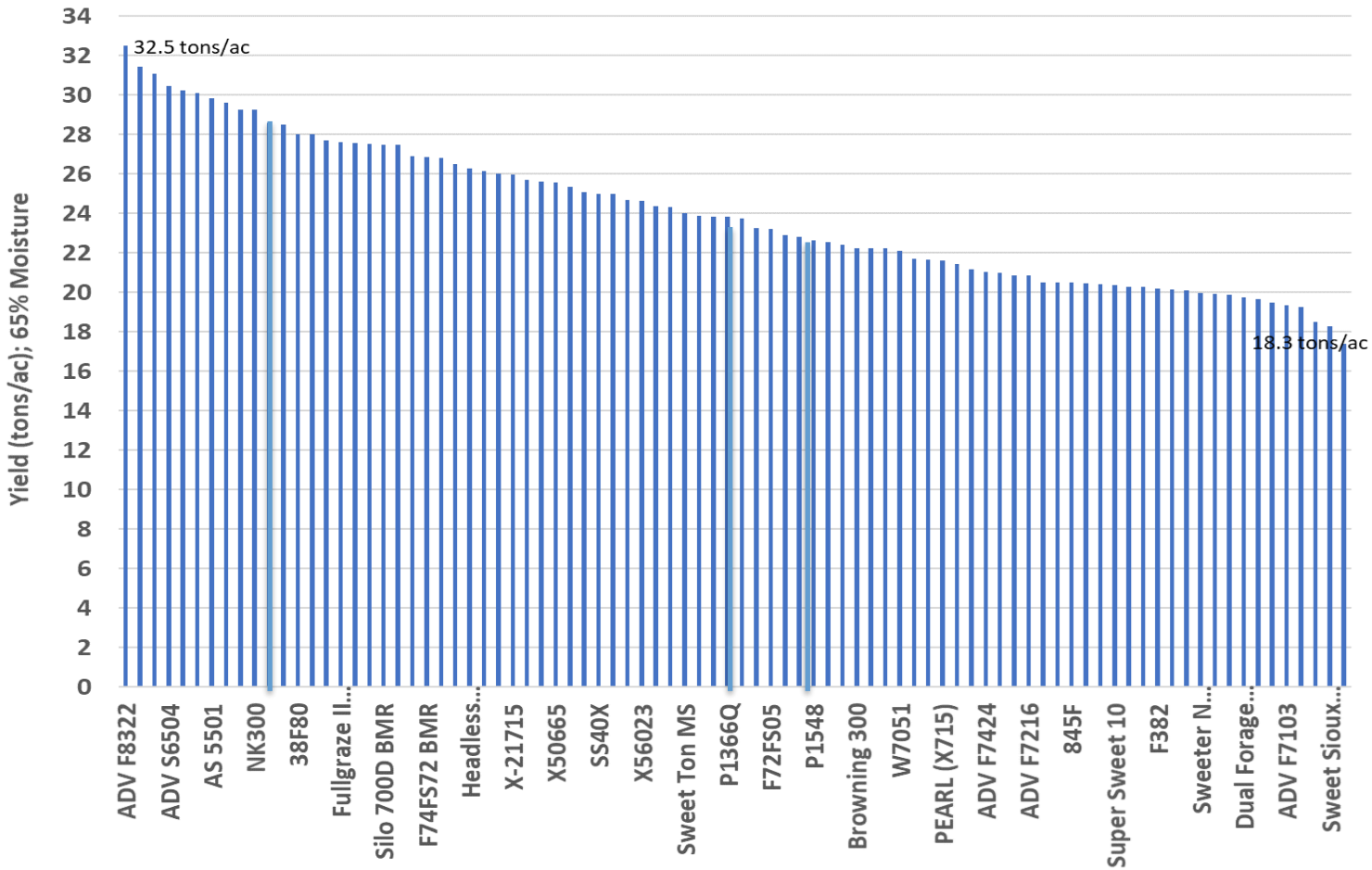
Source: Bell, TAMU



AMS Approved

2021 Texas A&M AgriLife Forage Sorghum Variety Trial

- Planting Date: June 7, 2021
- Forage Sorghum Seeding Rate: 80,000 seeds/acre
- Corn Silage Seeding Rate: 32,000 seeds/acre
- In-season Irrigation: ~8.25 inches
- In-season Precipitation: ~8 inches



AMS Approved

Source: Bell, TAMU

Corn vs Sorghum Costs

	Corn (27 tons)	Sorghum (20 tons)	Difference
Seed	$132	$16	$116
Fertilizer	$226	$118	$108
Irrigation	$124 (20 inches)	$85 (14 inches)	$39
Harvest & Hauling	$338	$250	$88
Other	$347	$242	$105
Total Variable Costs	**$1,167 ($43/ton)**	**$711 ($35/ton)**	**$456**

2026 Texas A&M AgriLife Extension Panhandle District 1 Budgets

Sorghum trials and nutrition

Douglas Duhatschek, DVM, PhD

Acknowledgements

Funding sources:

SORGHUM CHECKOFF

Texas Association of Dairymen

DMI DAIRY MANAGEMENT INC.™

RICHARDSON SEEDS Est. 1955 Proven Dependable

Ferraroni MANGIMI Partnership for Success!

- Dairy farmers, crop producers and custom harvesters.
- Rock River Laboratory, Watertown, WI.
- Southwest Regional Dairy Center.



Dr. Juan Piñeiro



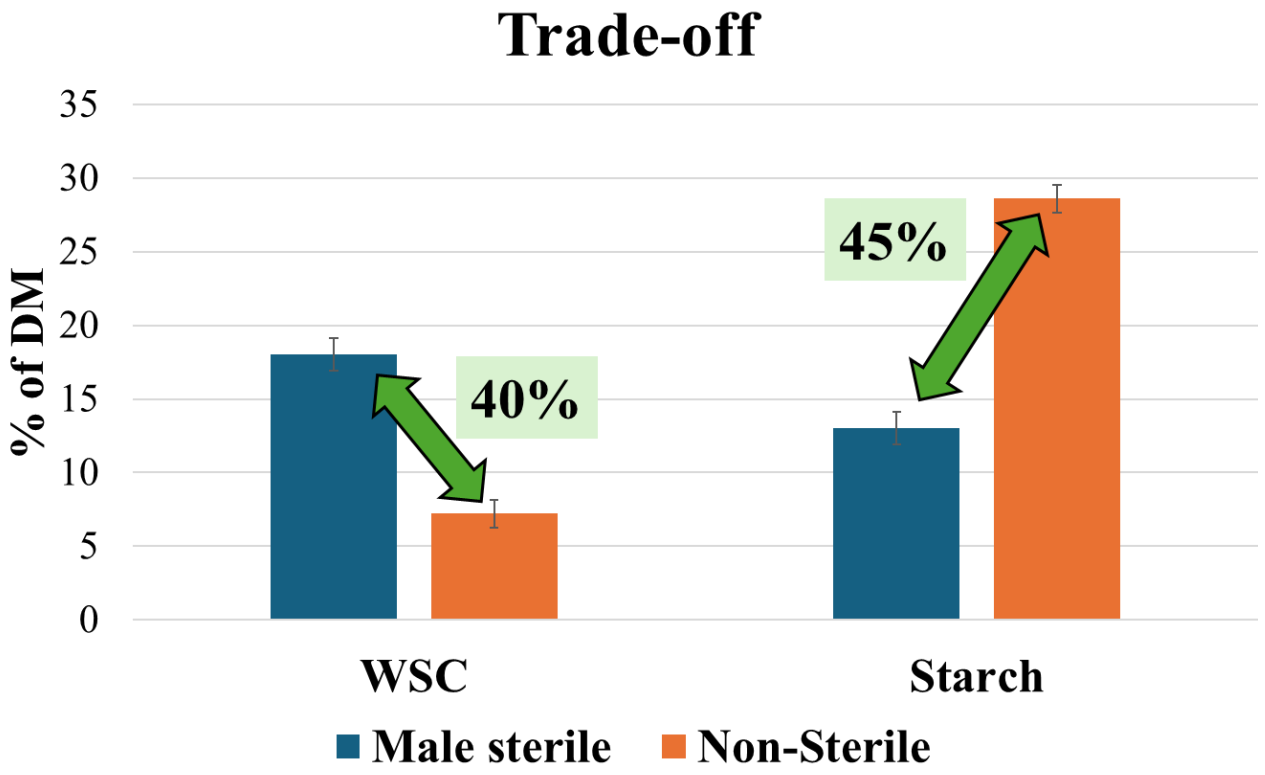
Dr. Jourdan Bell

- Dr. Luiz F. Ferraretto
- Diego Druetto
- Dr. Michael Conner
- Dr. William P. Weiss



Focus on fiber

- **BMR x conventional**
  - BMR ~5%-point higher NDFD
- **Male-sterile sorghum**
  - Accumulates WSC trading-off with grain production
  - Wider harvest window
  - May need wilting to dry
  - Proved to work as partial replacement for corn silage → Increased DMI when replacing 50% of corn silage
  - Greater risk of ergot → flower remains open without pollination

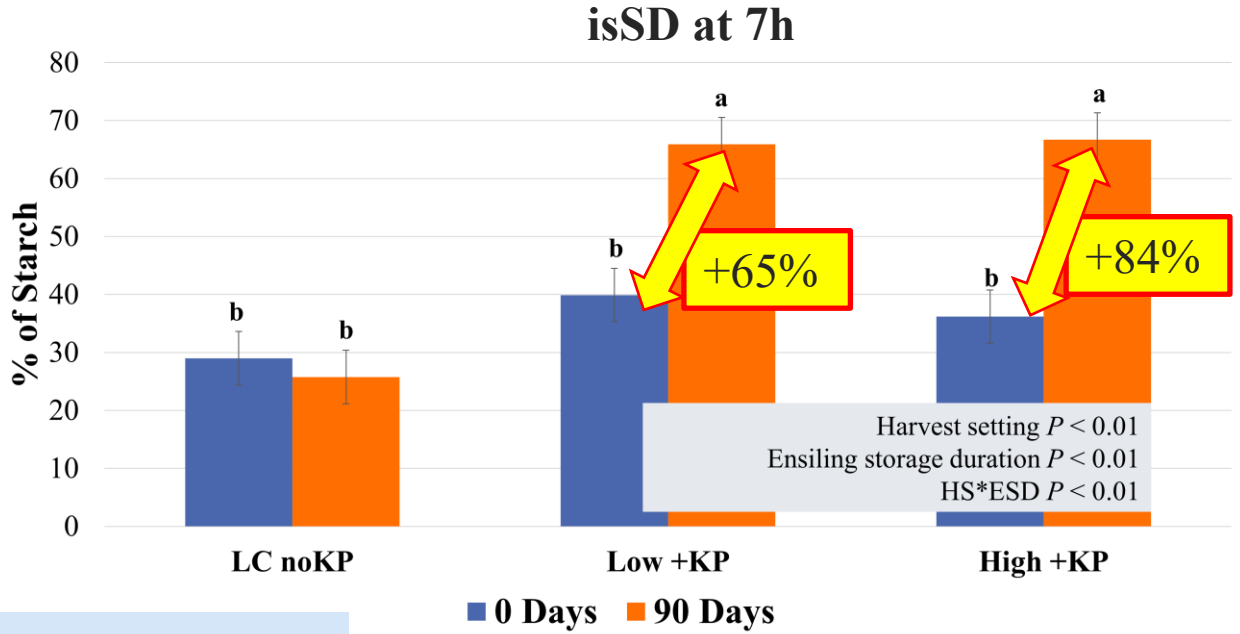


Item	Dietary treatment			
	Control	25%-BMR-MS-SS	50%-BMR-MS-SS	SEM
DMI, kg/d	23.6[b]	26.6[a]	26.3[a]	0.53
ECM, kg/d	40.4[b]	44.4[a]	43.7[a]	0.95
Milk yield, kg/d	35.1[b]	38.6[a]	37.5[a]	0.84

Duhatschek et al., 2024 and 2026.

Focus on starch digestibility

	2021 (corn KP)	2024 (Durracut KP)			
	Corn Rg2.0	F10 Rg1.0	F24 Rg1.0	F10 Rg0.5	F24 Rg0.5
DM, %	34	35	36	35	34
Starch, %	31	33	32	31	29
$BPS_{2.36mm}$, % of starch	.	64	52	70	58
isSD7, 0 mo	75	77	79	80	81
isSD7, 3 mo		85	87	85	86
isSD7, 6 mo		83	90	85	90
isSD7, 9 mo		84	90	85	92



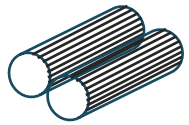
What do I need to get there: **Treat it like corn**

- Maturity → late soft dough - early hard dough
- KP and settings → Sorghum specific KP & <1mm gap
- Hybrid → 1- Early to mid maturing cycle
  2- bigger heads ~starch >30% of DM
- Ensiling time → at least 3mo → 5mo

Piñeiro et al., unpublished data; Duhatschek et al., 2025.

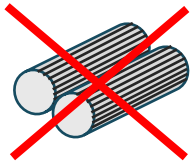
ROI. Low + KP vs. Low no.KP (90 d of ED)

Investment = **$2.5/ton**
↑ 40 %-points isSD7



Low + KP

Vs.



Low no.KP

			Return	ROI
Return:	Milk 2024 model	↑ 37 lbs Milk/ton	↑ ~$6.3/ton	2.5
	DGC savings	↓DGC 2 lbs/cow/d	↑ ~$8/ton	3.2
	Nutrients price	↑NEL ↑MP ↑NDFD	↑ ~$7/ton	2.7

Slide courtesy of Dr. Piñeiro; Diepersloot et al., 2024; Ferraretto, 2023; Weiss, 2022

Thank you

Contact:

(607) 216 7540

douglas.duhatschek@parnell.com

Kernel processing

Lyndon Luckasson

Director KP Sales, Scherer Inc

DurraCut™ Sorghum Silage

Patent Pending Technology



Forage sorghum harvested without the use of kernel processors. 85% of berries intact.



Forage sorghum harvested with the use of kernel processors. 2% of berries intact and 98% of berries processed.

Increased starch digestibility in dairy cows

	Low-cut height without Kernel Processing		Low-cut height with Kernel Processing		
Ensiling Times	0 days	90 days	0 days	90 days	210 days
ADF, % DM	24.3^{a}	23.9^{a}	22.1^{a}	22.0^{ab}	21.92^{a}
aNDFom, % DM	34.2^{a}	33.3^{a}	30.4^{ab}	27.5^{a}	32.56^{b}
Starch, % DM	33.1^{b}	30.6^{b}	37.2^{b}	36.7^{a}	31.01^{b}
2.36 mm Berry Processing Score (BPS), % starch	7.7^{c}	8.6^{c}	55.8^{b}	56.7^{b}	
Rumen in situ starch digestibility after 7 hours of incubation (isSD7), % starch	29.0^{b}	25.8^{b}	39.9^{b}	65.9^{a}	86.02^{a}

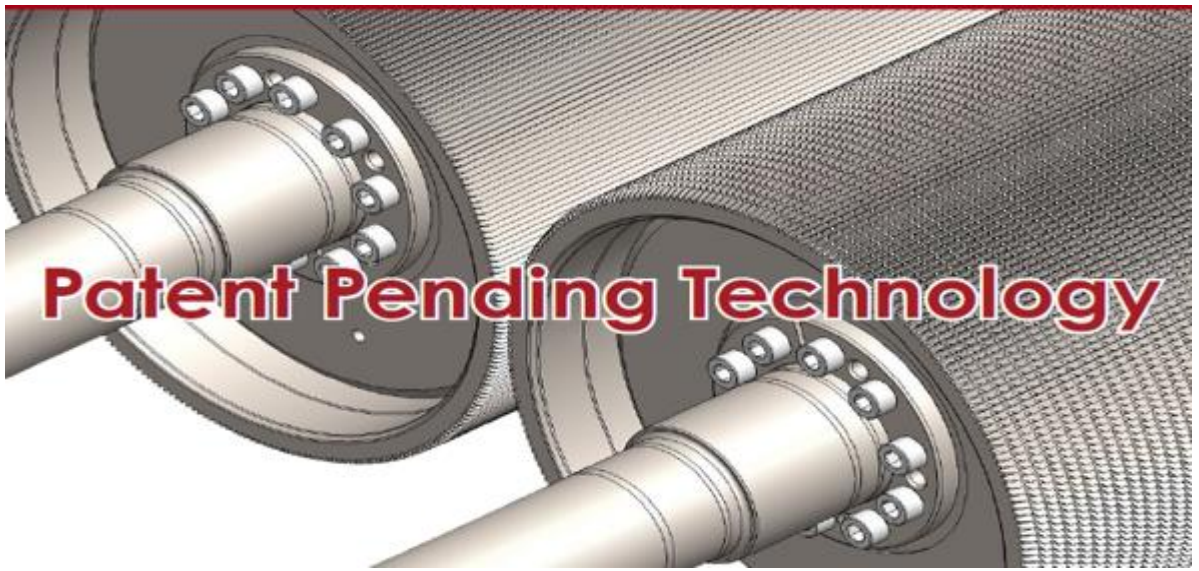
DurraCut Kernel Processor Rolls

Engineered for maximum feed efficiency and starch availability

- **Innovative Kernel Processing Technology**
  - Breakthrough design engineered specifically for forage sorghum and other small grains.
  - Achieves up to 100% berry processing, ensuring optimal starch accessibility and digestibility.
- **Enhanced Feed Performance**
  - Improves starch digestibility in dairy cows, resulting in higher milk production.
  - Reduces intact berries from 85% to just 2% — a major improvement in feed quality.
  - Improves feed efficiency and gain in beef cattle.
- **Tested and Validated**
  - Field-proven data demonstrate significant improvements over traditional harvesting methods.
  - Ideal for operations seeking measurable ROI in feed conversion and herd performance.

Cost of Operation

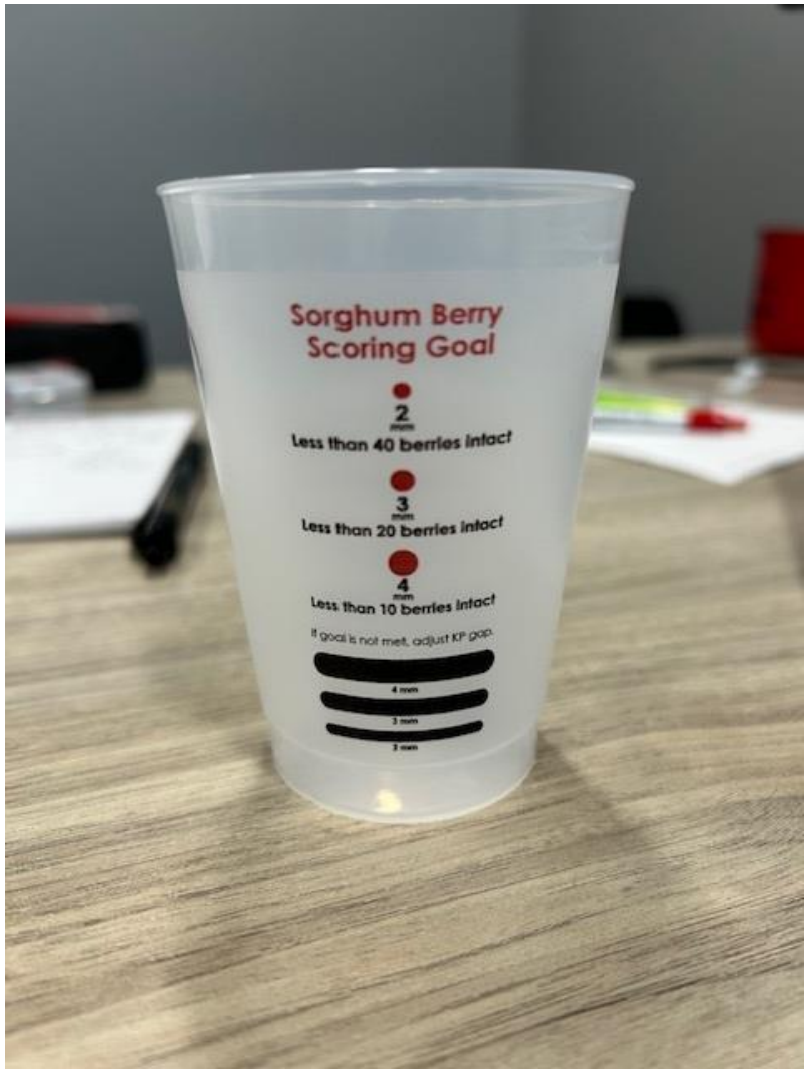
- When we compare to harvesting Corn Silage with a kernel processor, we will have **~15% reduced** throughput when harvesting Sorghum
  - As long as we are comparing sorghum to corn with similar starch content!
- **Processing fodder is more difficult than processing grain**
  - Higher grain means more tons/hr







Sorghum Berry Scoring





DURRACUT Availability

- Krone 80 series
- NH 2007 - present
- Claas 2004 – present
- JD 2016 - present

Grower/Harvester Experience

Braden Gibson
Gibson Farms
Dumas, TX

Sorghum growing experience

- Sorghum hybrids over time
- Planting techniques(air drill, planter row spacing)
- Tillage options
- Weed pressure
- Pest management
  - SCA
- Disease concerns
- Standability

Sorghum Harvesting experience

- Harvest timing/harvest window
- Dry down/moisture
- Harvest efficiency

Questions?

Dr. Brent Bean, Director of Agronomy, United Sorghum Checkoff

Dr. Jourdan Bell, Texas A&M Agrilife

Dr. Douglas Duhatschek, Parnell

Lyndon Luckasson, Scherer

Braden Gibson, Gibson Farms

Feeding Dairy Cattle Under Water Constraints: *Tactical Strategies for Herd Resilience*

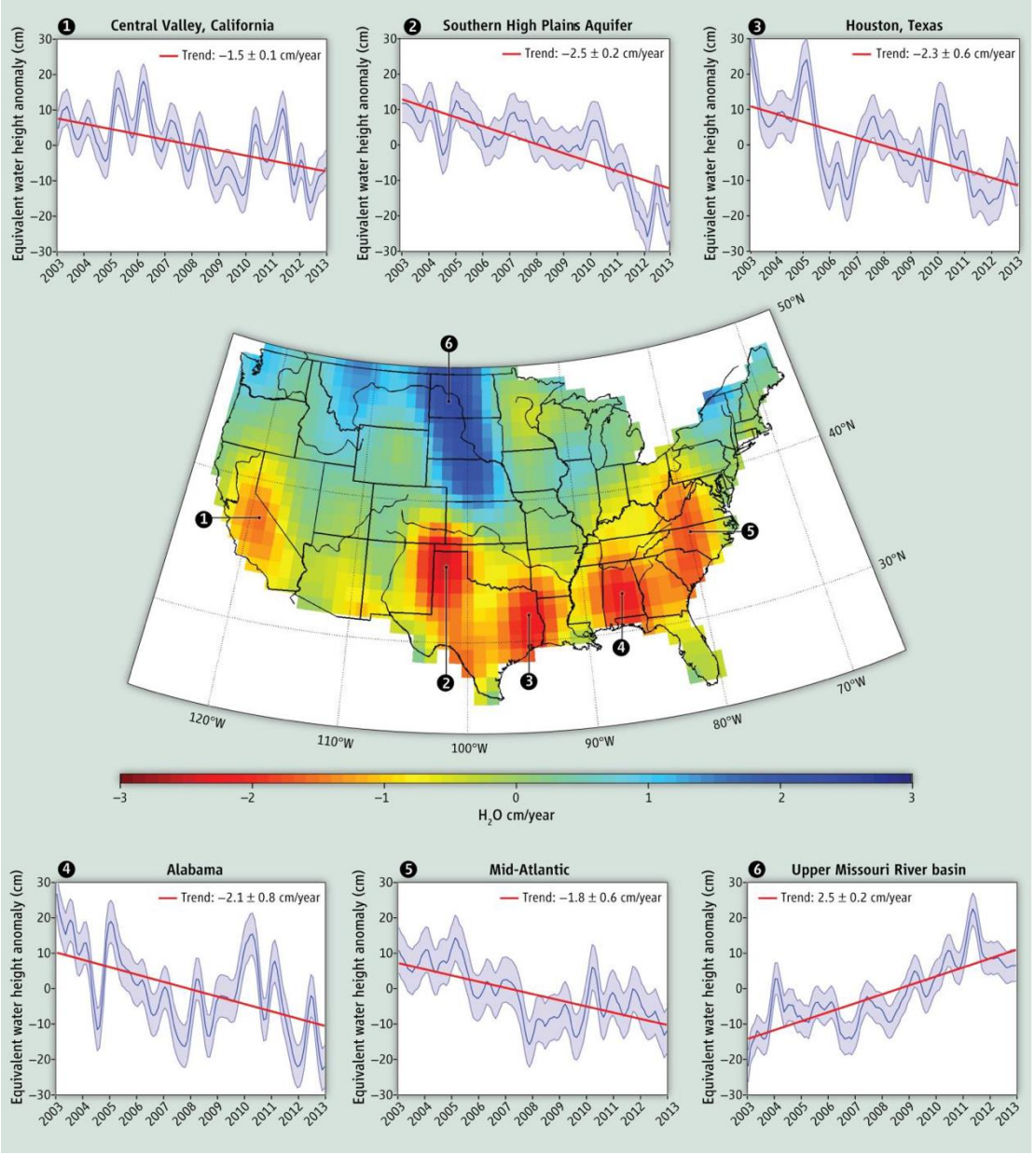


P. J. Kononoff and K. A. Harpestad

Department of Animal Science, University of Nebraska-Lincoln, Lincoln, NE

2026 High Plains Dairy Conference
2:00 – 2:45 PM (45 min)
March 4, 2026
Embassy Suites by Hilton Amarillo Downtown
Amarillo, TX, 79101

HIGH PLAINS DAIRY CONFERENCE



Trends in Freshwater Storage from GRACE, 2003-2012

- California (Central Valley) → Documented groundwater depletion in a core U.S. dairy and forage production region.
- Mid-Atlantic → Measurable drought-related groundwater declines in an important milk shed.
- Upper Midwest / Northern Plains → Increasing water storage in the Upper Missouri Basin signals greater flood variability risk.
- High Plains → Southern High Plains Aquifer losses threaten irrigation-dependent dairy systems.

Famiglietti and Rodell, 2013

What would you do next year with less water?

“Reduce forage acres”



Photo courtesy of K. K. Buse



Photo courtesy of A. Ramírez Ramírez

What cows run on….

- Metabolizable energy
- Effective fiber
- How do we supply this when forage is constrained?



What is energy?

- Ability of a feed *to support work* done or products formed
- We measure the amount of *heat* released when something is completely burned
- If 1 kg of *sawdust* is burned it will release approximately the same amount of heat as 1 kg of *corn grain*
  - Sawdust will support less and milk production

1 kg = 1 kg



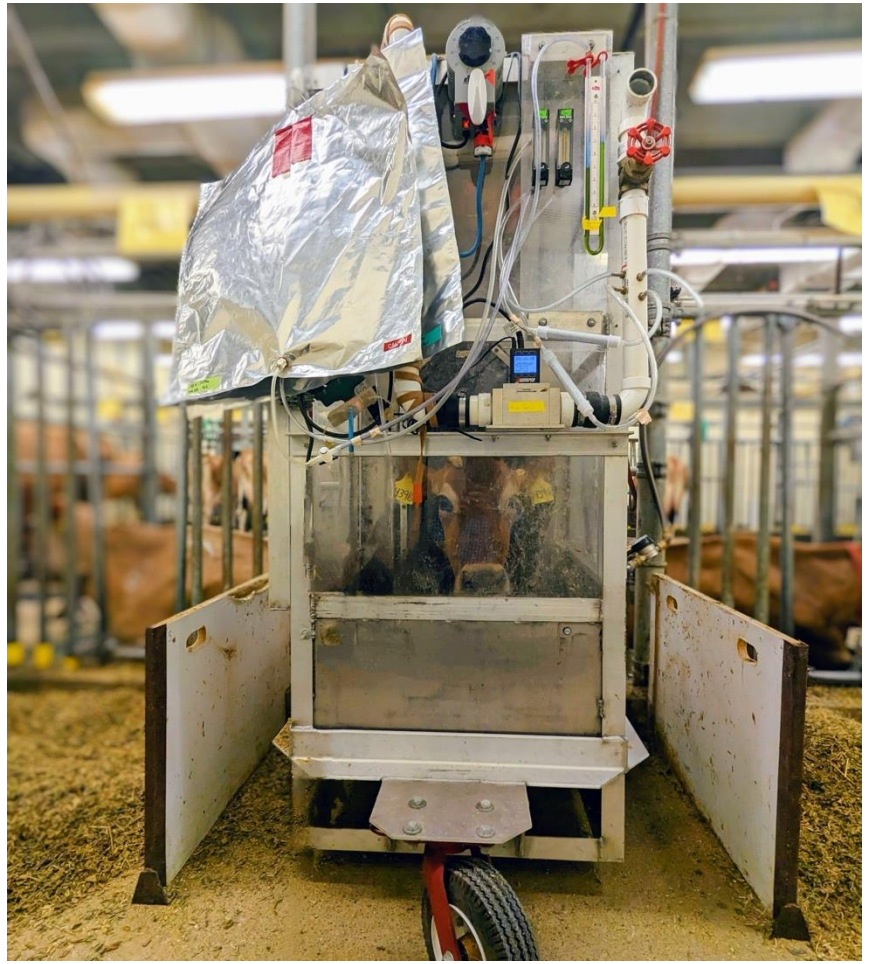


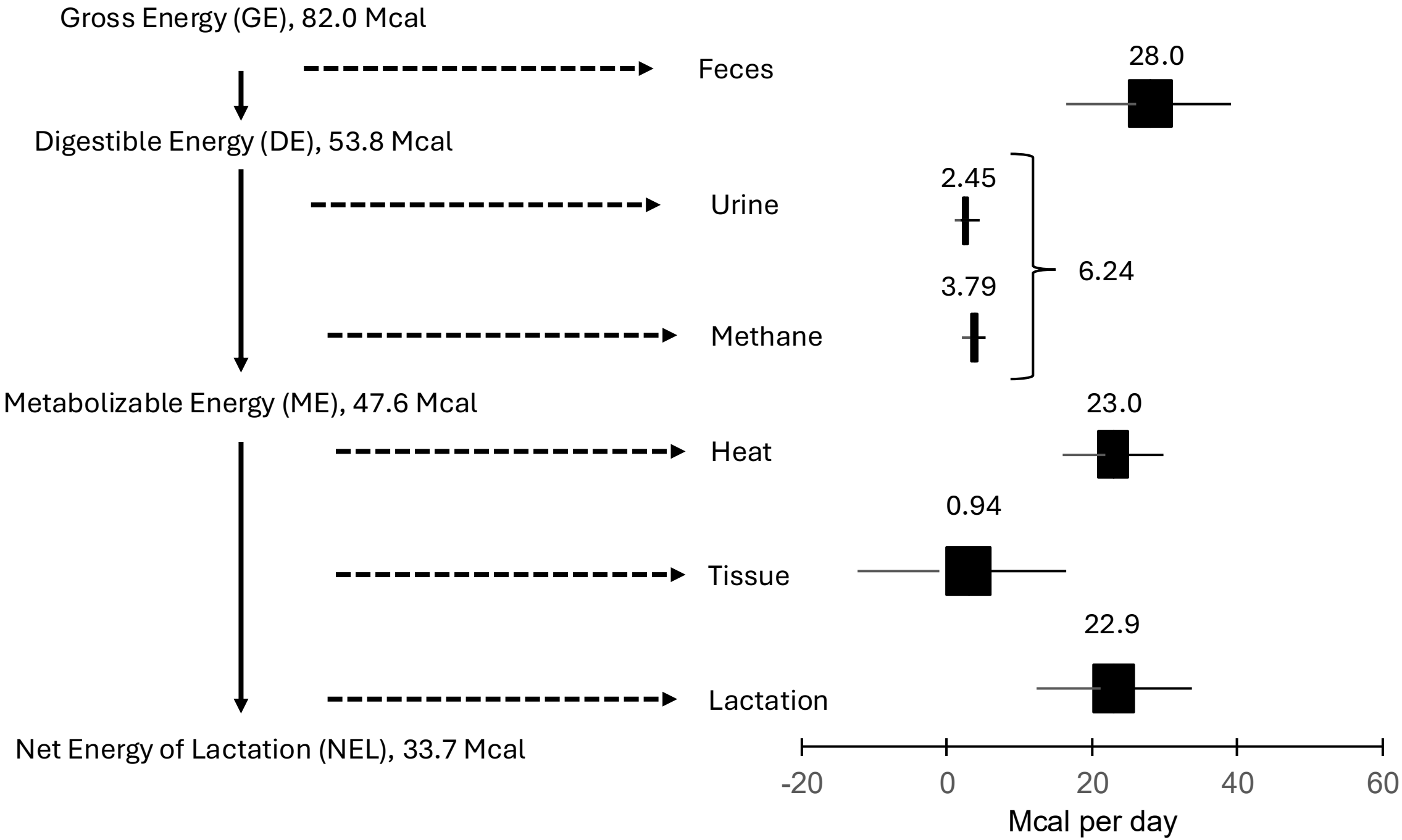
(Weiss, 2007; Proc. Minnesota Nutr. Conf., Minneapolis, MN, Page 9-18)

Measuring energy utilization








Gross Energy (GE), 82.0 Mcal
Feces
28.0
Digestible Energy (DE), 53.8 Mcal
Urine
2.45
Methane
3.79
6.24
Metabolizable Energy (ME), 47.6 Mcal
Heat
23.0
Tissue
0.94
Lactation
22.9
Net Energy of Lactation (NEL), 33.7 Mcal
-20
0
20
40
60
Mcal per day

Part I. Silage choices


Photo courtesy of A. Ramírez Ramírez

Item, % DM	Corn Silage (typical)	Alfalfa Silage	Sorghum (immature)	Sorghum (mature)
Dry matter	35.4	42.9	29.2	28.7
Crude protein	7.7	20.5	11.7	11.3
Starch	32.9	2.0	8.1	2.7
NDF	40.9	43.2	56.7	61.6
Lignin	3.05	7.42	4.92	5.15
NDFD48	52.0	49.4	58.5	63.6
DE, mcal/kg	2.93	2.59	2.45	2.38

NASEM, 2021



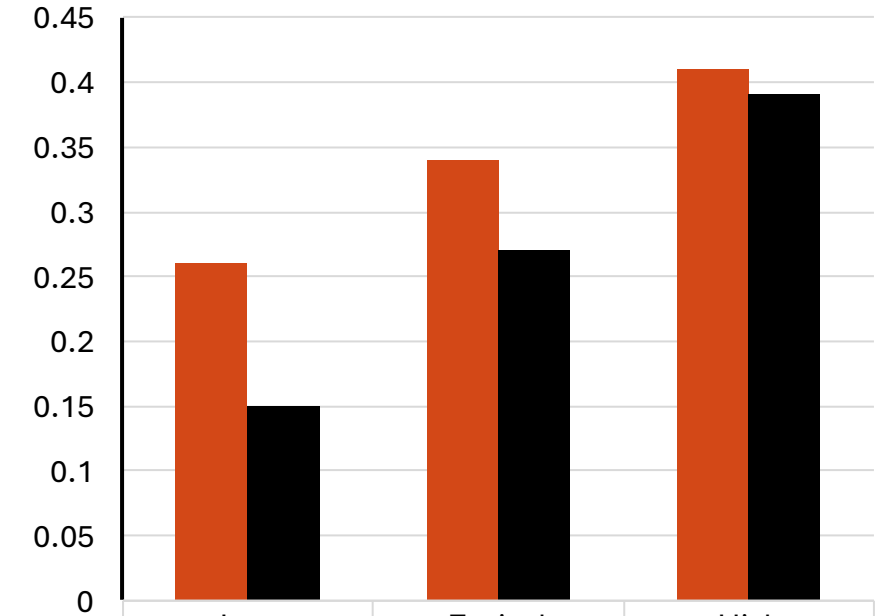




Photos courtesy of A. Ramírez Ramírez

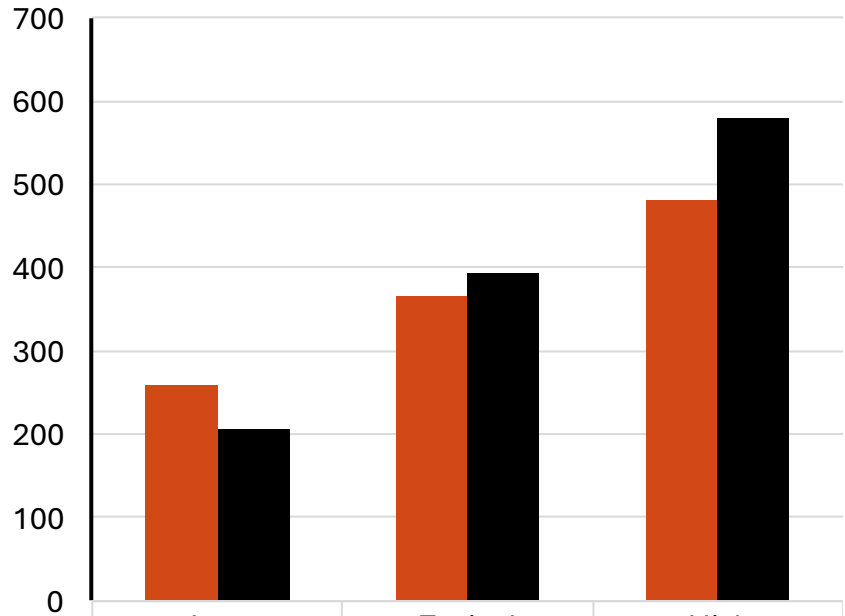
Water and feed returns per Acre-Inch, Kansas field data

Tons DM per Acre-Inch



	Low	Typical	High
Sorghum Silage	0.26	0.34	0.41
Corn Silage	0.15	0.27	0.39

Mcal NEL per Acre-Inch



	Low	Typical	High
Sorghum Silage	260	365	480
Corn Silage	205	392	580

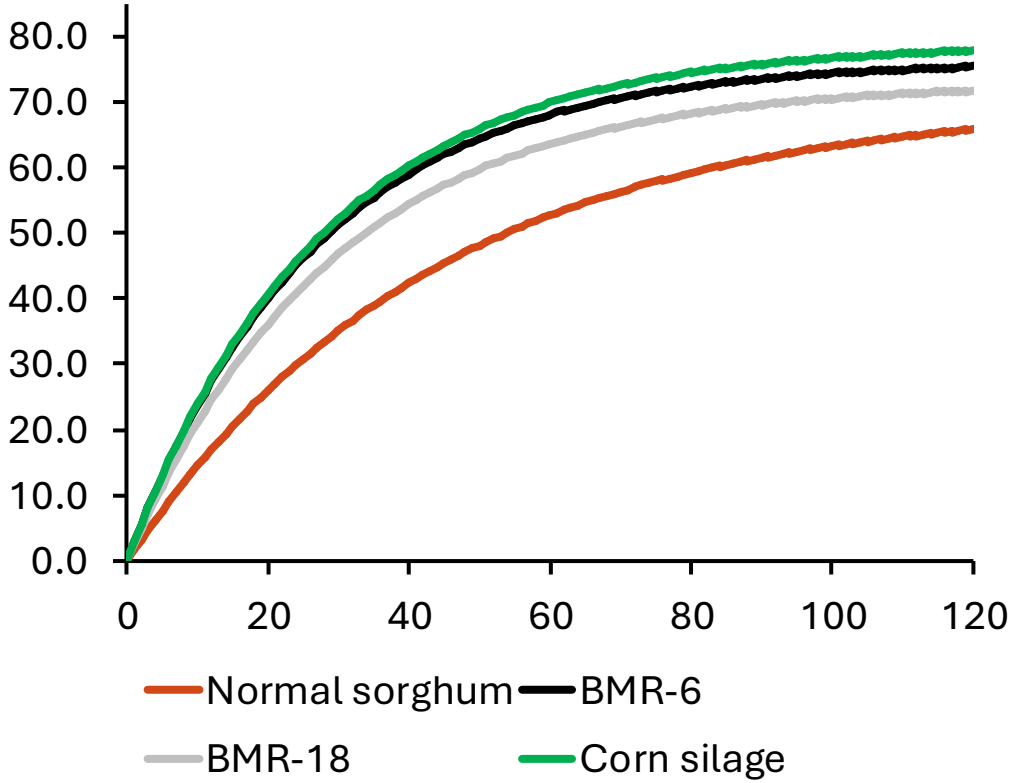
Waite (2016)

Corn Silage and Sorghum Silage

Silage: Chemical Composition

Item, % DM	Corn Silage	Normal Sorghum	BMR-6 Sorghum	BMR-18 Sorghum
Crude protein	8.4	7.3	7.5	7.8
Starch	19.9	10.9	16.8	14.5
NDF	46.1	58.1	50.2	48.2
Lignin	5.53	8.8	6.9	6.22
NDFD48, %	59.1	56.4	62.4	61.0

NDF digestion (%) over time



Oliver et al., 2004

Replacing corn silage with BMR Sorghum Silage

	Corn Silage	Normal Sorghum	BMR-6 Sorghum	BMR-18 Sorghum
DMI, lbs/d	54.0	51.6	56.0	52.0
NDF digestibility, %	54.1[a]	40.8[c]	54.4[a]	47.9[b]
Milk, lbs/d	75.1[a]	68.9[b]	75.8[a]	71.6[ab]
Fat, lbs/d	2.93[a]	2.47[b]	2.98[a]	2.71[ab]
Protein, lbs/d	2.22	2.02	2.20	2.13
4% FCM, lbs/d	74.0[a]	64.7[b]	74.9[a]	69.3[ab]
FE, lbd/lbs	1.38[a]	1.25[b]	1.37[a]	1.35[a]

Oliver et al., 2004

Replacing corn silage with BMR Sorghum Silage



J. Dairy Sci. TBC
https://doi.org/10.3168/jds.2025-27271
© TBC, The Authors. Published by Elsevier Inc. on behalf of the American Dairy Science Association®.
This is an open access article under the CC BY license (https://creativecommons.org/licenses/by/4.0/).

Effects of partially replacing corn silage with brown midrib male-sterile sorghum silage on intake, digestibility, and milk production in dairy cows

Douglas Duhatschek,[1] Artur G. Pilati,[1] Joao P. Mittelstadt,[1] Alana M. Lee,[1] Kimberly B. Wellmann,[2] Michael Conner,[3] Gustavo M. Schuenemann,[4] Sushil Paudyal,[1] Jason K. Smith,[1] Jourdan M. Bell,[5] Luiz F. Ferraretto,[6] Vinícius N. Gouvêa,[1] and Juan M. Piñeiro[1]*

[1]Department of Animal Science, Texas A&M University, College Station, TX 77845
[2]Department of Animal Science, Tarleton State University, Stephenville, TX 76402
[3]360 Ag Management, Lingleville, TX 76446
[4]Department of Veterinary Preventive Medicine, The Ohio State University, Columbus, OH 43210
[5]Department of Soil and Crop Sciences, Texas A&M University, College Station, TX 77805
[6]Department of Animal & Dairy Sciences, University of Wisconsin–Madison, Madison, WI 53706

Forages: Chemical Composition

Item, % DM	Corn Silage	Sorghum Silage
Dry matter	36.5	27.5
Crude protein	7.9	10.6
Starch	33.3	3.4
NDF	37.5	49.5
Lignin	4.2	4.1
NDFD30	59.3	58.9
DE, mcal/kg	2.85	2.54

(Duhatschek et al., 2026)

Replacing corn silage with BMR Sorghum Silage

	Control 47% CS/0%SS	Low Sorghum 36% CS/12 % SS	High Sorghum 24%CS/24%SS
DMI, lbs/d	52.4[b]	59.1[a]	58.4[a]
NDF digestibility, %	44.7[ab]	49.5[a]	37.0[b]
Milk, lbs/d	78.0[b]	85.8[a]	83.3[a]
Fat, lbs/d	3.60	3.67	3.71
Protein, lbs/d	2.89	2.80	2.80
ECM, lbs/d	89.8[b]	98.7[a]	97.1[a]
FE, lbd/lbs	1.70	1.66	1.66

[1]Corn grain: 17, 22, and 27% of diet DM for Control, Low Sorghum, and High Sorghum

(Duhatschek et al., 2026)

Nutrient Digestibility and DE

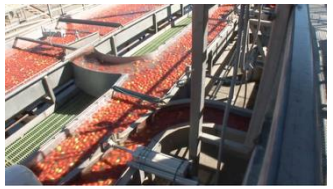
	Control 47% CS/0%SS	Low Sorghum 36% CS/12 % SS	High Sorghum 24%CS/24%SS
Dig NDF intake, lb	15.6	19.0	16.8
DE from NDF, Mcal	29.4	36.0	31.8
Dig starch intake, lb	15.6	17.6	17.0
DE from starch, Mcal	29.6	33.5	32.3
DE from NDF+starch, Mcal	59.0	69.4	64.0

(Duhatschek et al., 2026)

Part II. Increasing Our Reliance on Coproducts

- "… secondary products produced in addition to the principle product (AAFCO, 2016)."
- Originate from a wide range of industries including the food, fiber, beverage, and bioenergy industries.
- Contain a high concentration of nutrients.
- Improve palatability.








Feeds

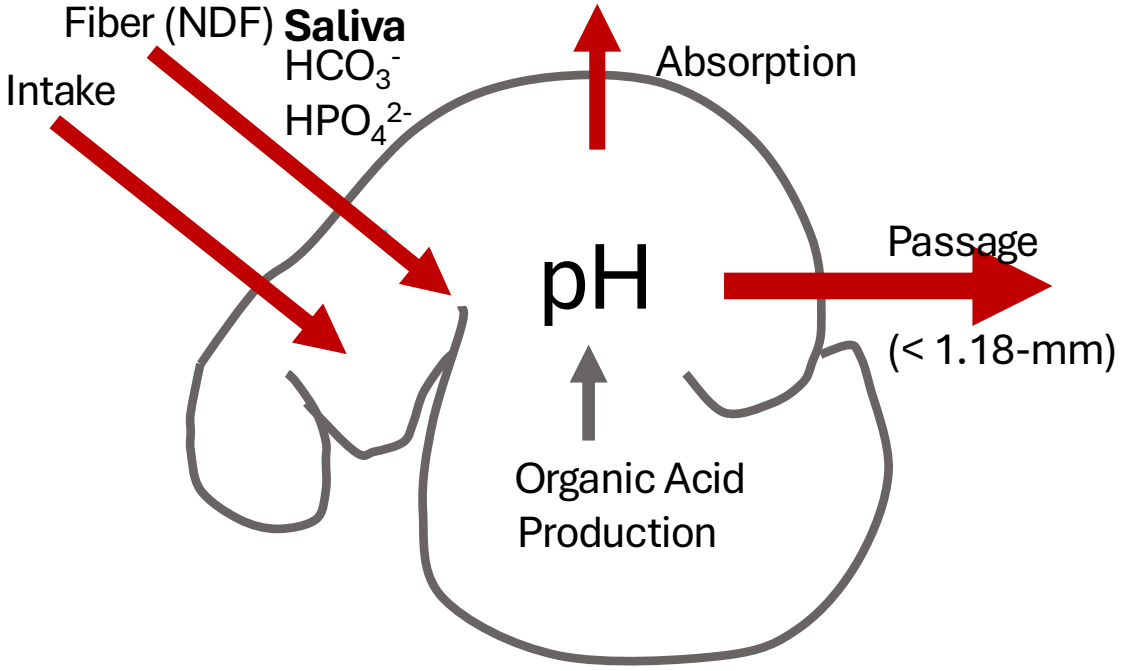
Alfalfa, ~ 21% CP, 41 % NDF

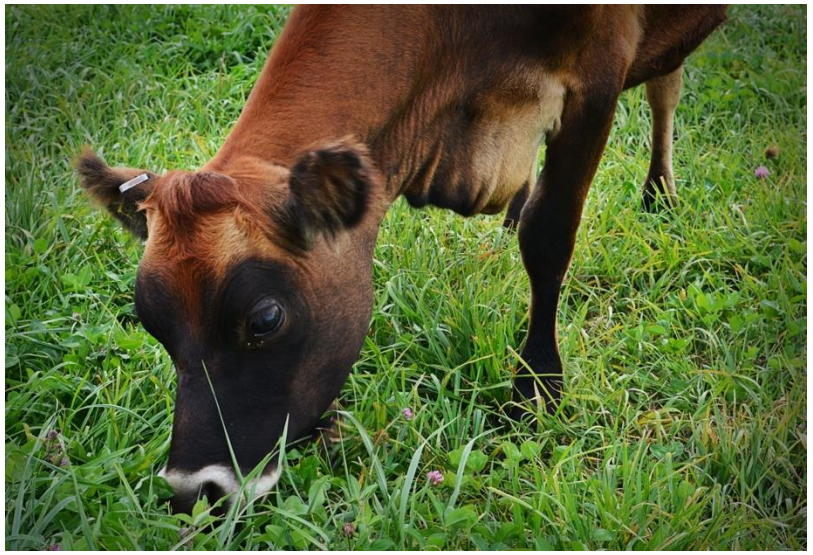


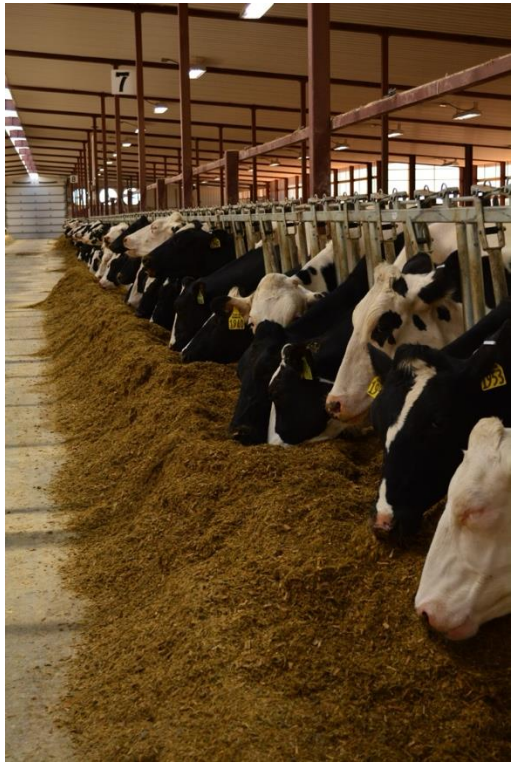
Corn Coproducts (DDGS), 31% CP, 31% NDF



Effective Fiber





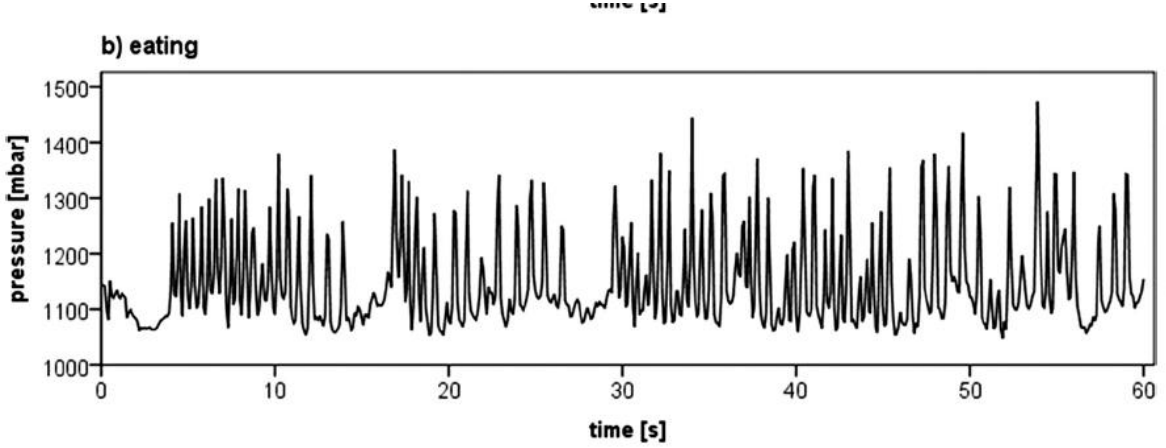


Factors affecting rumen pH

1 L of saliva = 7.5 g bicarbonate

(Erdman, 1988)

Eating Activity

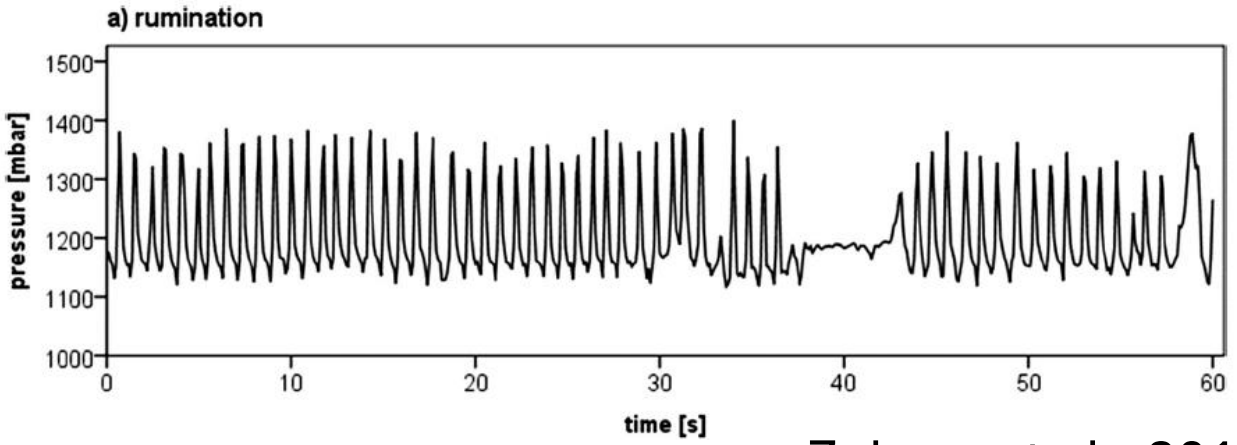


Zehner et al., 2017

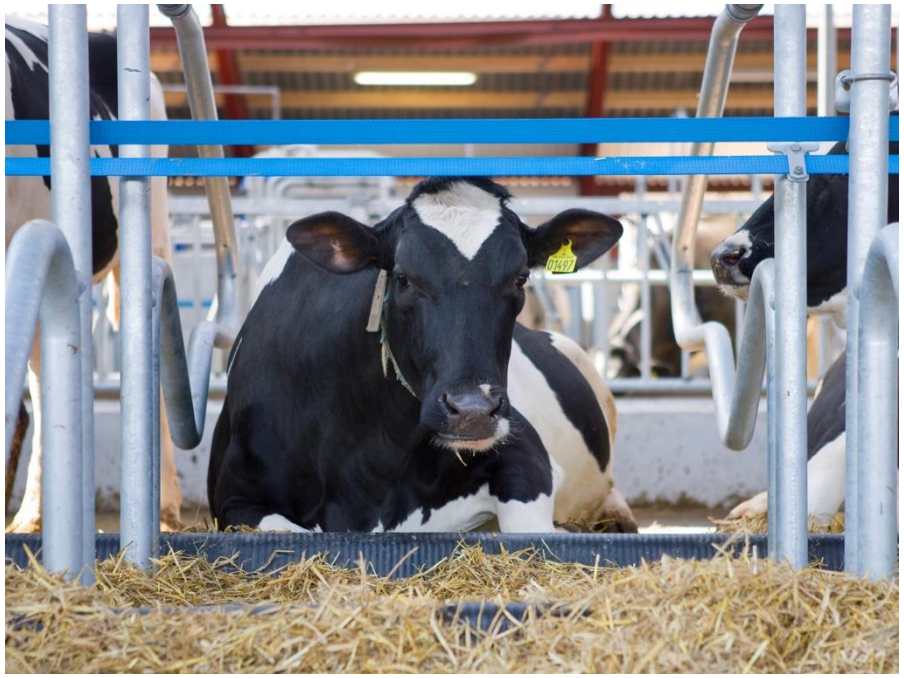


- prehension of feed by the mouth, followed by chewing and swallowing of the boli (Beauchemin, 1991).
- 284 min/d (range: 141 – 507 min/d) (White et al., 2017a).
- heterogeneous with irregular interruptions and unsteady frequencies (Zehner et al., 2017).
- Affected by *availability*, *% forage*, *chemical composition* and *physical processing* of the diet (Albright, 1993; Susenbeth et al., 1998).

Rumination Activity



Zehner et al., 2017



- Quiet and relaxed state of awareness and often exhibited when animals are lying down with their heads and eyelids lowered (Albright and Arave, 1997).

- 436 min/d (range: 236 – 610 min/d) (White et al., 2017a).
- > 30 movements, > 3 min in duration (Zegner et al., 2017)

- Cyclical process of ingesta, remastication, and reswallowing (Beauchemin, 1991).

- Upon reaching the mouth, a small portion of liquid and small particles contained in the bolus are reswallowed, whereas the remaining bolus material is remasticated and *mixed with saliva* for 30 to 60 s before it is reswallowed.





Penn State Particle Separator

Penn State Particle Separator Recommendations

Screen	Pore Size (inches)	Particle Size (inches)	Corn Silage	Haylage	TMR
Upper Sieve (19mm)	0.75	> 0.75	3 to 8	10 to 20	2 to 8
Middle Sieve (8mm)	0.31	0.31 to 0.75	45 to 65	45 to 75	30 to 50
Lower Sieve (1.18mm)	0.16	0.16 to 0.31	20 to 30	30 to 40	10 to 20
Bottom Pan	-	< 0.16	< 10	< 10	30 to 40

Study 1: Replacing alfalfa with DDGS/Straw Mixture



Replacing alfalfa

Can we make something physically and chemically similar to alfalfa?



	Control	LoDDGS	MedDDGS	HiDDGS
Corn silage	37.0	37.0	37.0	37.0
Alfalfa hay	18.2	12.1	6.1	-
Straw	-	2.1	4.2	6.2
Corn	14.7	13.7	12.8	12.0
DDGS	-	6.0	12.1	18.1
Concentrate	30.1	31.2	27.8	26.7
NDF	29.2	29.3	29.3	29.4
fNDF	23.3	22.0	20.7	19.3

Knoell et al., 2024



Control (CON)



LowDDGS (LBP)



MedDDGS (MBP)



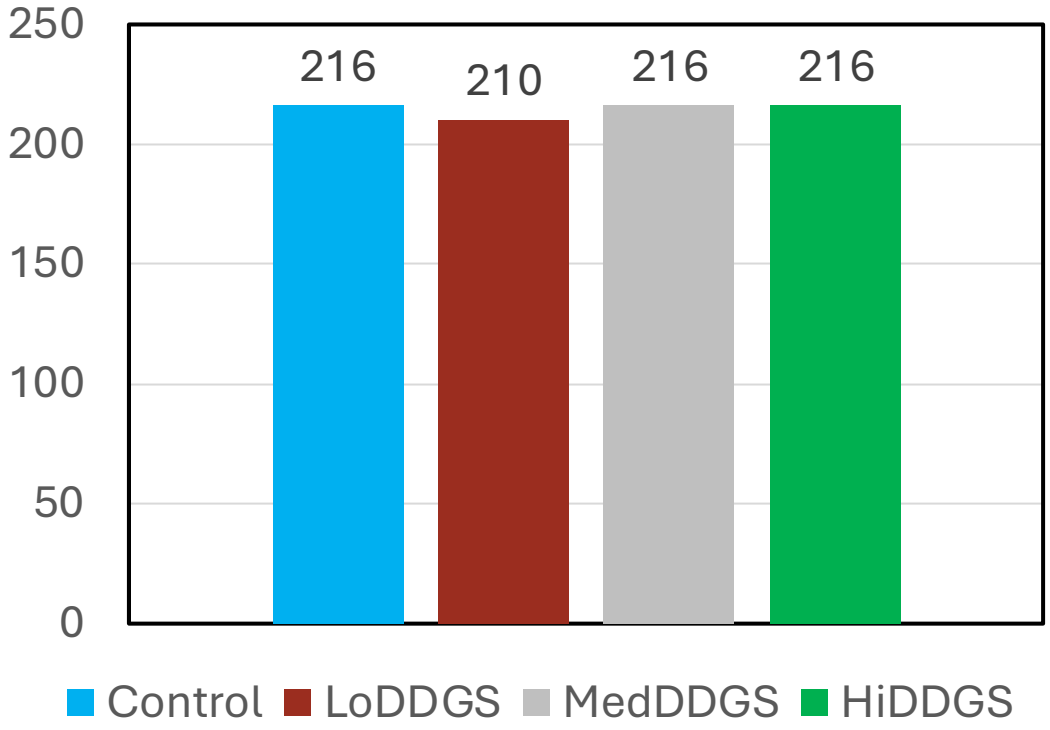
HighDDGS (HBP)

	Recommendations	Control	LoDDGS	MedDDGS	HiDDGS
Particle Size, Inches					
0.75	2 to 8	4	3	4	4
0.31	30 to 50	25	24	24	23
0.16	10 to 20	49	47	43	43
0.75	30 to 40	23	26	27	31

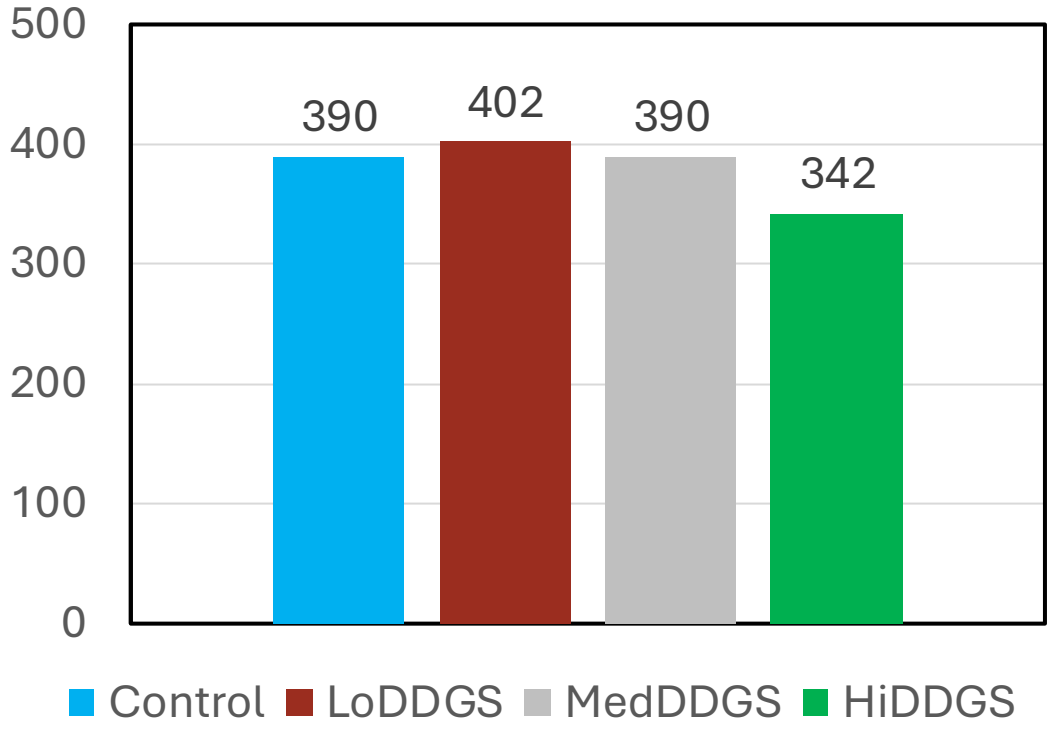
[2]Determined using the Penn State Particle Separator on DM basis (Heinrichs and Kononoff, 2002).

Chewing behaviors (No effect on DMI)

Eating, min/d (SEM = 10.3) P > 0.54



Ruminating, min/d (SEM = 13.2) P = 0.04 quadratic;

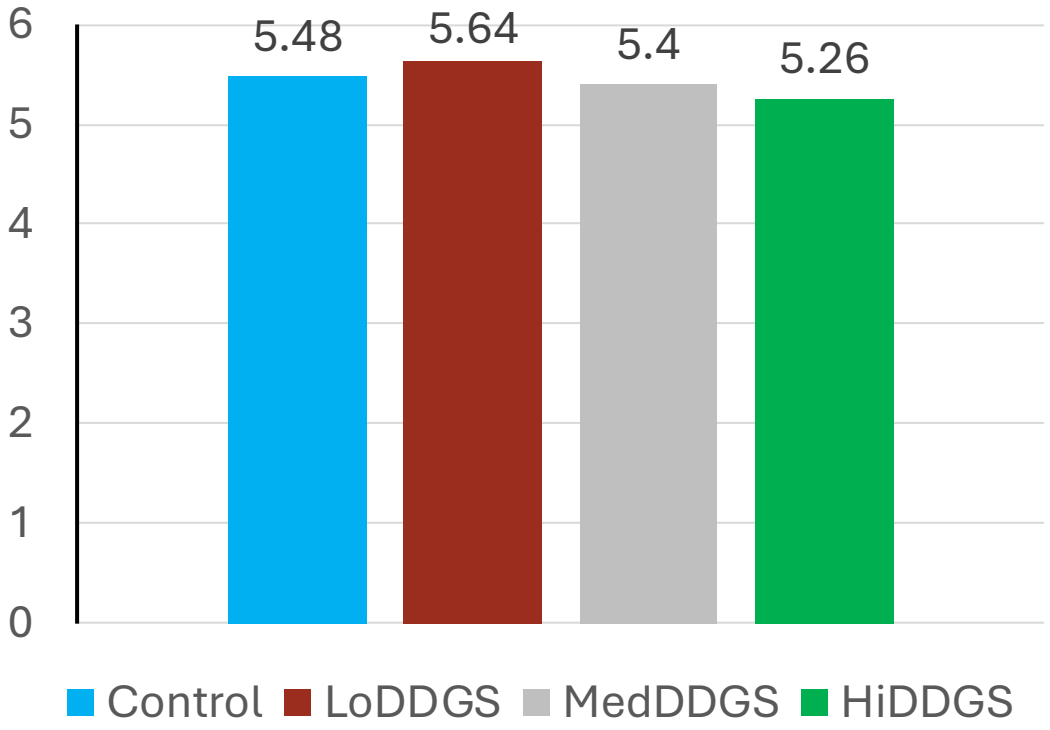


Knoell et al., 2024

Production (No effect on DMI)

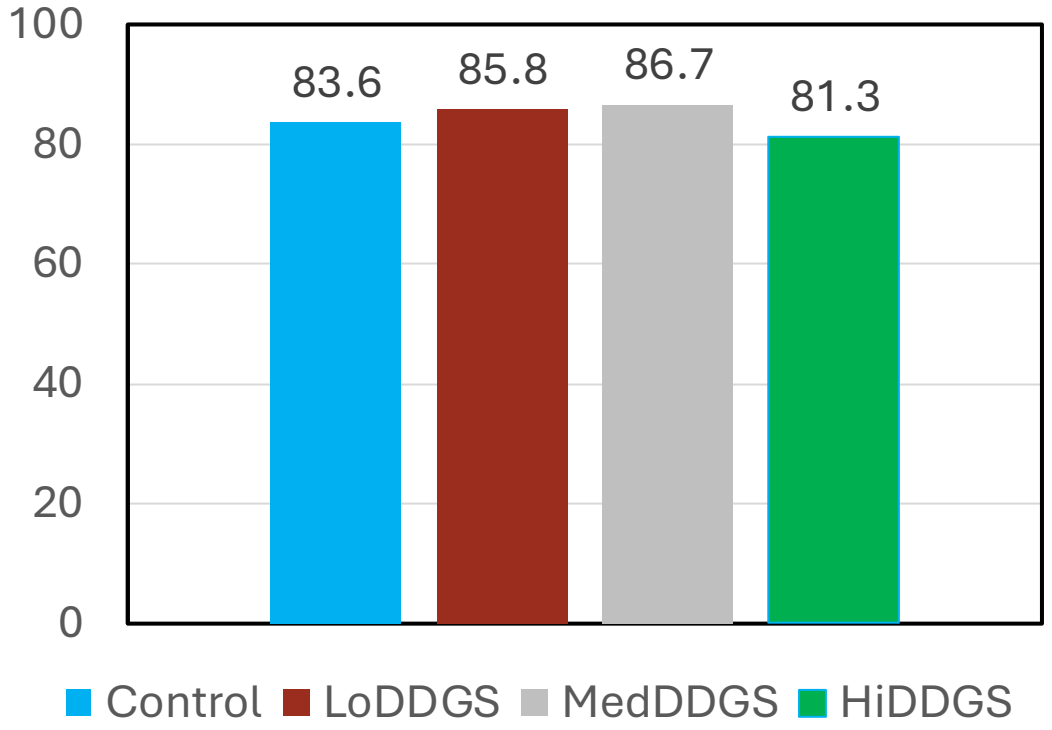
Percent Milk Fat (SEM = 0.261)

P > 0.36



Energy Correct Milk, lbs/d (SEM = 2.35)

P = 0.06, quadratic



Knoell et al., 2024

Study 2: Feeding a Corn Milling Product (CMP)





Replacing alfalfa with a CMP



	Treatment			
Item (%DM)	**Control**	**CMPbase**	**CMP↑fiber**	**CMP↓forage**
Corn silage	35.0	35.0	35.0	35.0
Alfalfa hay	17.5	9.35	8.00	4.80
Corn milling product	-	40.0	40.0	40.0
Ground corn	23.6	14.2	9.00	18.7
Cottonseed fuzzy	4.00	-	4.00	-
Wheat straw	1.00	-	2.50	-
Soybean meal	8.00	-	-	-
Non-enzymatically browned soybean meal (NEBSBM)	4.29	-	-	-
Calcium salt of FA	2.50	1.5	1.5	1.5
Mineral and vitamin	4.11	-	-	-
Starch	29.5	25.1	21.3	28.5
NDF	27.8	29.9	32.6	28.3
fNDF	22.5	18.1	19.6	16.2

Fincham et al., 2025

Energy Supply

	Treatment			
Item Mcal/d	Control	CMPbase	CMP↑fiber	CMP↓forage
DE	59.5[b]	63.4[a]	64.1[a]	64.3[a]
ME	52.3[b]	56.5[a]	56.9[a]	57.7[a]
NEL	35.4[b]	38.9[a]	38.9[a]	40.2[a]

Fincham et al., 2025

Energy Use

	Treatment			
Item Mcal/d	Control	CMPbase	CMP↑fiber	CMP↓forage
Feces	30.7	29.0	31.2	29.7
Urine	2.68^{b}	2.89^{ab}	3.01^{a}	2.77^{b}
Methane	4.46^{a}	4.01^{b}	4.21^{ab}	3.83^{b}
Heat	26.0	26.6	26.9	26.2
Milk	23.4	23.8	24.2	23.5
Tissue	2.55^{b}	5.42^{a}	5.16^{a}	7.13^{a}
Feed efficiency[1]	0.490^{b}	0.512^{ab}	0.515^{ab}	0.527^{a}

[1]Feed efficiency = (Milk energy + Tissue energy) / ME intake

Fincham et al., 2025

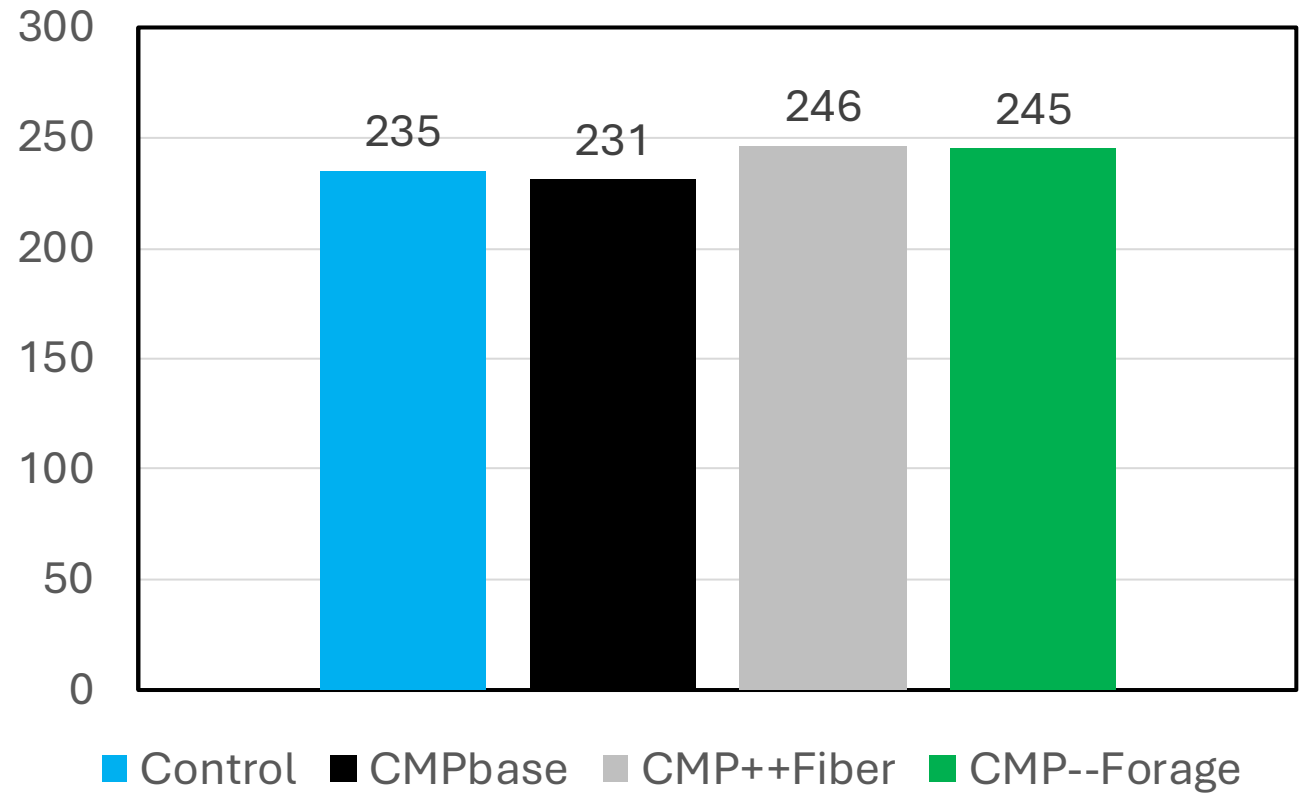
TMR Particle Size

	Recommendations	Control	CMPbase	CMP↑fiber	CMP↓forage
Particle Size, Inches					
0.75	2 to 8	3	2	2	2
0.31	30 to 50	32	37	42	37
0.16	10 to 20	13	20	20	19
0.75	30 to 40	51	42	36	42

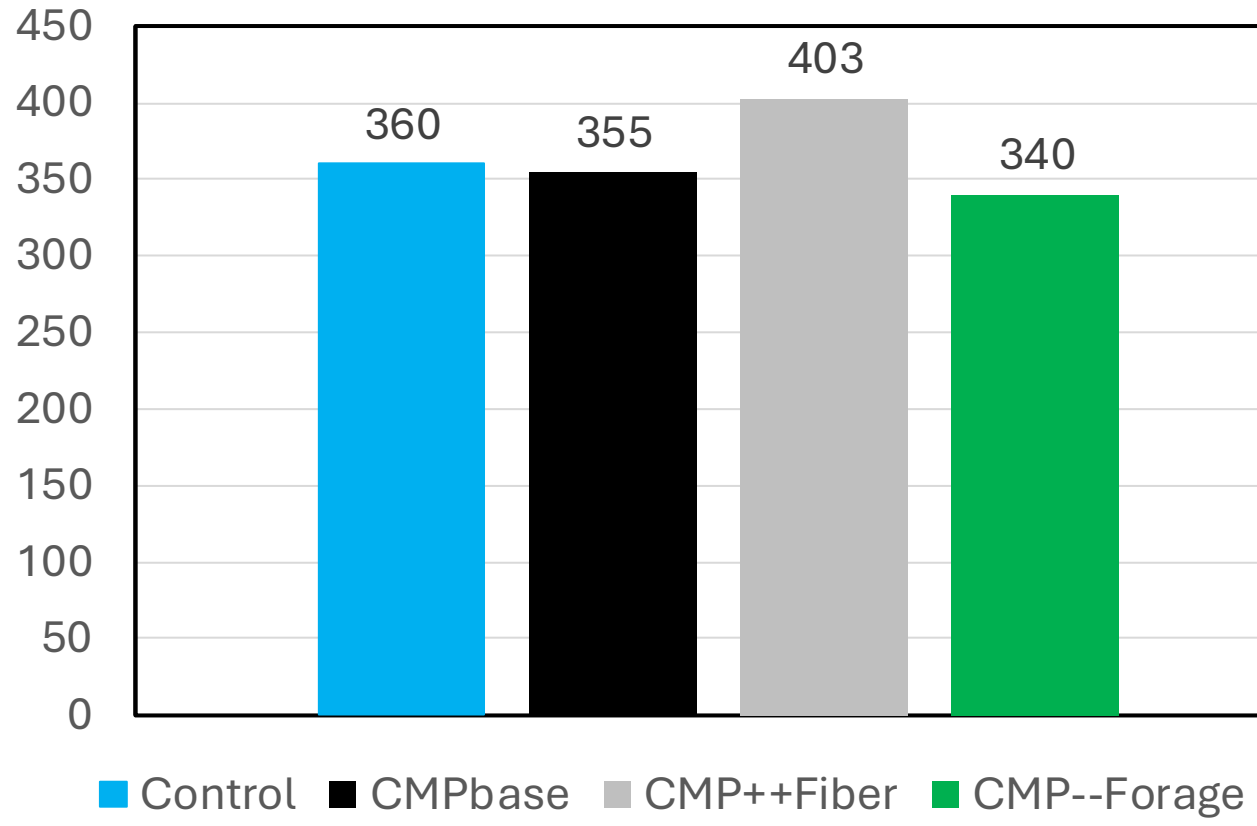
[2]Determined using the Penn State Particle Separator on DM basis (Heinrichs and Kononoff, 2002).

Chewing behaviors (No effect on DMI)

Eating, min/d (P = 0.58; SEM = 11.6)

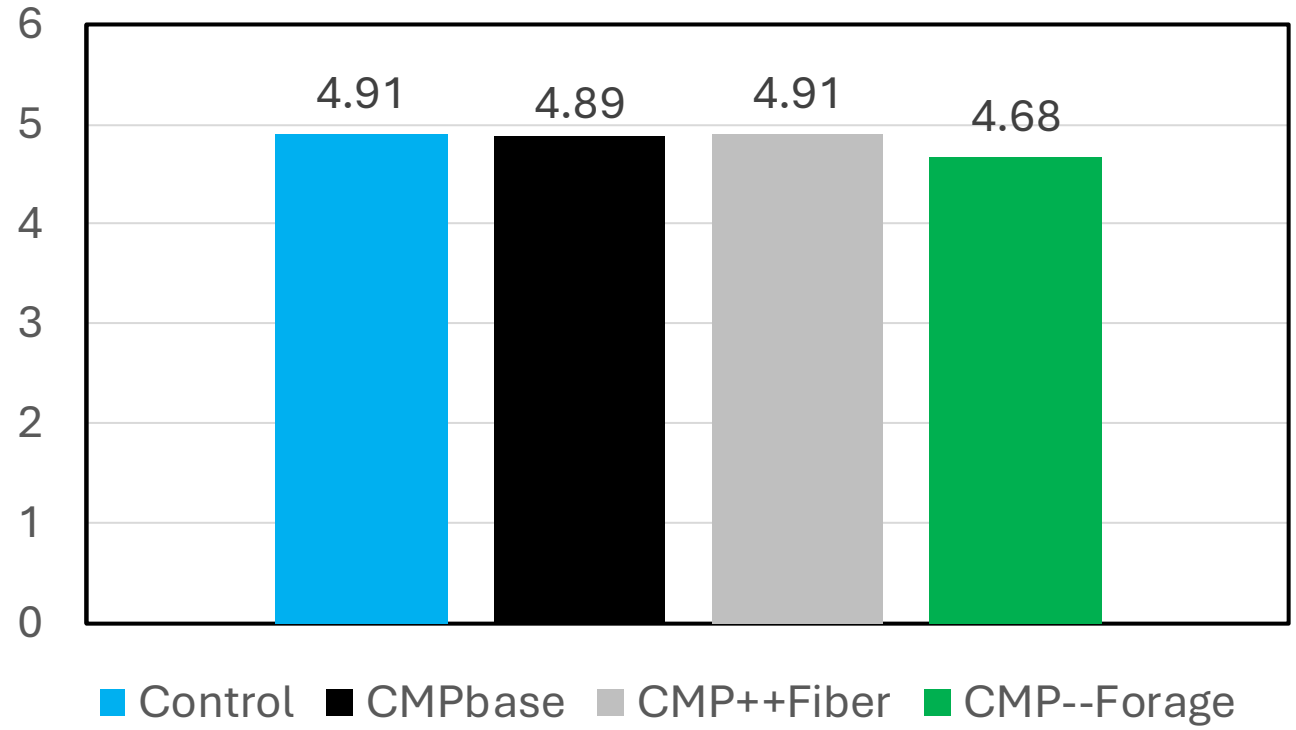


Ruminating, min/d (P = 0.05; SEM = 19.1)

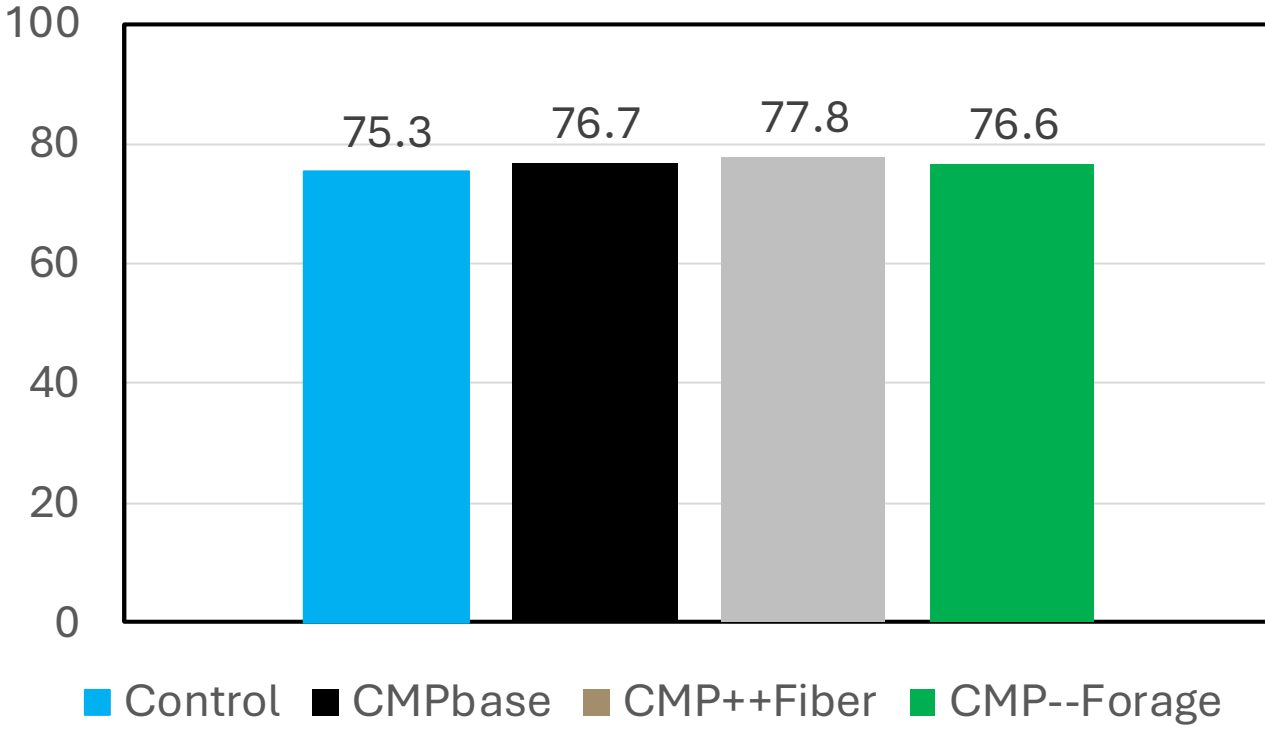


Production (No effect on DMI)

Percent Milk Fat (P = 0.18; SEM = 0.261)



Energy Correct Milk, lbs/d (P = 0.73; SEM = 2.76)



Fincham et al., 2025

Summary

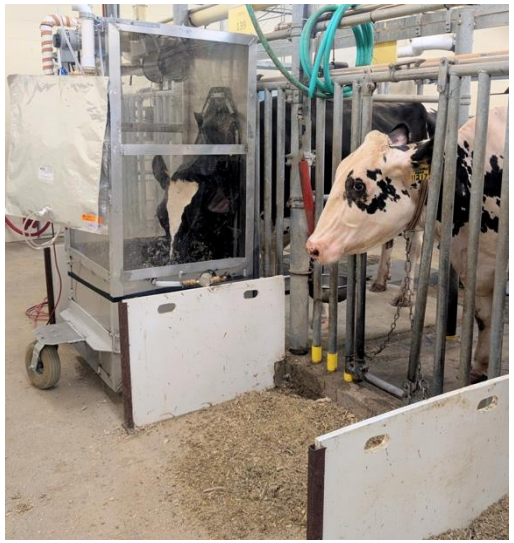
Forage Choices

- The Brown Midrib (BMR) trait consistently improves fiber digestibility.
- BMR sorghum can close the performance gap with corn silage.
- Intake drives the production response.
- Not all BMR hybrids perform equally.
- The grain fraction remains the primary nutritional limitation.
- Sorghum is agronomically resilient and nutritionally viable when designed correctly.

Coproduct formulations

- Very palatable, stimulates intake.
- Possible to successfully replaced alfalfa without reducing intake or milk production.
- Increasing coproduct inclusion can be supported by effective fiber.
- Energy supply can be maintained and even increased.







Panel on Protecting the Milk Supply:

Managing Risk, Safety, and Continuity in 2026

A panel moderated by Dan Rice, Sr. Consultant Nationwide

High Plains Dairy Conference:
20 years providing science and information to dairy producers of the High Plains

Jason Lombard, DVM MS

Colorado State University



- **Panel on Protecting the Milk Supply: Managing Risk, Safety, and Continuity in 2026**

- **<u>Focus for this Presentation and Panel discussion:</u>**
  - 1 What do we know about H5N1 after 2 years?
  - 2 Ideas on why H5N1 spread at will through the dairy industry
  - 3 How do we implement the ‘correct’ biosecurity procedures?
  - 4 The dairy industry must get serious about biosecurity

High Plains Dairy Conference:
20 years providing science and information to dairy producers of the High Plains

Disclaimer

AgNext
COLORADO STATE UNIVERSITY
SUSTAINABLE SOLUTIONS
FOR ANIMAL AGRICULTURE

- *The findings and conclusions in this presentation are my own and should not be construed to represent any official USDA or U.S. Government determination or policy*

- *The data used in, or part of this presentation, was made possible, in part, by an agreement with the United States Department of Agriculture's APHIS. This presentation may not necessarily express the views of APHIS.*

Timeline of H5N1 Detections in the U.S.

AgNext
COLORADO STATE UNIVERSITY
SUSTAINABLE SOLUTIONS FOR ANIMAL AGRICULTURE

Dec 2021



Wild Birds

- Carolinas
- Blue-winged Teal
- American Widgeon
- Gadwall
- Northern Shoveler

Feb 2022



Commercial Turkeys

- Indiana

2022-early 2024



Numerous

- First H5N1 genotype B3.13 detected in wild birds
- Commercial and backyard poultry
- 1st Human Case – maybe
- Goats B3.6 genotype

2024



Dairy Cattle

- B3.13 genotype
- Texas and Kansas
- Spread to multiple states
- Commerical and backyard poultry
- Human Case in Texas
- Alpacas B3.13
- Swine D1.2 genotype

Feb 2025



Dairy Cattle

- Genotype D1.1
- Arizona and Nevada



Dairy Cattle

- Genotype D1.1
- Wisconsin





Dec 2025

HPAI Confirmed Cases in Livestock Herds

Reporting period: March 25, 2024 through February 18, 2026
Last reported new confirmed case: Saturday, December 13, 2025
Data updated weekdays by 12pm Eastern

Download Data

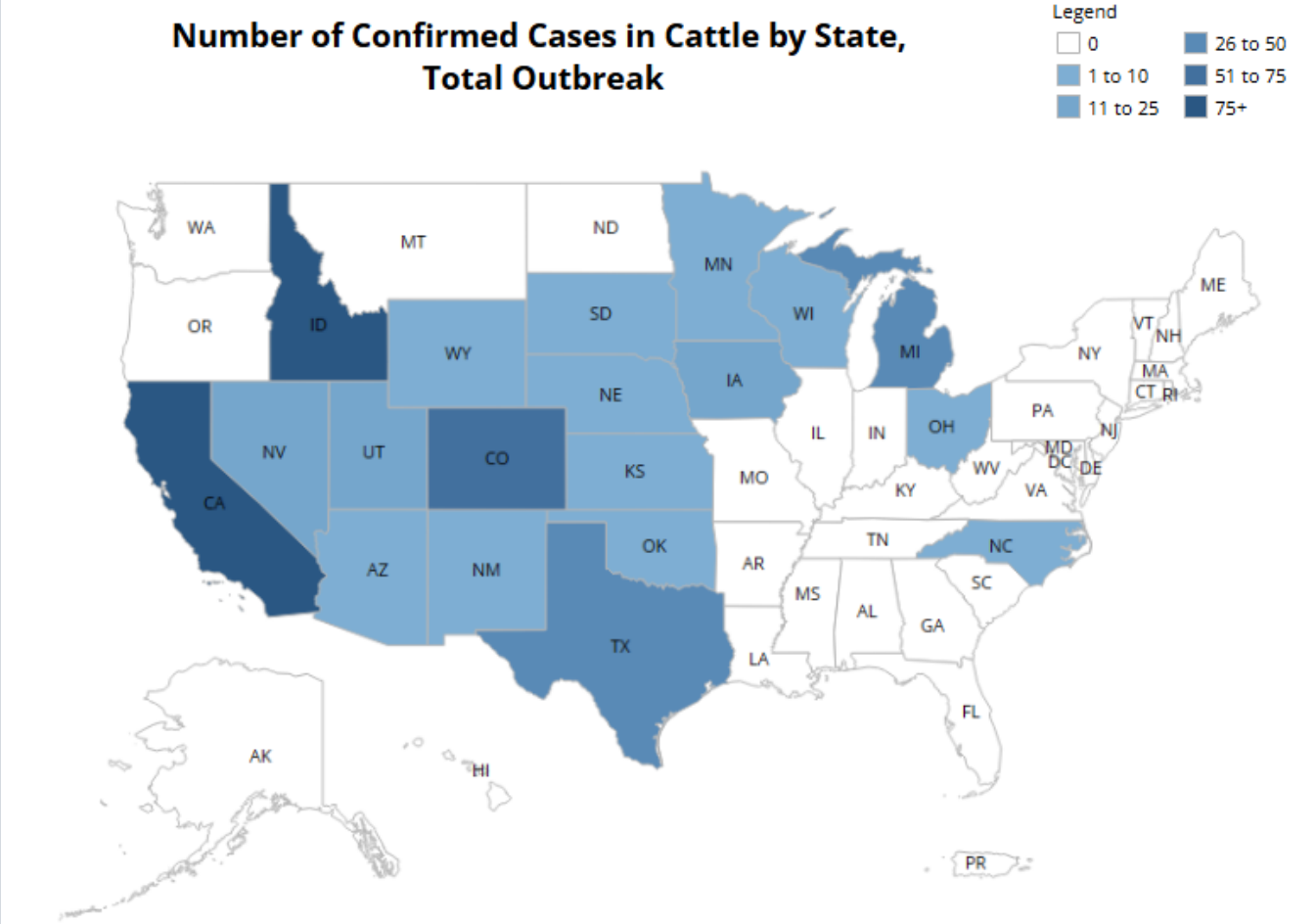
Choose time period: Total Outbreak
Choose species: Cattle

Situational Update

Click for International Exports

In the Total Outbreak, in Cattle, there were:
1,088 Confirmed Cases in **19** States

Number of Confirmed Cases in Cattle by State, Total Outbreak

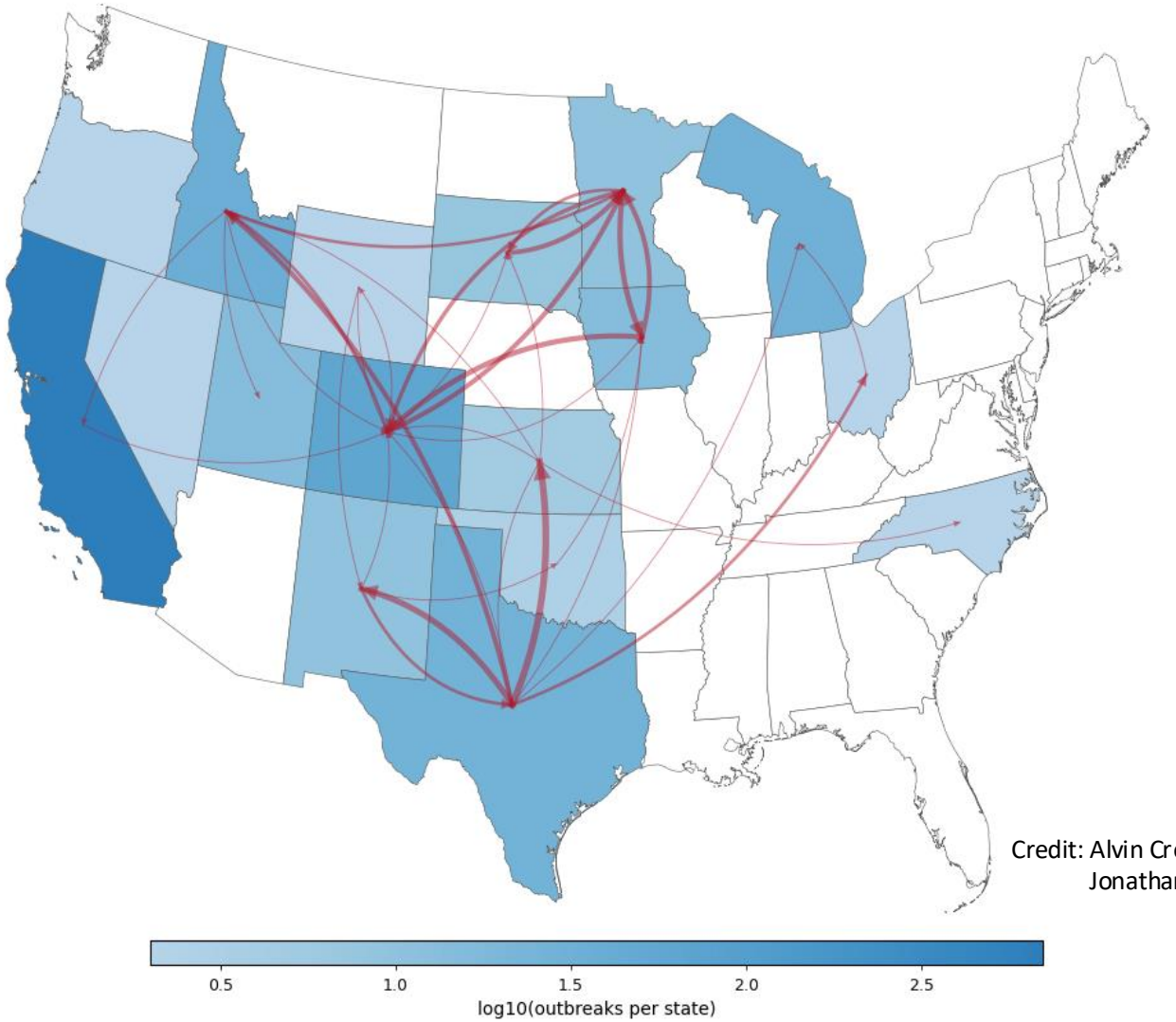


AgNext
COLORADO STATE UNIVERSITY
SUSTAINABLE SOLUTIONS
FOR ANIMAL AGRICULTURE

What do we know about H5N1 in dairy cattle?

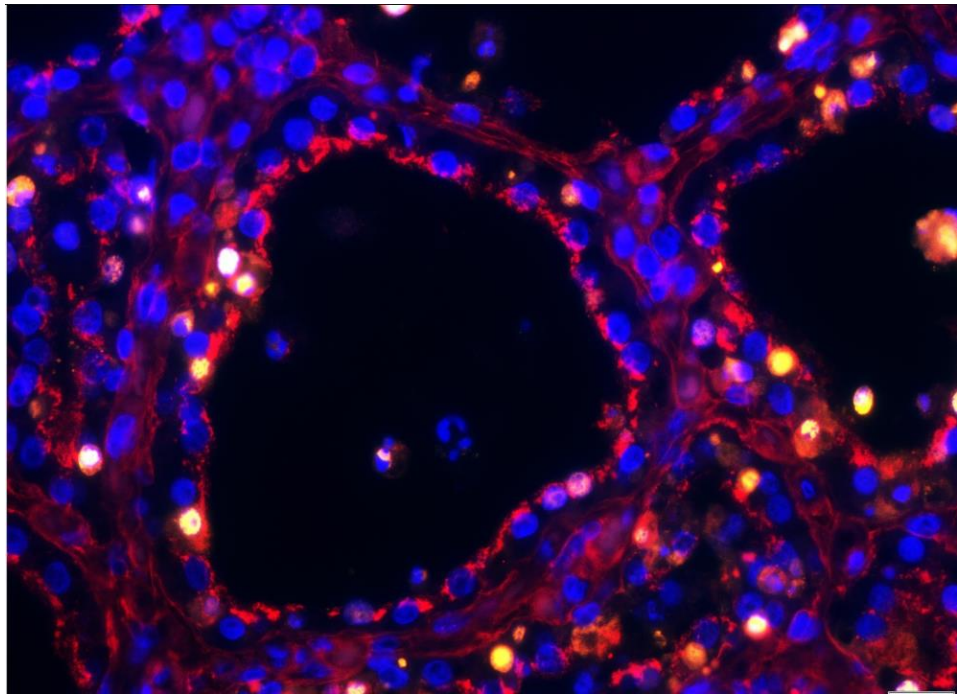
AgNext
COLORADO STATE UNIVERSITY
SUSTAINABLE SOLUTIONS
FOR ANIMAL AGRICULTURE

- Disease spread
  - Movement of cattle

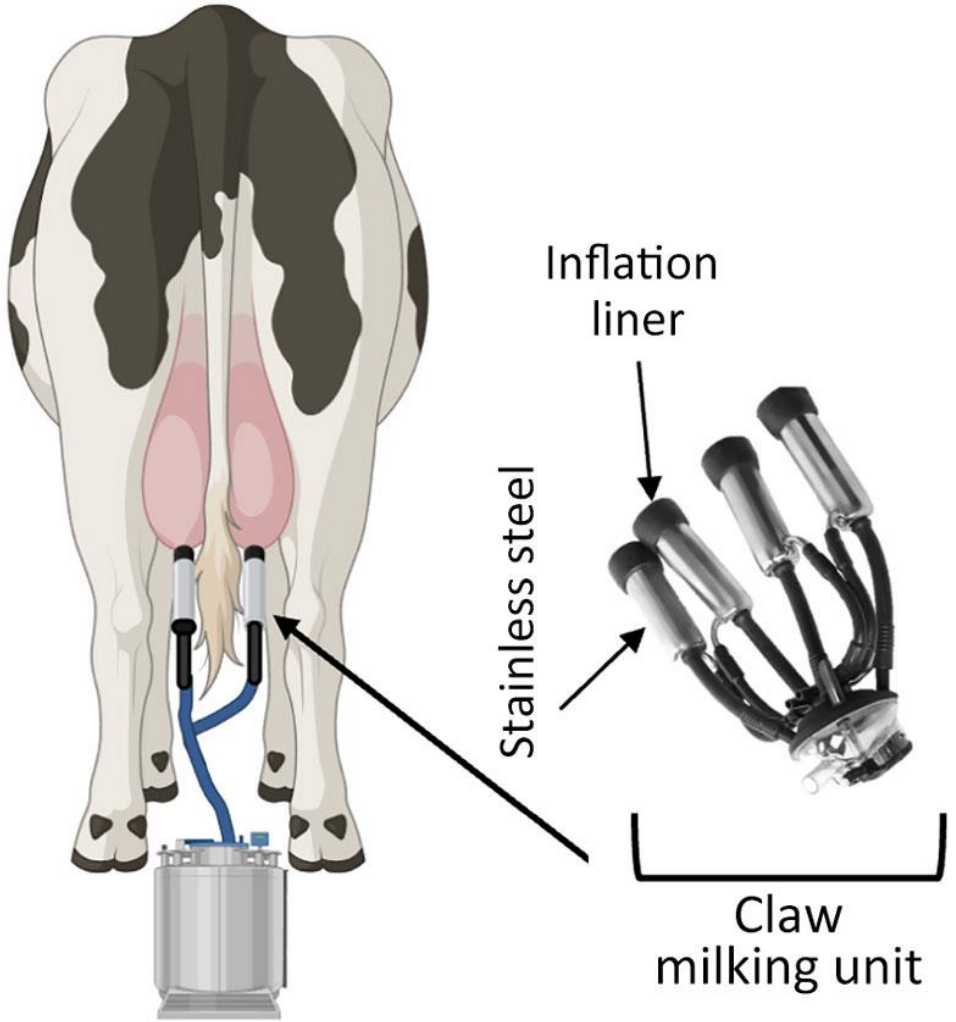


Credit: Alvin Crespo-Bellido (NIH) and Jonathan Pekar (U-Edinburgh)

It’s in the milk!!



- Sialic acid receptors = red
- AIV = yellow



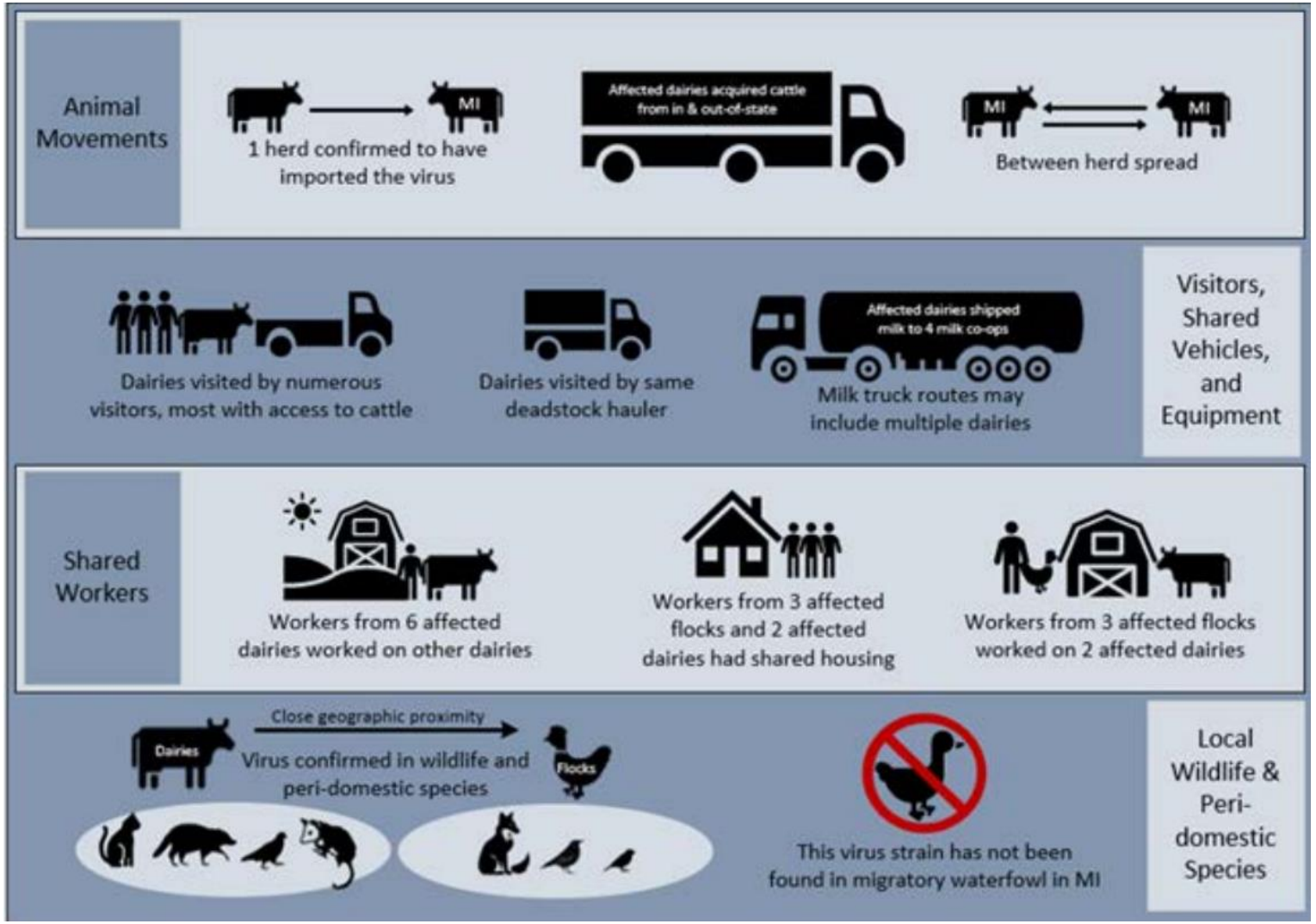
Nelli RK, Harm TA, Siepker C, et al. Sialic Acid Receptor Specificity in Mammary Gland of Dairy Cattle Infected with Highly Pathogenic Avian Influenza A(H5N1) Virus. *Emerging Infectious Diseases*. 2024;30(7):1361-1373. doi:10.3201/eid3007.240689.

Le Sage V, Campbell A, Reed DS, Duprex W, Lakdawala SS. Persistence of Influenza H5N1 and H1N1 Viruses in Unpasteurized Milk on Milking Unit Surfaces. Emerg Infect Dis. 2024;30(8):1721-1723. https://doi.org/10.3201/eid3008.240775

What do we know about H5N1 in dairy cattle?

AgNext
COLORADO STATE UNIVERSITY
SUSTAINABLE SOLUTIONS
FOR ANIMAL AGRICULTURE

- Disease spread
  - Movement of cattle
  - Movement of people

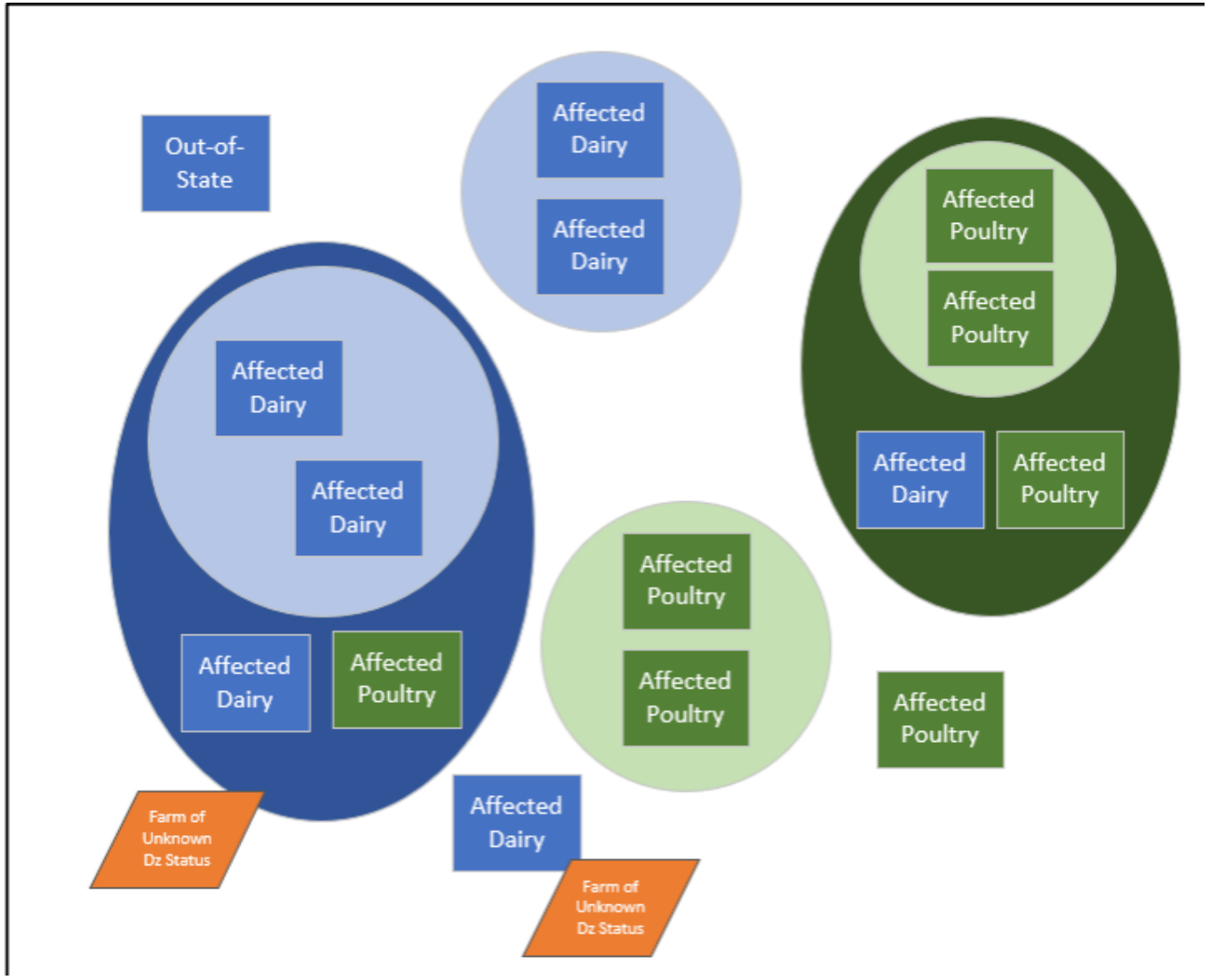


2024 Highly Pathogenic Avian Influenza (H5N1) - Michigan Dairy Herd and Poultry Flock Summary

What do we know about H5N1 in dairy cattle?

AgNext
COLORADO STATE UNIVERSITY
SUSTAINABLE SOLUTIONS
FOR ANIMAL AGRICULTURE

- Disease spread
  - Movement of cattle
  - Movement of people
  - Dairy → Poultry
  - Poultry → Dairy



2024 Highly Pathogenic Avian Influenza (H5N1) - Michigan Dairy Herd and Poultry Flock Summary

What do we know about H5N1 in dairy cattle?

AgNext
COLORADO STATE UNIVERSITY
SUSTAINABLE SOLUTIONS
FOR ANIMAL AGRICULTURE

- Disease spread
  - Movement of cattle
  - Movement of people
  - Dairy → Poultry
  - Poultry → Dairy
  - Aerosol

bioRxiv preprint doi: https://doi.org/10.1101/2025.02.12.637829; this version posted February 12, 2025. The copyright holder for this preprint (which was not certified by peer review) is the author/funder, who has granted bioRxiv a license to display the preprint in perpetuity. It is made available under aCC-BY 4.0 International license.

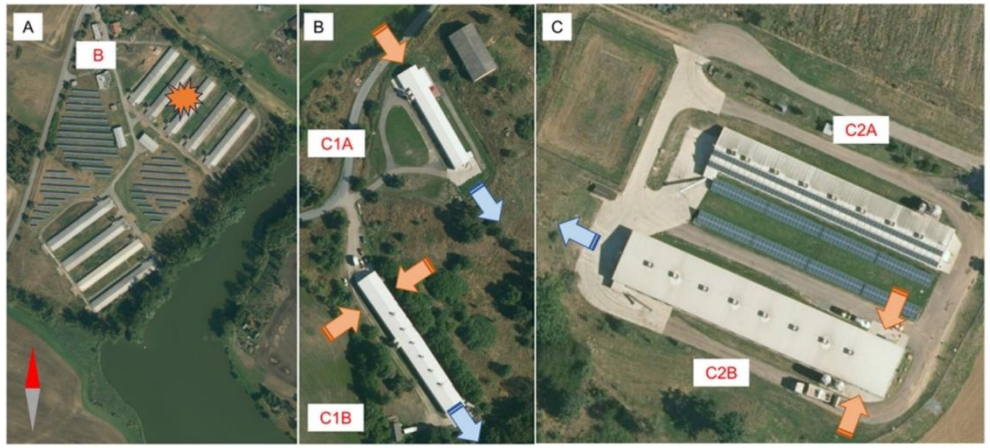
Genetic data and meteorological conditions: unravelling the windborne transmission of H5N1 high-pathogenicity avian influenza between commercial poultry outbreaks

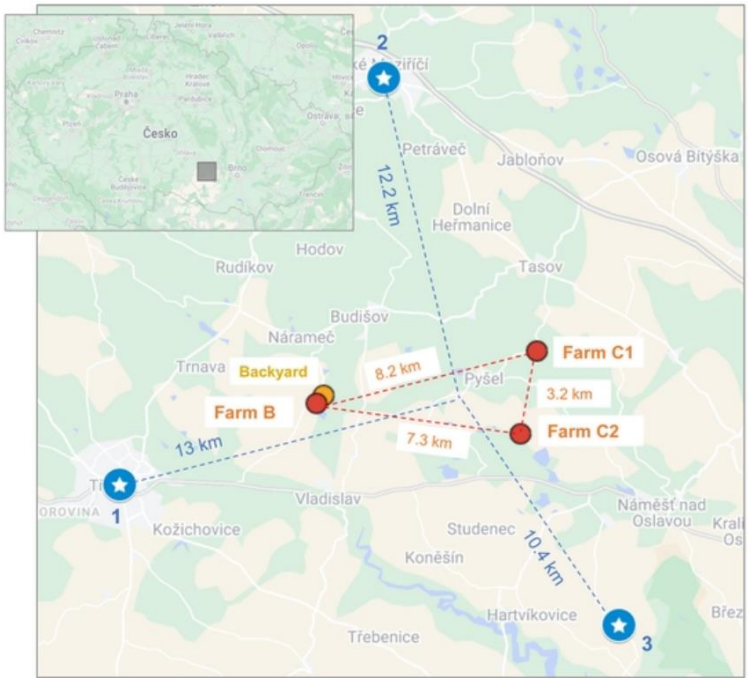
Alexander Nagy[1*], Lenka Černíková[1], Kamil Sedlák[1]

[1] State Veterinary Institute Prague, Prague, Czech Republic

* Corresponding author

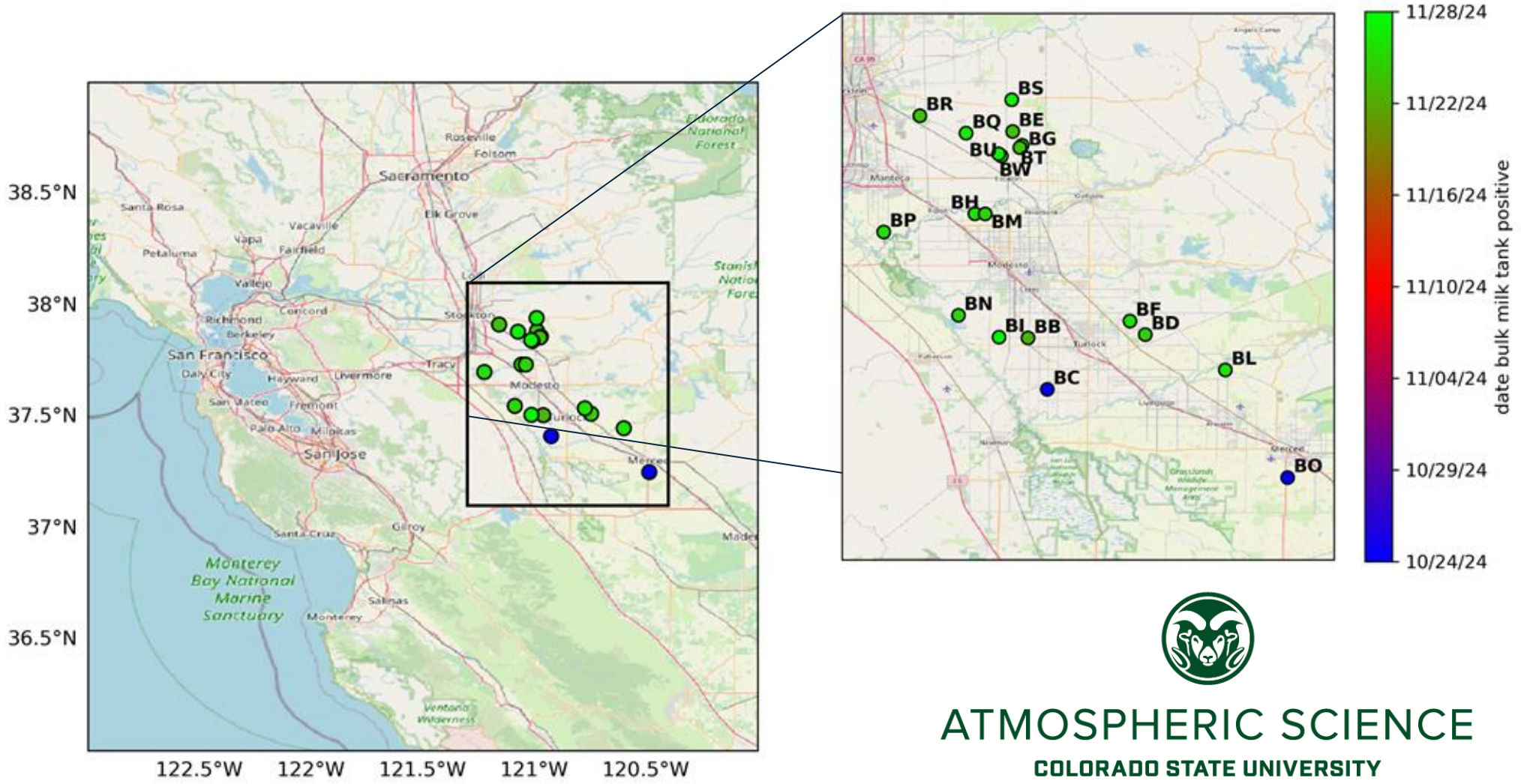
E-mail: alexander.nagy@svupraha.cz





Aerosol Investigation - California

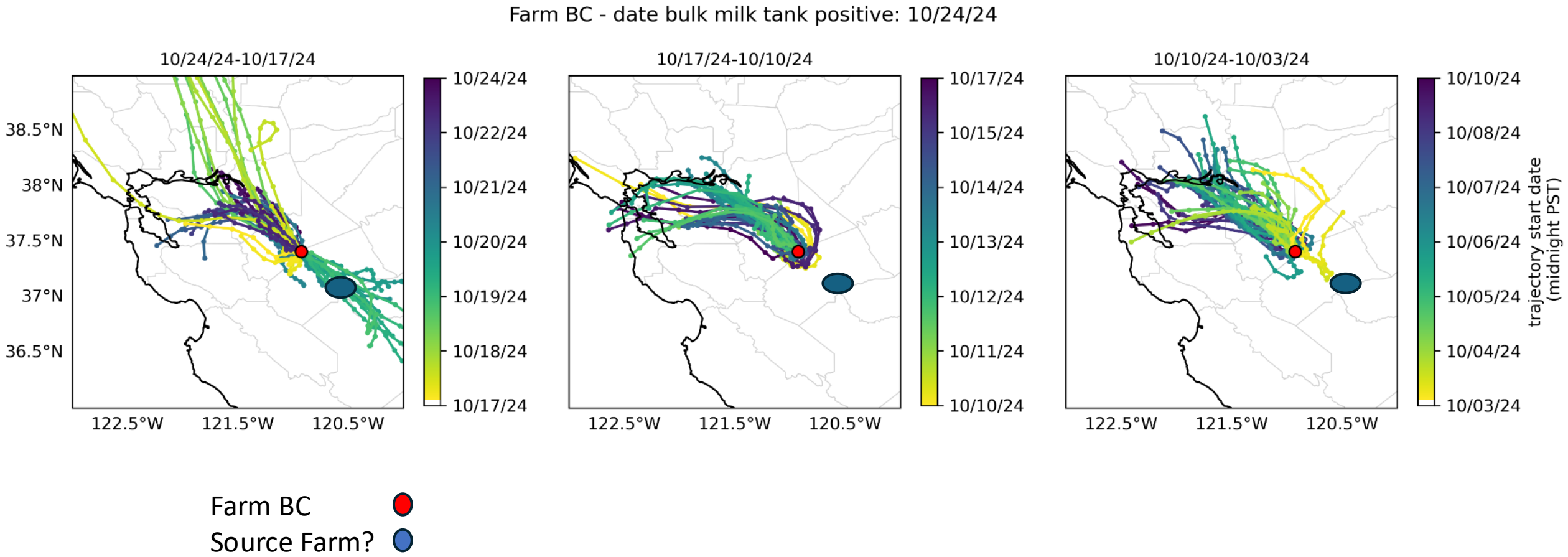
AgNext
COLORADO STATE UNIVERSITY
SUSTAINABLE SOLUTIONS
FOR ANIMAL AGRICULTURE



ATMOSPHERIC SCIENCE
COLORADO STATE UNIVERSITY

Aerosol Investigation - California

AgNext
COLORADO STATE UNIVERSITY
SUSTAINABLE SOLUTIONS
FOR ANIMAL AGRICULTURE



What do we know about H5N1 in dairy cattle?

AgNext
COLORADO STATE UNIVERSITY
SUSTAINABLE SOLUTIONS

- Disease spread
  - Movement of cattle
  - Movement of people
  - Dairy → Poultry
  - Poultry → Dairy
  - Aerosol
  - Flies

Article | Open access | Published: 28 November 2025

Detection of H5N1 highly pathogenic avian influenza virus RNA in filth flies collected from California farms in 2024

Dana Nayduch ✉, Stacey L.P. Scroggs, Phillip Shults, Luke A. Brendel, Lindsey M. Reister-Hendricks, Caitlin Taylor, Edward Bird, Brina Lopez & Edith S. Marshall

Scientific Reports **16**, Article number: 375 (2026) | Cite this article

2125 Accesses | **11** Altmetric | Metrics



What do we know about H5N1 in dairy cattle?

AgNext
COLORADO STATE UNIVERSITY
SUSTAINABLE SOLUTIONS
FOR ANIMAL AGRICULTURE

- Disease spread
  - Movement of cattle
  - Movement of people
  - Dairy → Poultry
  - Poultry → Dairy
  - Aerosol
  - Flies
  - Peridomestic birds
    - Swallow
    - Pigeons
    - starlings



Brief Report

AAVLD

Journal of Veterinary Diagnostic Investigation
1–6
© 2026 The Author(s)

Article reuse guidelines:
sagepub.com/journals-permissions
DOI: 10.1177/10406387261417354
jvdi.sagepub.com

Detection of highly pathogenic avian influenza A(H5N1) clade 2.3.4.4b virus in cull dairy cows with underlying respiratory and systemic disease

Daniel J. Righter, Erin B. Howey, Chris L. Siepker, Eric R. Burrough, Drew R. Magstadt, Marta Mainenti, Asha Fears, Aaron D. Lehmkuhl, Gleeson Murphy, Kimberly Lehman, Mia Kim Torchetti, Suelee Robbe-Austerman, Carrie E. Schmidt[1]

Abstract. Highly pathogenic avian influenza (HPAI) A(H5N1) clade 2.3.4.4b virus was identified in 4 cull dairy cows condemned by the U.S. Department of Agriculture because of pneumonia with accompanying systemic changes. Histologic findings were bronchopneumonia in 3 cows and embolic pneumonia and nephritis in 1 cow. In addition to detection of HPAI A(H5N1) virus by reverse-transcription real-time PCR in various formalin-fixed, paraffin-embedded tissues, influenza A virus was detected by immunohistochemistry and in situ hybridization in the pulmonary respiratory epithelium of 2 of the cows with bronchopneumonia and in renal medullary tubules of the cow with nephritis. A PCR panel screening for common bovine respiratory pathogens in the cows with bronchopneumonia revealed variable coinfections with *Histophilus somni*, *Pasteurella multocida*, *Mannheimia haemolytica*, *Mycoplasmopsis bovis*, and bovine coronavirus. We describe the distribution of HPAI A(H5N1) virus in naturally infected cows while highlighting the need for research on the roles of coinfection and immune response in influenza viral replication.

AgNext
COLORADO STATE UNIVERSITY
SUSTAINABLE SOLUTIONS
FOR ANIMAL AGRICULTURE

Which of these can you control?

AgNext
COLORADO STATE UNIVERSITY
SUSTAINABLE SOLUTIONS
FOR ANIMAL AGRICULTURE



✓ New Introductions



Wind/Aerosols



Flies



People



Breathing



Peridomestic Birds

Why do we want to implement biosecurity?

AgNext
COLORADO STATE UNIVERSITY
SUSTAINABLE SOLUTIONS
FOR ANIMAL AGRICULTURE

- **Healthier, more productive, and profitable herd!**

- Reducing risk of disease introduction
  - Requires planning
  - Costs involved
  - Not failsafe
- You don’t always know how or when disease enters your herd
- Biosecurity practices should eliminate or minimize disease

When it works correctly, you don’t know what you have prevented

Biosecurity Umbrella

AgNext
COLORADO STATE UNIVERSITY
SUSTAINABLE SOLUTIONS FOR ANIMAL AGRICULTURE

Trichomonas ntrol

Re Johne's disease

Bovine viral diarrhea virus

Bio Tuberculosis

Anima testing Qu rance program

Foreign anim **Biosecurity isn't easy!** is

For ment

Hairy heel wart

V Bovine leukosis virus

Biologica *Streptococcus agalactiae* oterroris H5N1

Dis *Mycoplasma*tion C *Staphylococcus aureus*

Acknowledgements

- Dr. Chloe Stenkamp-Strahm
- Dr. Kathy Whitman
- Dr. Sangeeta Rao
- Dr. Bruce Wagner
- Dr. Lindsey Garber
- Dr. Natalie Urie
- Dr. Rhyannon Moore-Foster
- Dr. Linzy Jauch
- Dr. Brian McCluskey
- Dr. Barb Petersen
- Sami Smith
- Erin Burke
- Madison Morse
- Irene Reis
- Luan Mora
- Lex Galligan
- Madison Gallivan
- Rhyse Campion
- Alexa Phillips
- Kara Linder
- Rebecca Williamson
- Marcie Bernard
- Kate Schinkel
- Eliza Behzadi
- Participating Dairy Producers
- The Cows ☺
- CSU – Veterinary Diagnostic Laboratory
  - Dr. Kristy Pabilonia
- Lander Veterinary Clinic
  - Dr. Blaine Melody
- Colorado Department of Agriculture
  - Dr. Maggie Baldwin
- California Department of Food and Agriculture (CDFA)
  - Dr. Edie Marshall
- Iowa State University – Veterinary Diagnostic Laboratory
- IDEXX Laboratories
- The Dairy Authority Laboratory
  - Dr. Greg Goodell
- CSU Atmospheric Sciences
- CSU Centroid

AgNext
COLORADO STATE UNIVERSITY
SUSTAINABLE SOLUTIONS FOR ANIMAL AGRICULTURE

USDA

cdfa
CALIFORNIA DEPARTMENT OF FOOD & AGRICULTURE

LANDER VETERINARY CLINIC
EST. 1950

IOWA STATE UNIVERSITY
Veterinary Diagnostic Laboratory

THE Dairy AUTHORITY

COLORADO
Department of Agriculture

Geospatial Centroid

IDEXX

ATMOSPHERIC SCIENCE
COLORADO STATE UNIVERSITY

HIGH PLAINS DAIRY CONFERENCE

Karen Bohnert
Dairy Editorial Director, Farm Journal



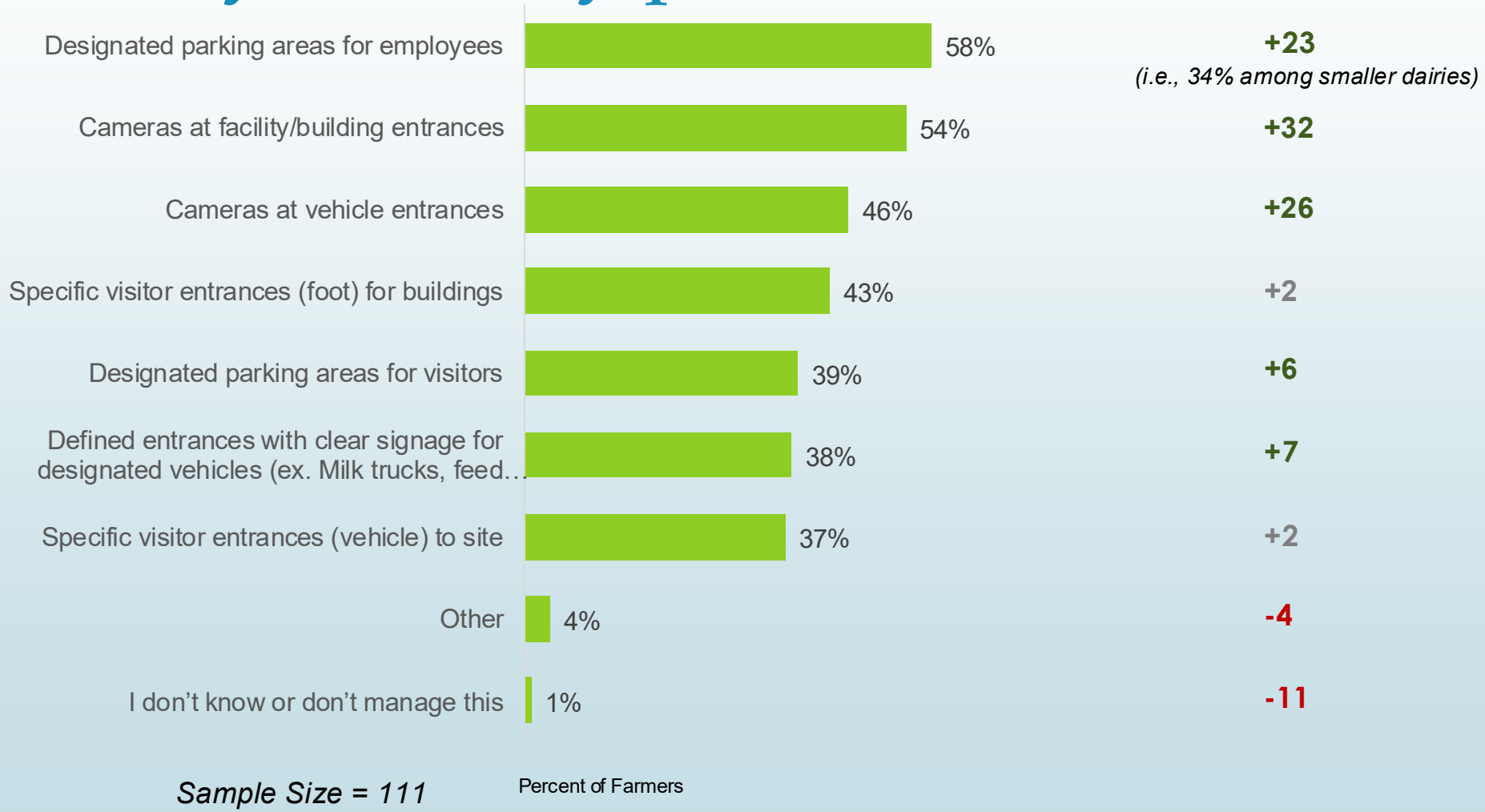
Panel on Protecting the Milk Supply: Managing Risk, Safety, and Continuity in 2026

Focus for this Presentation and Panel discussion:

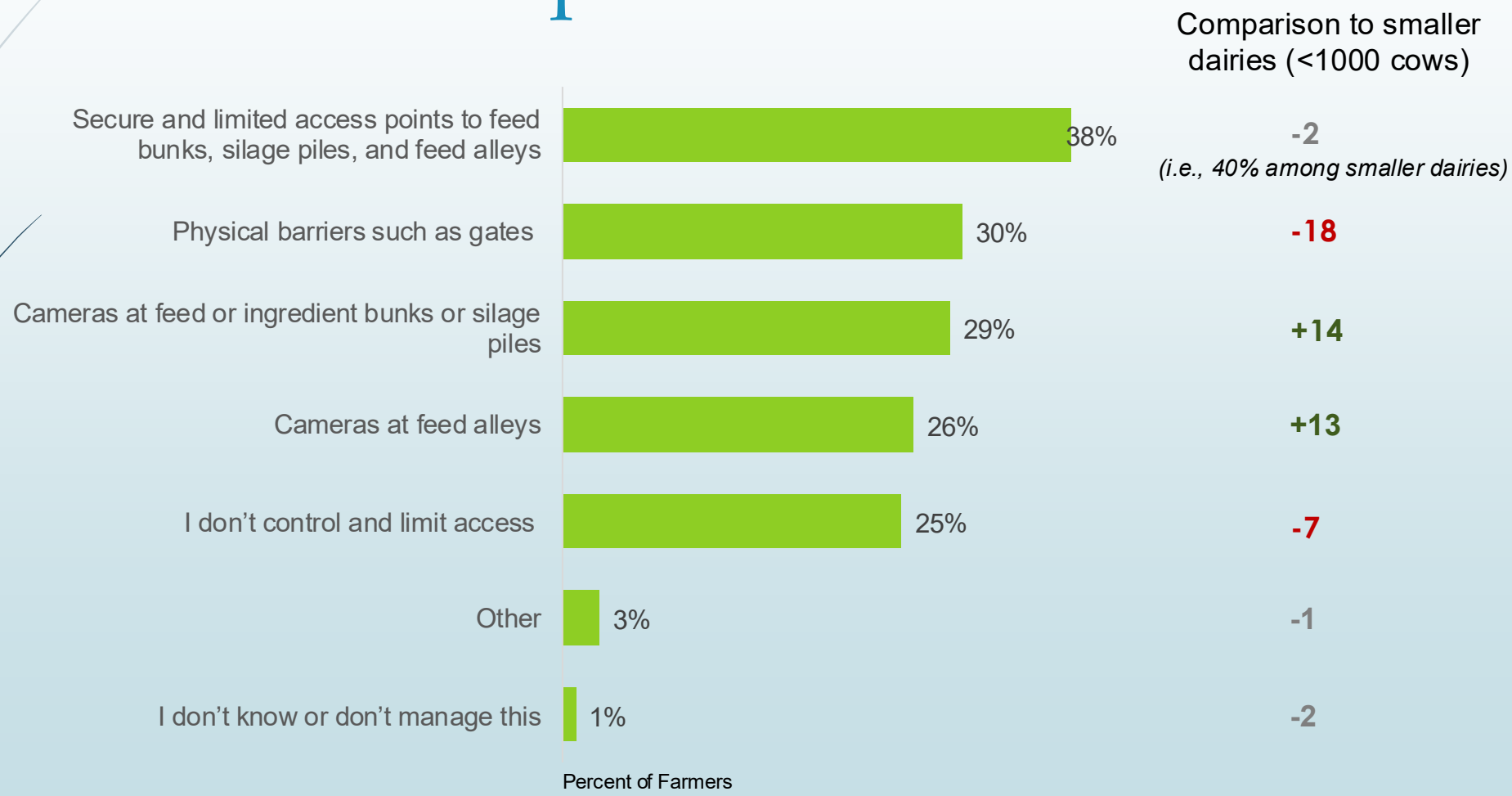
- 1 The Reality of the Gap
- 2 The Producer's Dilemma: ROI vs. Risk
- 3 The Data: Large vs. Small Operations
- 4 The "Why" Behind the Urgency
- 5. Recommendation for Action Steps

High Plains Dairy Conference:
20 years providing science and information to dairy producers of the High Plains

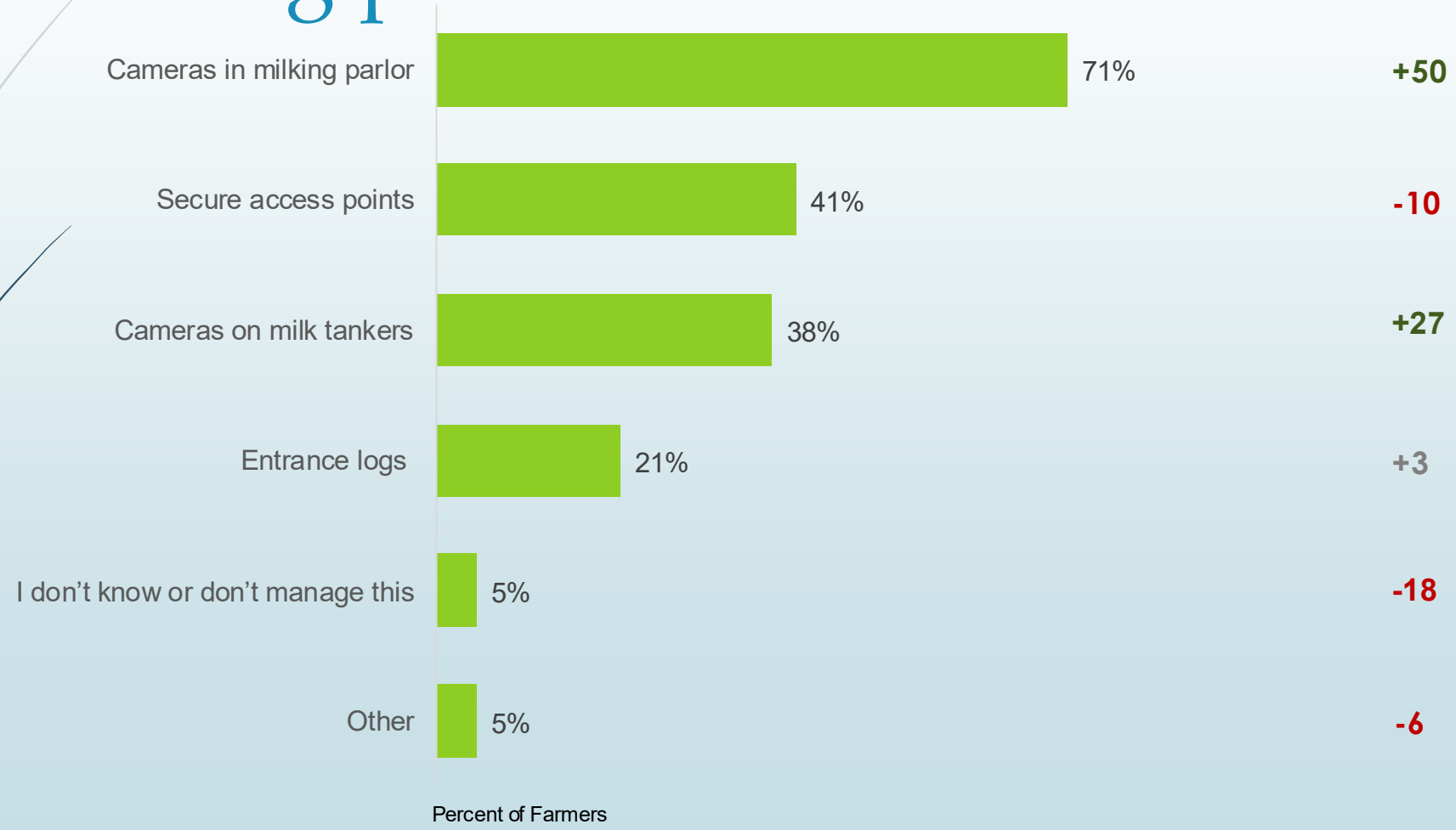
How do you secure the perimeter and entrances of your dairy premises?



How do you control and limit access to areas where feed is provided or stored?



How do you control and limit access to your milking parlor and milk tankers?



What Can You Do? Recommendations for Action

Assemble the team & review protocols now — Even if you feel your dairy is in a good place, it never hurts to be prepared as birds and other wildlife or others in the supply chain may bring threats to your door. The most advanced dairies review protocols often, *before* a challenge takes place.

Look at your perimeter and sanitation — Even the most advanced dairies had room to grow when it came to sanitation in transport and worker areas and insecure feed areas in particular.

If you serve dairy producers, support them in their biosecurity investments. Their work to protect their dairies benefits us all and cost was mentioned as a barrier to further biosecurity improvements, how can you help?



New World Screwworm

Samantha Holeck, DVM, MS
State Veterinarian
New Mexico Livestock Board







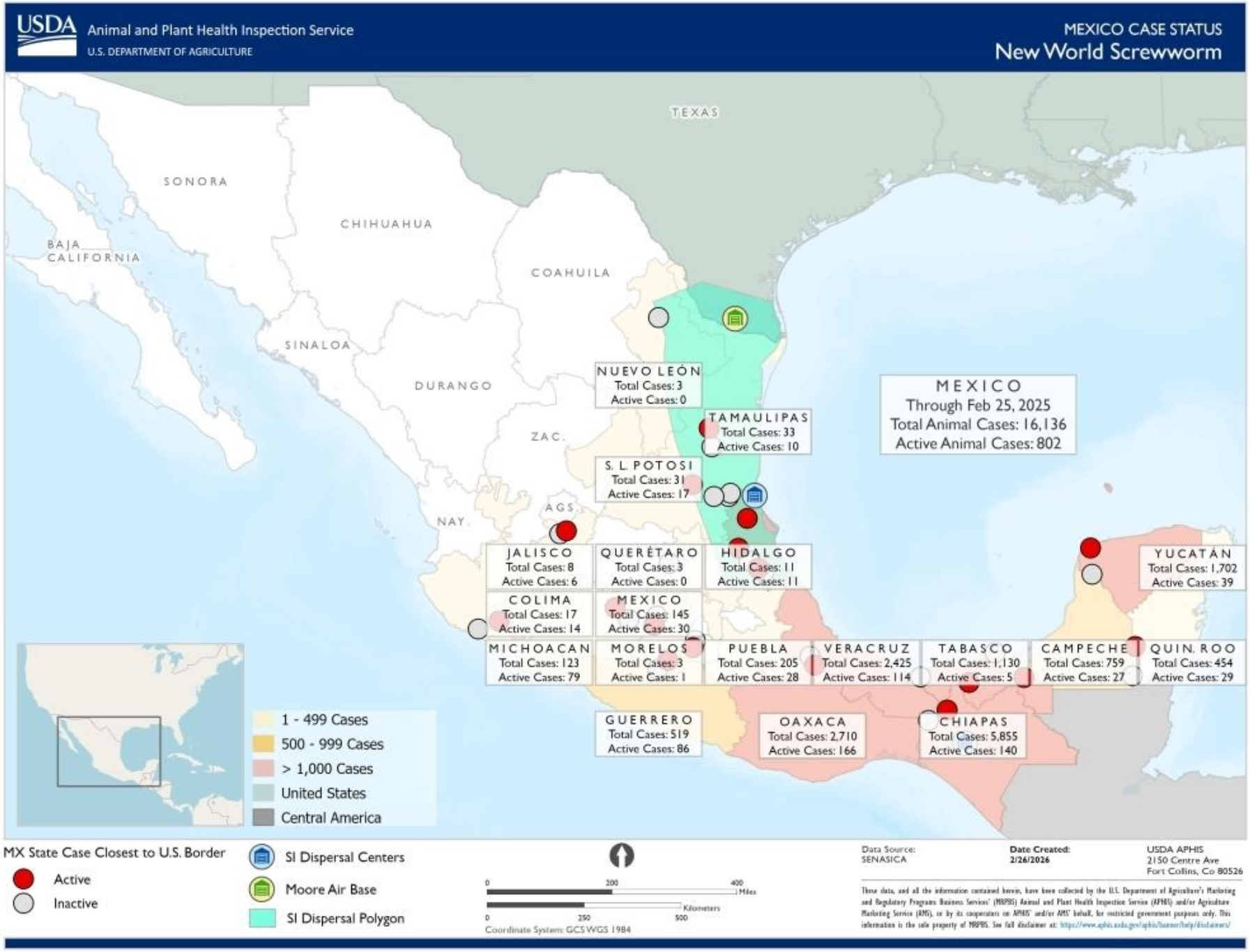


What it’s not…

History of screwworm distribution and eradication



GUSANO BARRENADOR DEL GANADO
USDA
COPEG


USDA
Animal and Plant Health Inspection Service
U.S. DEPARTMENT OF AGRICULTURE
MEXICO CASE STATUS
New World Screwworm
TEXAS
SONORA
CHIHUAHUA
BAJA CALIFORNIA
COAHUILA
SINALOA
DURANGO
ZAC.
NAY.
AGS.
NUEVO LEÓN
Total Cases: 3
Active Cases: 0
TAMAULIPAS
Total Cases: 33
Active Cases: 10
S. L. POTOSI
Total Cases: 31
Active Cases: 17
MEXICO
Through Feb 25, 2025
Total Animal Cases: 16,136
Active Animal Cases: 802
JALISCO
Total Cases: 8
Active Cases: 6
QUERÉTARO
Total Cases: 3
Active Cases: 0
HIDALGO
Total Cases: 11
Active Cases: 11
COLIMA
Total Cases: 17
Active Cases: 14
MEXICO
Total Cases: 145
Active Cases: 30
YUCATÁN
Total Cases: 1,702
Active Cases: 39
MICHOACAN
Total Cases: 123
Active Cases: 79
MORELOS
Total Cases: 3
Active Cases: 1
PUEBLA
Total Cases: 205
Active Cases: 28
VERACRUZ
Total Cases: 2,425
Active Cases: 114
TABASCO
Total Cases: 1,130
Active Cases: 5
CAMPECHE
Total Cases: 759
Active Cases: 27
QUIN. ROO
Total Cases: 454
Active Cases: 29
GUERRERO
Total Cases: 519
Active Cases: 86
OAXACA
Total Cases: 2,710
Active Cases: 166
CHIAPAS
Total Cases: 5,855
Active Cases: 140
1 - 499 Cases
500 - 999 Cases
> 1,000 Cases
United States
Central America
MX State Case Closest to U.S. Border
Active
Inactive
SI Dispersal Centers
Moore Air Base
SI Dispersal Polygon
0 200 400 Miles
0 250 500 Kilometers
Coordinate System: GCS WGS 1984
Data Source: SENASICA
Date Created: 2/26/2026
USDA APHIS
2150 Centre Ave
Fort Collins, Co 80526

Samantha Holeck, DVM, MS



- **Panel on Protecting the Milk Supply: Managing Risk, Safety, and Continuity in 2026**

- **<u>Focus for this Presentation and Panel discussion:</u>**
  - 1 Where is NWS now?
  - 2 What should we expect if we get NWS in the US?
  - 3 What does this threat mean for the dairy industry?
  - 4 What tools do we have to control NWS?
  - 5 How long will we be dealing with NWS?

High Plains Dairy Conference:
20 years providing science and information to dairy producers of the High Plains

Expectations and Implications

- This will change the way we do business
  - Movement restrictions
  - Trade restrictions (live animals only, NOT products)
  - More intensive inspections
  - +/- treatments
- Other risk factors
  - Fly can move independently
  - Ground can be “contaminated” – part of the life cycle

What tools are in our toolbox today?

- Don’t focus just on medications
- Prevent injuries, adjust management practices
- Keep wounds clean and protected
- Remove larvae (and dispose of them correctly!!)




How long will NWS be here…

Dee Ellis, DVM MPA



- **Panel on Protecting the Milk Supply: Managing Risk, Safety, and Continuity in 2026**

- **<u>Focus for this Presentation and Panel discussion:</u>**

  - Secure Milk Supply (SMS)Overview
  - Business continuity during a disease outbreak
  - Practical basic biosecurity management practices

High Plains Dairy Conference:
20 years providing science and information to dairy producers of the High Plains

Secure Milk Supply Plan



- Enhanced biosecurity plan
- Voluntary, science- and risk-based framework
- Template created in partnership between industry and USDA
- Provides disease response & regulatory Coordination (USDA guidelines usually implemented however by state animal health officials)

Secure Milk Supply Plan

- Complements other "Secure" plans for pork, beef, poultry and egg
- Intended to ensure continued movement of milk in a disease outbreak
- intended for dairies with no evidence of infection
- Focus of the plan originally was originally Foot and Mouth Disease



Secure Milk Supply Plan (cont.)

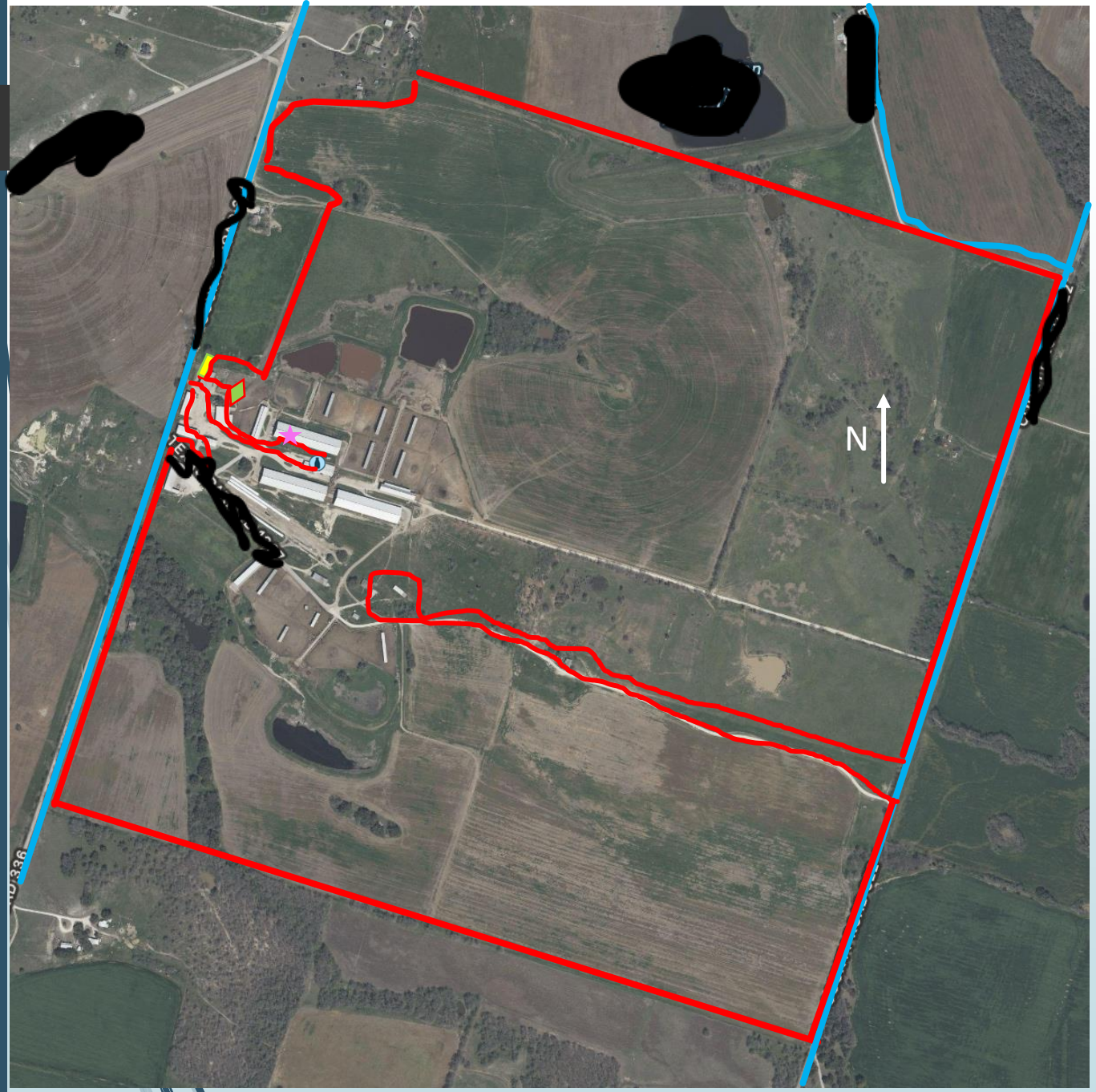
- **Preparedness (Before an Outbreak)**
  - Written, operation-specific biosecurity plan
- **Continuity of Business Planning**
    - Milk shipments
    - Feed deliveries
    - Animal movements
    - Essential personnel access
        - Personnel
        - Veterinarians
        - Vendors
        - contractors



Secure Milk Supply Plan(cont.)

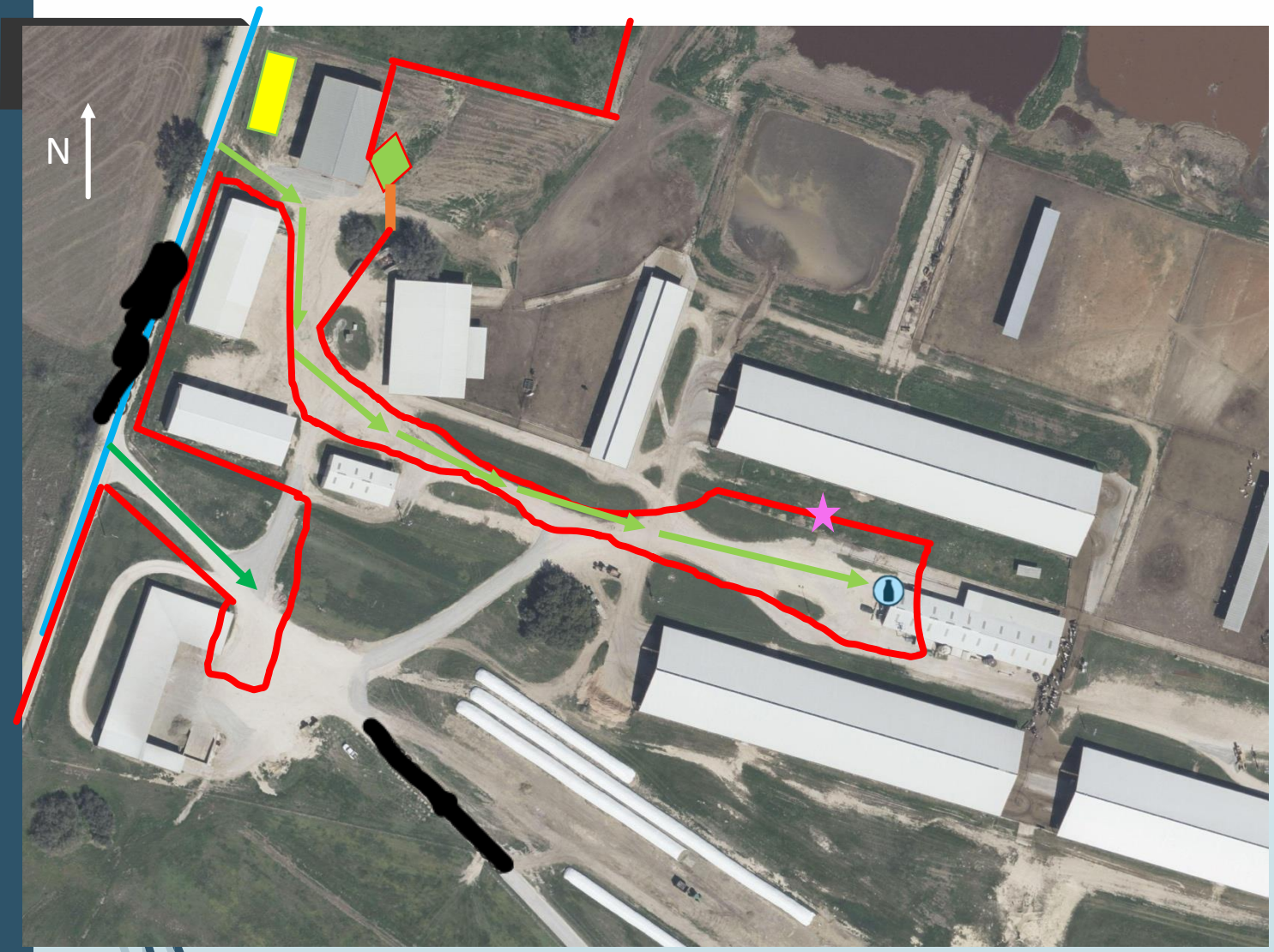
- Employee awareness/training
  - Identification of a Biosecurity Manager
- Milk tanker procedures
  - Bulk milk hauler/sampler – who is responsible? Dairy or truck driver?
  - Texas Dept of State Health Services Regulations apply
- Communication Strategy
- Clear communication pathways between:
  - Producers
  - Milk processors
  - State animal health officials
  - Federal authorities





- Public Road
- Line of Separation (LOS)
- LOS Access Point
- Vehicle cleaning & disinfecting station(s)
- Designated parking area
- Milk truck route to milk house
- Milk house
- Carcass disposal
- Carcass removal pathway
- Deliveries (non-essential)
- Animal loading/unloading

Sample Dairy Map



- Line of Separation (LOS)
- LOS Access Point
- Vehicle cleaning & disinfecting station(s)
- Designated parking area
- Milk truck route to milk house
- Milk house
- Deliveries (non-essential)
- Animal loading/unloading
- Feed truck route to commodity area
- Public Road

Secure Milk Supply Summary

- Every SMS Plan is unique to the dairy evaluated
- Biosecurity concepts are same however for all
- Plan can be tedious and hard to complete
- Don't sacrifice good for perfect
- Search for resources to help complete this
- Share with employees
- "Clean/Dirty" most important to understand
- Post map in location for all to see every day
- Update when appropriate
- File with FARM plan documents



Basic Biosecurity Actions to Consider

- Talk to your veterinarian about dairy biosecurity
- Talk to Coop representative about their biosecurity expectations
- Create a map with basic dairy site information
- Post map in visible location
- When plan is activated create logs for:
  - Cattle ingress/egress
  - Visitor ingress/egress
  - Put up barriers to visualize clean/dirty line (police tape, etc)
- Educate employees about biosecurity, especially clean/dirty side concept
- Control wildlife contact with cattle

Secure Milk Supply Implementation

- Current grant opportunity to have an SMS prepared for your dairy currently
- Partnership between Texas A&M AgriLife and Texas A&M College of Veterinary Medicine
- We will come to your dairy to help write your plan
- Contacts for writing SMS plan
  - Dr. Dee Ellis – Texas A&M AgriLife – College Station
  - Dr. Mike Kleinhenz – Texas A&M College of Veterinary Medicine – Canyon

The End



Questions

High Plains Dairy Conference:
20 years providing science and information to dairy producers of the High Plains