56th Florida Dairy Production Conference

University of Florida

Straughn IFAS Extension Center
Gainesville, Florida
December 1, 2022

UF/IFAS
University of Florida
ON BEHALF of all the faculty of the University of Florida welcome to the 56th Florida dairy production conference.

The Florida Dairy Production Conference started in 1964 and aims to create a program which brings together some of the newest research, innovations, recommendations, and ideas for improving the sustainability and profitability of the Florida dairy industry. The presented information provides practical take-home messages for dairy farmers and highlights emerging trends in the dairy industry. The conference strives to provide a friendly learning and sharing atmosphere with networking opportunities for our target audience of dairy owners and employees, allied dairy industry professionals, students and dairy educators that includes great opportunities for networking. This year’s conference will include aspects of nutrition, reproduction and calf management, as well as a dedicated afternoon discussing the role of heat-stress on dairy cattle production.

A full synopsis of the meeting and complete proceedings including links to recorded presentations can be found here: [https://animal.ifas.ufl.edu/dairy/conferences--meetings/florida-dairy-production-conference/](https://animal.ifas.ufl.edu/dairy/conferences--meetings/florida-dairy-production-conference/)

Regards,

John Bromfield  Peter Hansen
Geoffrey Dahl  José Santos
Lané Haimon  Matti Moyer

The Organizing Committee
SCHEDULE OF EVENTS

9:55 AM  Welcome and introduction. Saqib Mukhtar, Associate Dean, UF/IFAS Extension

Lané Haimon, Chair

10:00 AM  What have we learned about feed efficiency in dairy cows. Jose Santos. Dept. of Animal Sciences, University of Florida

10:25 AM  Strategic use of ovarian data to improve pregnancy outcomes following timed AI. Rafael Bisinotto. Dept. Large Animal Clinical Sciences, University of Florida

10:50 AM  BREAK

11:10 AM  Considering dairy calf social behavior to improve welfare. Emily Miller-Cushon. Dept. of Animal Sciences, University of Florida

11:35 AM  The impact of season and heat stress on uterine disease. John Bromfield. Dept. of Animal Sciences, University of Florida

12:00 PM  LUNCH

Zack Seekford, Chair

2:00 PM  Making a dairy cow that is genetically more resistant to heat stress. Peter Hansen. Dept. of Animal Sciences, University of Florida

2:40 PM  Heat abatement during the pre-weaning phase: Friend or Foe? Ricardo Chebel, Dept. Large Animal Clinical Sciences, University of Florida


4:00 PM  RECEPTION
56th Florida Dairy Production Conference Sponsors

**Platinum**

**STgenetics**
Amber Dammen Buol
amber.dammen@stgen.com

**Gold**

**Genus ABS**
Eddie Fredrickson
edgar.fredriksson@genusplc.com

**Progressive Dairy Solutions**
Amanda Bishop
abishop@pdscows.com

**Florida Dairy Farmers**
Avery LeFils
averyl@floridamilk.com
Silver

**DHI Cooperative Inc.**
Brian Winters  
brian.winters@dhicoop.com

**Royal DSM**
Paige Gott  
paige.gott@dsm.com

**Dairy Design Engineers**
Jake Martin  
jake@dairydesign.com

**Premier Select Sires**
Melanie Herman  
mherman@premierselect.com

**Seneca Dairy Systems LLC**
Jeremy Arend  
jarend@senecadairy.com

**Ag-Pro**
Vicki Frankland  
vicki.frankland@agprousa.com

**Zoetis**
Jorge Fulleda  
jorge.fulleda@zoetis.com
Bronze

Alliance Dairies
Jan Henderson
jhenderson@alliancedairies.com

Diamond V
John Gilliland
jgilliland@diamondv.com

Suwannee Valley
Will Lloyd
willlloyd@svfeeds.com

TechMix
Tami Fasching
tamifasching@techmixglobal.com
What Have We Learned About Feed Efficiency in Dairy Cows

José E.P. Santos and Mariana N. Marinho
Department of Animal Sciences
University of Florida

Milk Production in the Last 50 Years

Feed Efficiency Over the Years

Larger Cows, Increased Intake ....

✓ Maintenance requirements: 700 kg cow (1,540 lb cow)
  ✓ NRC (2001): 700 kg x 0.08 = 56.0 Mcal per day (~ 14.5 lb of DM of a lactating cow diet)
  ✓ NASEM (2021): 700 kg x 0.10 = 70.0 Mcal per day (~ 17.8 lb of DM of a lactating cow diet)
To improve the proportion of feed energy captured in milk:
- Increase milk production relative to maintenance (Dilution of maintenance)
- Increase the conversion of GE to NE (Improve RFI)

Residual feed intake (RFI) is a trait that measures feed conversion efficiency adjusting for other factors.
- Differs from Gross Feed Efficiency (ECM/DMI):
  - Energy required for production, maintenance, tissue accretion/loss, and adjusted for cohort

Factors Affecting Feed Efficiency
- Simply increasing yield of ECM improves gross feed efficiency, but improvement decrease as intake increases
  - Preventing diseases
  - Diet formulation
  - Improving the animal’s intrinsic ability to utilize nutrients

Inflammatory Disease and Nutrient Flux
- Control
  - Steers received saline (no inflammation)
- Challenge
  - Intra-tracheal challenge with 10 mL containing $1 \times 10^9$ CFU of *Mannheimia haemolytica* at hour 0
At 0.67 efficiency, this is equivalent to the true protein in 8 kg of milk (18 lbs)
Association Between RFI and Performance up to 105 DIM

<table>
<thead>
<tr>
<th>Item</th>
<th>Q1</th>
<th>Q2</th>
<th>Q3</th>
<th>Q4</th>
<th>SEM</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cows, n</td>
<td>212</td>
<td>213</td>
<td>213</td>
<td>213</td>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td>Inseminated, %</td>
<td>90.4</td>
<td>90.1</td>
<td>97.7</td>
<td>99.1</td>
<td>0.8</td>
<td>0.7</td>
</tr>
<tr>
<td>First AI</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pregnant d 74, %</td>
<td>31.0</td>
<td>30.9</td>
<td>30.5</td>
<td>26.5</td>
<td>3.5</td>
<td>0.72</td>
</tr>
<tr>
<td>Second AI</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pregnant d 74, %</td>
<td>36.5</td>
<td>29.0</td>
<td>27.4</td>
<td>17.6</td>
<td>4.2</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Pregnancy per AI all AI, %</td>
<td>31.4</td>
<td>30.6</td>
<td>31.2</td>
<td>24.5</td>
<td>2.2</td>
<td>0.03</td>
</tr>
<tr>
<td>Pregnant by 300 d, %</td>
<td>70.0</td>
<td>80.7</td>
<td>82.4</td>
<td>71.5</td>
<td>3.3</td>
<td>0.05</td>
</tr>
<tr>
<td>21-d cycle pregnancy rate</td>
<td>21.2</td>
<td>21.1</td>
<td>22.0</td>
<td>16.6</td>
<td>1.8</td>
<td>0.02</td>
</tr>
</tbody>
</table>

Nehme Marinho et al. in preparation

Association Between RFI and Incidence of Diseases and Survival

N = 393 Holsteins with daily ECM yield, DMI, BW, and BCS

<table>
<thead>
<tr>
<th>Item</th>
<th>Q1</th>
<th>Q2</th>
<th>Q3</th>
<th>Q4</th>
<th>SEM</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cows, n</td>
<td>26</td>
<td>36</td>
<td>29</td>
<td>26</td>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td>Somatic cell score</td>
<td>2.36</td>
<td>2.66</td>
<td>2.83</td>
<td>2.66</td>
<td>0.19</td>
<td>0.41</td>
</tr>
<tr>
<td>Retained placenta, %</td>
<td>12.2</td>
<td>13.3</td>
<td>11.1</td>
<td>14.3</td>
<td>3.3</td>
<td>0.02</td>
</tr>
<tr>
<td>Metritis, %</td>
<td>13.3</td>
<td>19.4</td>
<td>17.2</td>
<td>22.5</td>
<td>4.0</td>
<td>0.40</td>
</tr>
<tr>
<td>Mastitis, %</td>
<td>15.3</td>
<td>13.3</td>
<td>12.1</td>
<td>15.3</td>
<td>3.5</td>
<td>0.89</td>
</tr>
<tr>
<td>Displaced abomasum, %</td>
<td>1.0</td>
<td>2.0</td>
<td>3.0</td>
<td>4.1</td>
<td>1.5</td>
<td>0.60</td>
</tr>
<tr>
<td>Lameness, %</td>
<td>10.2</td>
<td>5.1</td>
<td>2.0</td>
<td>8.2</td>
<td>2.4</td>
<td>0.14</td>
</tr>
<tr>
<td>Respiratory, %</td>
<td>2.0</td>
<td>3.1</td>
<td>1.0</td>
<td>2.0</td>
<td>1.4</td>
<td>0.81</td>
</tr>
<tr>
<td>Left herd by 300d, %</td>
<td>10.2</td>
<td>13.3</td>
<td>5.1</td>
<td>9.2</td>
<td>2.8</td>
<td>0.29</td>
</tr>
</tbody>
</table>

Nehme Marinho et al. (2021) J. Dairy Sci. 104: 5493-5507

Association Between RFI and Reproductive Performance

N = 851 Holsteins with daily ECM yield, DMI, BW, and BCS

<table>
<thead>
<tr>
<th>Item</th>
<th>Q1</th>
<th>Q2</th>
<th>Q3</th>
<th>Q4</th>
<th>SEM</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cows, n</td>
<td>212</td>
<td>213</td>
<td>213</td>
<td>213</td>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td>Inseminated, %</td>
<td>96.4</td>
<td>99.1</td>
<td>97.7</td>
<td>99.1</td>
<td>0.8</td>
<td>0.72</td>
</tr>
<tr>
<td>First AI</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pregnant d 74, %</td>
<td>31.0</td>
<td>30.9</td>
<td>30.5</td>
<td>26.5</td>
<td>3.5</td>
<td>0.72</td>
</tr>
<tr>
<td>Second AI</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pregnant d 74, %</td>
<td>36.5</td>
<td>29.0</td>
<td>27.4</td>
<td>17.6</td>
<td>4.2</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Pregnancy per AI all AI, %</td>
<td>31.4</td>
<td>30.6</td>
<td>31.2</td>
<td>24.5</td>
<td>2.2</td>
<td>0.03</td>
</tr>
<tr>
<td>Pregnancy by 300 d, %</td>
<td>70.0</td>
<td>80.7</td>
<td>82.4</td>
<td>71.5</td>
<td>3.3</td>
<td>0.05</td>
</tr>
<tr>
<td>21-d cycle pregnancy rate</td>
<td>21.2</td>
<td>21.1</td>
<td>22.0</td>
<td>16.6</td>
<td>1.8</td>
<td>0.02</td>
</tr>
</tbody>
</table>


Relationship Between RFI and Hepatic Mitochondrial Respiration

N = 393 Holsteins with daily ECM yield, DMI, BW, and BCS

<table>
<thead>
<tr>
<th>Item</th>
<th>High Feed Efficiency</th>
<th>Low Feed Efficiency</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Leak respiration, pmol O₂/s/mg of mitochondria</td>
<td>31.4 ± 2.2</td>
<td>32.1 ± 2.1</td>
<td>0.64</td>
</tr>
<tr>
<td>ATP coupled respiration, pmol O₂/s/mg of mitochondria</td>
<td>21.2 ± 1.5</td>
<td>20.9 ± 1.1</td>
<td>0.26</td>
</tr>
</tbody>
</table>

Nehme Marinho et al. in preparation
### Phenotypic RFI and Total Tract Apparent Digestibility

<table>
<thead>
<tr>
<th>Digestibility</th>
<th>Low Efficiency (+RFI)</th>
<th>High Efficiency (-RFI)</th>
<th>SEM</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>DM, %</td>
<td>74.2</td>
<td>75.0</td>
<td>0.5</td>
<td>0.29</td>
</tr>
<tr>
<td>OM, %</td>
<td>76.5</td>
<td>77.1</td>
<td>0.6</td>
<td>0.52</td>
</tr>
<tr>
<td>CP, %</td>
<td>71.1</td>
<td>72.6</td>
<td>1.0</td>
<td>0.31</td>
</tr>
<tr>
<td>NDF, %</td>
<td>44.5</td>
<td>44.8</td>
<td>1.0</td>
<td>0.83</td>
</tr>
<tr>
<td>Starch, %</td>
<td>98.8</td>
<td>98.5</td>
<td>0.2</td>
<td>0.29</td>
</tr>
<tr>
<td>Fat, %</td>
<td>82.7</td>
<td>82.5</td>
<td>0.9</td>
<td>0.88</td>
</tr>
</tbody>
</table>

Means of digestibility analyzed at 65 and 125 d in the study.

---

### Phenotypic RFI and Ruminal Parameters

<table>
<thead>
<tr>
<th>Digestibility</th>
<th>Phenotypic feed efficiency</th>
<th>SEM</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Digestibility</td>
<td>Low Efficiency (+RFI)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>pH</td>
<td>6.4</td>
<td>6.3</td>
<td>0.05</td>
</tr>
<tr>
<td>Acetate, mMol/L</td>
<td>68.1</td>
<td>72.3</td>
<td>1.5</td>
</tr>
<tr>
<td>Propionate, mMol/L</td>
<td>25.4</td>
<td>27.7</td>
<td>1.0</td>
</tr>
<tr>
<td>Butyrate, mMol/L</td>
<td>14.6</td>
<td>16.0</td>
<td>0.5</td>
</tr>
<tr>
<td>Total VFA, mMol/L</td>
<td>113.1</td>
<td>121.2</td>
<td>2.2</td>
</tr>
<tr>
<td>Ammonia N, mg/dL</td>
<td>7.8</td>
<td>8.9</td>
<td>0.5</td>
</tr>
</tbody>
</table>

Means of digestibility analyzed at 65 and 125 d in the study.

---

### RFI and Rumen Microbiome

---

### Can we Select for RFI?

- **Feed Saved (FSAV)**
  - Includes the economic values of cow body weight composite (BWC) with residual feed intake (RFI)
  - **FSAV PTA** represents the expected pounds of feed saved per lactation

- **Formulas:**
  \[
  PTA_{FSAV} = -1 \times (P_{TA_{RFI}}) - 151.8 \times (P_{TA_{BWC}})
  \]

- **Example:**
<table>
<thead>
<tr>
<th></th>
<th>Cow A</th>
<th>Cow B</th>
<th>Cow C</th>
</tr>
</thead>
<tbody>
<tr>
<td>Weight (lb)</td>
<td>1500</td>
<td>1570</td>
<td>1430</td>
</tr>
<tr>
<td>BWC</td>
<td>0</td>
<td>+1.5</td>
<td>-1.5</td>
</tr>
<tr>
<td>Milk yield (lb/lact)</td>
<td>25,000</td>
<td>25,000</td>
<td>25,000</td>
</tr>
<tr>
<td>Expected DMI (lb/lact)</td>
<td>18,000</td>
<td>18,300</td>
<td>17,500</td>
</tr>
<tr>
<td>Actual DMI (lb/lact)</td>
<td>18,000</td>
<td>18,500</td>
<td>17,300</td>
</tr>
<tr>
<td>RFI (lb/lact)</td>
<td>0</td>
<td>+200</td>
<td>-200</td>
</tr>
<tr>
<td>Feed saved (lb/lact)</td>
<td>0</td>
<td>-428</td>
<td>+428</td>
</tr>
</tbody>
</table>

\[
PTA_{FSAV} = -1 \times (P_{RFI}) - 151.8 \times (P_{BWC})
\]

Each unit represents 16 kg of mature BW
Genetic Correlations Between Feed Saved and Daughter Fertility or Resistance to Metritis

\[ r = 0.10 \]
\[ r = 0.26 \]

Acknowledgements

✓ Dr. Adeoye Oyebade
✓ Ana Carolina M Silva
✓ Juan M. Bollatti
✓ Dr. Leandro F. Greco
✓ Dr. Natalia Martinez
✓ Dr. Marcos Zenobi
✓ Richard Lobo
✓ Dr. Roney Zimpel
STRATEGIC USE OF OVARIAN DATA TO IMPROVE PREGNANCY OUTCOMES FOLLOWING TIMED AI

Rafael S. Bisinotto
Department of Large Animal Clinical Sciences, University of Florida, Gainesville, FL, USA

2022 Florida Dairy Production Conference
Gainesville, FL

Key Physiological Events in Timed AI Programs

Individual approach
Identification of low fertility cohorts and cows that do not respond to hormonal treatments

Population approach
Systematic control of reproduction Proactive work with groups of cows

↑ Pregnancy per AI

Key Physiological Events in Timed AI Programs

Ovulation and Follicular emergence
Luteolysis
Synchronized ovulation

GnRH PGF
2 α
GnRH AI

NPD
NPD
GnRH AI
Targeted Progesterone Supplementation

30% of lactating dairy cows subjected to timed AI protocols lack a CL
(Piro et al., 2003; Stevenson et al., 1999; Brudt et al., 2009)

Development of strategies for progesterone supplementation in dairy cows
without CL during follicle growth that improve fertility responses

Blood sampling - Progesterone

Study day

0 1 2 3 4 5 6

GnRH

CL present

CL absent

GnRH + AI

US

PGF

2

α

Diestrus

(n = 946)

2 CIDR

(n = 218)

Control

(n = 234)

GnRH

GnRH

GnRH

GnRH + AI

GnRH + AI

GnRH + AI

CL present

CL absent

Bisinotto et al. (2013) J. Dairy Sci. 96:2214-2225

Bisinotto et al. (2013) J. Dairy Sci. 96:2214-2225

30.8 28.6

11.1 6.9

46.8 43.7

4.7 5.1

0 10 20 30 40 50 60

P/AI 34 days 7 8 9

P/AI 62 days Short cycle Pregnancy loss

Control 2 CIDR

CL present

CL absent

GnRH

GnRH

GnRH

GnRH + AI

GnRH + AI

GnRH + AI

Bisinotto et al. (2013) J. Dairy Sci. 96:2214-2225

Bisinotto et al. (2013) J. Dairy Sci. 96:2214-2225

P < 0.05

a, b

a, b

a, b

P < 0.05

a, b

a, b

P < 0.05

a, b

P < 0.05
Targeted Progesterone Supplementation

Blood sampling: Progesterone

CL present

CL absent


Key Physiological Events in Timed AI Programs

GnRH

PGF

CL

Gestation

Synchronized ovulation

Luteolysis

Ovulation and follicular emergence
No CL / CL < 15 mm → P/AI = 10.3% (n = 58)
CL > 15 mm → P/AI = 33.2% (n = 497)
P = 0.001


Resynchronization for Cows Without CL at PGF<sub>2α</sub>

Resynchronization for Cows Without CL at PGF<sub>2α</sub>

Resynchronization for Cows Without CL at PGF<sub>2α</sub>

P/AI According to the Number of CL at PGF<sub>2α</sub>
12/2/2022

**P/AI According to the Number of CL at PGF$_{2\alpha}$**

- No CL
- Single CL
- Multiple CL

<table>
<thead>
<tr>
<th></th>
<th>P/AI 32 days</th>
<th>P/AI 60 days</th>
<th>Pregnancy loss</th>
</tr>
</thead>
<tbody>
<tr>
<td>No CL</td>
<td>76.0</td>
<td>46.0</td>
<td>11.2</td>
</tr>
<tr>
<td>Single CL</td>
<td>11.6</td>
<td>25.0</td>
<td>8.4</td>
</tr>
<tr>
<td>Multiple CL</td>
<td>20.0</td>
<td>47.5</td>
<td>6.1</td>
</tr>
</tbody>
</table>

**Use of Milk Progesterone Profile**

- BCS
- GnRH
- PGF$_{2\alpha}$
- GnRH + Timed AI

Day relative to AI:

-8  -3  -2  0  7  28  34  62

**Plasma P4 According to Milk P4 Groups**

- Identification of cows without functional CL
  - Sensitivity = 0.58
  - Specificity = 0.93
  - PPV = 0.91

- Group 1
- Group 2
- Group 3

**Use of Milk Progesterone Profile**

- Test line
- Reference line

- Milk progesterone group

- Identification of cows without functional CL
**Conclusions**

- Ovarian status at key points reflect
  - Hormonal milieu that support establishment and maintenance of pregnancy (oocyte maturation, embryo development, uterine function)
  - Response to exogenous hormonal treatments
- Use of cow side test based on ultrasonography and (increasingly) progesterone concentrations allows for evaluation of ovarian status at key points in a way that is integrated with reproductive management routines
- Information on ovarian status at key points allow for decision making and implementation of alternate protocols for cows with different physiological needs
Thank you

Rafael S. Bisinotto
rabisinotto@ufl.edu

Modesta Hernandez
Alliance Dairy (Trenton, FL)

Dr. Catalina Cabrera
Full Circle Dairy (Soto, FL)

Dr. Brittany Diehl
North Florida Holsteins (Bell, FL)

Dr. Tomás Gonzalez
Never Ranch (Hunford, CA)
Considering dairy calf social behavior to improve welfare

Emily Miller-Cushon
Associate Professor
Department of Animal Sciences,
University of Florida

56th Florida Dairy Production Conference
December 1, 2022

Social housing affects calf welfare

- Individually-housed calves will work for access to a social companion
- Calves choose to spend more time with familiar social companions and prefer to feed socially
- Reduced fear and reactivity to novelty in group-housed calves
- Potential for long-term effects on social ability

Social housing for dairy calves

- In the United States, 63% of calves were housed individually as of the 2014 NAHMS survey (USDA, 2016)
- Public perception of social housing is more positive (Perttu et al., 2020)
- Canada is moving towards requiring social housing for calves

Holm et al., 2002; Flannery et al., 2007; Miller-Cushon et al., 2016; Jensen et al., 1997; Costa et al., 2014; Veissier et al., 1994

Early social experience and adaptability
Response to novel social environments


Time near either calf in the test arena

- Close proximity (min)

<table>
<thead>
<tr>
<th>Time near either calf in the test arena</th>
<th>Close proximity (min)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Individual-housed</td>
<td>1.0</td>
</tr>
<tr>
<td>Pair-housed</td>
<td>2.0</td>
</tr>
</tbody>
</table>

*Close proximity (%)

- Percentage of time near the more familiar calf


- Close proximity (min)

<table>
<thead>
<tr>
<th>Time near either calf in the test arena</th>
<th>Close proximity (min)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Individual-housed</td>
<td>1.0</td>
</tr>
<tr>
<td>Pair-housed</td>
<td>2.0</td>
</tr>
</tbody>
</table>

*Percentage of time near the more familiar calf

How does early life social contact affect adaptation to group-housing?


**Effects of early social contact on behavior**

- Pair-housing
- Individual-housing
- Birth 2 weeks

**Milk intake (L/d)**

- SE = 0.17, \( P = 0.24 \)

**Days spent scouring**

- 5.6 vs. 4.1 days, SE = 0.58, \( P = 0.10 \)

Effects of early social contact on behavior


P = 0.0052

Social lying (h/d)

Initial grouping Regrouping

P = 0.06

Social contact affects feeding behavior

• Reduced feed neophobia
• Social facilitation and social learning

Costa et al., 2015.

Social contact stimulates solid feed intake

Lindner et al., 2022.

Weight gain during weaning:
0.32 vs. 0.064 kg/d (P = 0.05)

Pair-housed calves
Individually-housed calves

Treatment: P = 0.08
Social housing supports development of social behavior and improves adaptability to novel environments.

Social housing supports solid feed intake and early life performance.
Summary
Social housing supports development of social behavior and improves adaptability to novel environments
Social housing supports solid feed intake and early life performance
What’s next?
What about long-term effects?
What can social behavior tell us?

What can social behavior tell us?
Lung ultrasonography to diagnose subclinical BRD
Location tracking system
Analyzing social contacts in healthy and sick calves

Thank you!

Emily Miller-Cushon
emillerc@ufl.edu
@abwlab
The impact of season and heat stress on uterine disease.

John J. Bromfield
Department of Animal Sciences
University of Florida

Postpartum diseases are prevalent and reduce milk

Postpartum diseases are prevalent and reduce fertility

Milk production is negatively affected by heat stress
Reproduction is negatively affected by heat stress

Northeast ▼ 10.7%
Southeast ▼ 22.9%
Southern plains ▼ 23.2%
Midwest ▼ 10.9%
Northern plains ▼ 14.9%

How does heat stress contribute to the development of postpartum uterine disease?

93°F + 63% RH = 86 THI
65°F + 55% RH = 63 THI

Incidence of metritis is increased in warmer months

Milk yield is impacted by both metritis and warmer months
Elevated THI increases disease incidence

- Mastitis ▲ 0.02% per THI
- Puerperal disorders ▲ 0.01% per THI
- Retained placenta ▲ 0.01% per THI

Average THI for 5 d after calving

Gernand (2019) JDS

How does heat stress in the dry period effect health?

Cool:
- Feb-Mar. THI 62, Max 22.5°C

Heat stress:
- Sept. THI 77, Max 31°C

Heat stress compounds effect of metritis on milk production

Season P = 0.0001 Metritis P < 0.0001

Heat stress increases persistence of disease

Persistence of disease
Why does heat stress increase disease?

Disease progression is a balance
- Pathogen abundance
- Limiting pathogens (immunity)
- Control of inflammation
- Tolerating pathogens

Could heat stress increase bacteria prevalence?

Vaginal discharge increases bacterial load

Day 7 postpartum

Could heat stress alter host immune function?

Heat stress does not alter bacterial load
Heat stress exacerbates later immune responses

Cows avoid, tolerate and resist pathogens

Take home message
- heat stress increases the incidence & persistence of uterine disease
- heat stress does not alter pathogen abundance
- heat stress exacerbates immune responses

Cow physiology is altered by heat stress that increases susceptible to disease.

University of Florida
Paula Molinari
Mackenzie Dickson
Rosabel Ramirez
Geoff Dahl
KC Jeong

Swansea University
Martin Sheldon
Making a dairy cow that is genetically more resistant to heat stress

Peter J. Hansen
Dept. of Animal Sciences
University of Florida

Energy Corrected Milk (lb/day)

<table>
<thead>
<tr>
<th>Region</th>
<th>Winter</th>
<th>Summer</th>
<th>% Reduction</th>
</tr>
</thead>
<tbody>
<tr>
<td>Northeast</td>
<td>76.7</td>
<td>72.1</td>
<td>6.0%</td>
</tr>
<tr>
<td>Midwest</td>
<td>77.2</td>
<td>72.8</td>
<td>5.7%</td>
</tr>
<tr>
<td>Northern Plains</td>
<td>74.1</td>
<td>67.9</td>
<td>8.3%</td>
</tr>
<tr>
<td>Southeast</td>
<td>72.5</td>
<td>66.4</td>
<td>8.6%</td>
</tr>
<tr>
<td>Southern Plains</td>
<td>73.6</td>
<td>66.4</td>
<td>9.9%</td>
</tr>
</tbody>
</table>

Conception Rate (%)

<table>
<thead>
<tr>
<th>Region</th>
<th>Winter</th>
<th>Summer</th>
<th>% Reduction</th>
</tr>
</thead>
<tbody>
<tr>
<td>Northeast</td>
<td>42.0</td>
<td>37.5</td>
<td>10.7%</td>
</tr>
<tr>
<td>Midwest</td>
<td>42.1</td>
<td>37.5</td>
<td>10.9%</td>
</tr>
<tr>
<td>Northern Plains</td>
<td>42.9</td>
<td>36.5</td>
<td>14.9%</td>
</tr>
<tr>
<td>Southeast</td>
<td>42.0</td>
<td>32.4</td>
<td>22.9%</td>
</tr>
<tr>
<td>Southern Plains</td>
<td>41.9</td>
<td>32.2</td>
<td>23.2%</td>
</tr>
</tbody>
</table>

Guinn et al., J Dairy Sci. 102:11777
Afternoon Rectal Temperatures in Lactating Cows in Florida

Differences in body temperature regulation during heat stress and seasonal depression in milk yield between Holstein, Brown Swiss and crossbred cows

Animal Body Temperature

Breed effects on daily variation in vaginal temperature

Breed, P<0.0001
Breed x time, P<0.0001
**Maximum and average vaginal temperature**

![Temperature graph with Holstein, BS, and Cross breeds compared.]

**Conclusion**

Genetic differences in regulation of body temperature do not necessarily equate to differences in maintenance of milk yield during heat stress; there are genes related to thermotolerance independent of those involved in body temperature regulation.

**Australian Breeding Value for Heat Tolerance**

![Graph showing Australian Breeding Value for Heat Tolerance with significant differences between breeds.]

**Differences in regulation of vaginal temperature between extreme heat-tolerant and extreme heat-sensitive Holsteins in California based on Australian breeding value for heat tolerance (ABVHT)**

Jensen et al., J. Dairy Sci. 105:7820 (2022)
Table 5: Genetic contributions to Holstein Australian breeding value for heat tolerance and the US genetic PTA for cows located in e. Californian state (n = 1,285). US genetic breeding values (top 10)

<table>
<thead>
<tr>
<th>NAAB Code</th>
<th>NAME</th>
<th>Heat Tolerance</th>
<th>Reliability</th>
<th>Net Merit</th>
</tr>
</thead>
<tbody>
<tr>
<td>111H12237</td>
<td>PEAK ALTAFLADON - ET</td>
<td>86</td>
<td>38</td>
<td>+599</td>
</tr>
<tr>
<td>29H8375</td>
<td>RICECREST LANTZ - ET</td>
<td>87</td>
<td>38</td>
<td>-491</td>
</tr>
<tr>
<td>777H10661</td>
<td>STANTONS ADAGIO - ET</td>
<td>88</td>
<td>38</td>
<td>+324</td>
</tr>
<tr>
<td>7H151713</td>
<td>S-S-EIRESER Expresso</td>
<td>88</td>
<td>38</td>
<td>+386</td>
</tr>
<tr>
<td>29H16103</td>
<td>ABS EPHRAM - ET</td>
<td>88</td>
<td>38</td>
<td>+407</td>
</tr>
<tr>
<td>29H14174</td>
<td>DE SU FEDERISTO - ET</td>
<td>88</td>
<td>38</td>
<td>+480</td>
</tr>
<tr>
<td>7H14174</td>
<td>DIZ ALTME LATROSE - ET</td>
<td>89</td>
<td>38</td>
<td>-498</td>
</tr>
<tr>
<td>7H151716</td>
<td>S-S-HEADWHELITONE - ET</td>
<td>89</td>
<td>38</td>
<td>+314</td>
</tr>
<tr>
<td>7H151716</td>
<td>S-S-ARROW RIVERS - ET</td>
<td>89</td>
<td>38</td>
<td>+231</td>
</tr>
<tr>
<td>551H3753</td>
<td>ST GEN NOBLE ABOTSFORD</td>
<td>89</td>
<td>38</td>
<td>+687</td>
</tr>
</tbody>
</table>

Bottom 10 US Bulls for Heat Tolerance - 2020

<table>
<thead>
<tr>
<th>NAAB Code</th>
<th>NAME</th>
<th>Heat Tolerance</th>
<th>Reliability</th>
<th>Net Merit</th>
</tr>
</thead>
<tbody>
<tr>
<td>111H12237</td>
<td>PEAK ALTAFLADON - ET</td>
<td>86</td>
<td>38</td>
<td>+599</td>
</tr>
<tr>
<td>29H8375</td>
<td>RICECREST LANTZ - ET</td>
<td>87</td>
<td>38</td>
<td>-491</td>
</tr>
<tr>
<td>777H10661</td>
<td>STANTONS ADAGIO - ET</td>
<td>88</td>
<td>38</td>
<td>+324</td>
</tr>
<tr>
<td>7H151713</td>
<td>S-S-EIRESER Expresso</td>
<td>88</td>
<td>38</td>
<td>+386</td>
</tr>
<tr>
<td>29H16103</td>
<td>ABS EPHRAM - ET</td>
<td>88</td>
<td>38</td>
<td>+407</td>
</tr>
<tr>
<td>29H14174</td>
<td>DE SU FEDERISTO - ET</td>
<td>88</td>
<td>38</td>
<td>+480</td>
</tr>
<tr>
<td>7H14174</td>
<td>DIZ ALTME LATROSE - ET</td>
<td>89</td>
<td>38</td>
<td>-498</td>
</tr>
<tr>
<td>7H151716</td>
<td>S-S-HEADWHELITONE - ET</td>
<td>89</td>
<td>38</td>
<td>+314</td>
</tr>
<tr>
<td>7H151716</td>
<td>S-S-ARROW RIVERS - ET</td>
<td>89</td>
<td>38</td>
<td>+231</td>
</tr>
<tr>
<td>551H3753</td>
<td>ST GEN NOBLE ABOTSFORD</td>
<td>89</td>
<td>38</td>
<td>+687</td>
</tr>
</tbody>
</table>

Top 10 US Bulls for Heat Tolerance - 2020

<table>
<thead>
<tr>
<th>NAAB Code</th>
<th>NAME</th>
<th>Heat Tolerance</th>
<th>Reliability</th>
<th>Net Merit</th>
</tr>
</thead>
<tbody>
<tr>
<td>111H12237</td>
<td>PEAK ALTAFLADON - ET</td>
<td>86</td>
<td>38</td>
<td>+599</td>
</tr>
<tr>
<td>29H8375</td>
<td>RICECREST LANTZ - ET</td>
<td>87</td>
<td>38</td>
<td>-491</td>
</tr>
<tr>
<td>777H10661</td>
<td>STANTONS ADAGIO - ET</td>
<td>88</td>
<td>38</td>
<td>+324</td>
</tr>
<tr>
<td>7H151713</td>
<td>S-S-EIRESER Expresso</td>
<td>88</td>
<td>38</td>
<td>+386</td>
</tr>
<tr>
<td>29H16103</td>
<td>ABS EPHRAM - ET</td>
<td>88</td>
<td>38</td>
<td>+407</td>
</tr>
<tr>
<td>29H14174</td>
<td>DE SU FEDERISTO - ET</td>
<td>88</td>
<td>38</td>
<td>+480</td>
</tr>
<tr>
<td>7H14174</td>
<td>DIZ ALTME LATROSE - ET</td>
<td>89</td>
<td>38</td>
<td>-498</td>
</tr>
<tr>
<td>7H151716</td>
<td>S-S-HEADWHELITONE - ET</td>
<td>89</td>
<td>38</td>
<td>+314</td>
</tr>
<tr>
<td>7H151716</td>
<td>S-S-ARROW RIVERS - ET</td>
<td>89</td>
<td>38</td>
<td>+231</td>
</tr>
<tr>
<td>551H3753</td>
<td>ST GEN NOBLE ABOTSFORD</td>
<td>89</td>
<td>38</td>
<td>+687</td>
</tr>
</tbody>
</table>

Cameron
Born 3/19/2010
The SLICK1 mutation is a mutation in the prolactin receptor gene that causes growth of short hair. Prolactin receptor, "Slick" prolactin receptor, Normal hair, Slick (dominant), Heterozygote, Homozygote. Animals inherit two copies of every gene.

- Sweating (↑) Conduction (↑) Convection (↑) Heat gain from radiation (↓)
- Reflection (↓) Insulation (↓)
Daily variation in vaginal temperature (July 31-Aug 13) in freestall barns with fans and sprinklers:
- Wild-type (n=13)
- Half-sibs (n=8)
- SLICK (n=16)

Vaginal temperature (°F):
- Wild-type: 100.4°F
- Half-sibs: 101.1°F
- SLICK: 101.8°F

The SLICK haplotype reduces seasonal variation in milk yield for cows in freestall barns:

Milk yield (lb/day):
- Slickdude NM: $791
- Inferno NM: $769

Calving Interval - Puerto Rico:
- Holstein: 17 months
- Slick Holstein: 15 months

Inferno NM 5769: Thermo Regulatory Genetics

Slickdude NM 5791: CRV Genetics
How Useful Is It to Produce a Genetically Thermotolerant Dairy Animal?

The slick gene improves body temperature regulation in heifers in Florida but not in California

Carmicle et al., J Dairy Sci. 105: 9216 (2022)

Acknowledgements

Serdal Dikmen
UF Dairy Unit, Hague Florida
Larson Dairy, Okeechobee Florida
Gracewood Dairy, Okeechobee, Florida
Maddox Dairy, Riverdale CA
Da Silva Dairy, Vanderham West Dairy, Wreden Ranch - CA

Guzik Dairy, Riverside CA

Froylan Sosa Dairy

UF Dairy Unit

L.E. "Red" Larson Endowment

Erin McEwan

UF Dairy Unit

Froylan Sosa and Colleen Larson DataGene

L.E. "Red" Larson

Endowment

Froylan Sosa and Colleen Larson DataGene

L.E. "Red" Larson

Endowment

Froylan Sosa and Colleen Larson DataGene

L.E. "Red" Larson

Endowment

Froylan Sosa and Colleen Larson DataGene

L.E. "Red" Larson

Endowment
Heat abatement during the pre-weaning phase: Friend or Foe?

A. B. Montevecchio¹ and R. C. Chebel¹,²
¹Department of Large Animal Clinical Sciences
²Department of Animal Sciences

Projected decadal increases in heat stress (THI ≥ 70) between 2000 to 2100

Thermal Stress and Calves
• Thermoregulation – mechanism by which mammals maintain tightly controlled body temperature in order to survive
  - In thermoneutral conditions, mammals do not expend any additional energy
• Thermoneutral zones are dependent on:
  - Ambient temperature and air movement, moisture, hair coat, sunlight, bedding, and rumination

Projected costs associated with impaired performance of replacement heifers due to heat stress:
- Heifers 0 to 1 year of age: US$ 12.1 million/y
- Heifers 1 to 2 years of age: US$ 36.2 million/y

Models used were adapted from finishing beef cattle
During the SE Dairy Stewardship Program held in 2018 in southern GA and FL, producers “demanded” research on best housing strategies for pre-weaned calves in the SE.

Materials and Methods

**Control**: Outdoors; **SH**: Shade; **SHF**: Shade + fans

- **Male calves**
  - Control: $\delta = 20$
  - SH: $\delta = 21$, $\gamma = 125$
  - SHF: $\delta = 19$, $\gamma = 102$

Collaborating Herd

Experimental design: Males

- Individual hutches
- Ceiling fan
- Male calves

Control: Outdoors; SH: Shade; SHF: Shade + fans.
Effects of heat abatement strategy on air velocity and temperature inside the hutch.


Effects of heat abatement strategy on rectal temperature and respiratory frequency.


Effects of heat abatement strategy on lying behavior.

Effects of heat abatement strategy on performance at weaning


**Average daily THI according to treatment and date**

<table>
<thead>
<tr>
<th>Date</th>
<th>Control</th>
<th>SH</th>
<th>SHF</th>
</tr>
</thead>
<tbody>
<tr>
<td>7/8</td>
<td>7/12</td>
<td>7/15</td>
<td>8/5</td>
</tr>
<tr>
<td>8/12</td>
<td>8/15</td>
<td>8/18</td>
<td>9/5</td>
</tr>
<tr>
<td>8/22</td>
<td>9/5</td>
<td>9/18</td>
<td>9/25</td>
</tr>
<tr>
<td>9/5</td>
<td>9/18</td>
<td>9/25</td>
<td>9/30</td>
</tr>
<tr>
<td>9/16</td>
<td>9/25</td>
<td>9/30</td>
<td>10/14</td>
</tr>
</tbody>
</table>

**Experimental design: Females**

**Effects of heat abatement strategy on rectal temperature, respiratory frequency, and the risk of hyperthermia**

<table>
<thead>
<tr>
<th>Variables</th>
<th>SH (±SEM)</th>
<th>SHF (±SEM)</th>
<th>P - value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Air velocity, m/sec</td>
<td>0.41 ± 0.05</td>
<td>1.23 ± 0.05</td>
<td>&lt; 0.01</td>
</tr>
<tr>
<td>Air temperature, °C</td>
<td>30.5 ± 0.1</td>
<td>30.2 ± 0.1</td>
<td>0.02</td>
</tr>
<tr>
<td>Rectal temperature, °C</td>
<td>38.8 ± 0.02</td>
<td>38.7 ± 0.03</td>
<td>0.02</td>
</tr>
<tr>
<td>Hyperthermia, %</td>
<td>30.3 ± 2.0</td>
<td>21.9 ± 1.9</td>
<td>&lt; 0.01</td>
</tr>
<tr>
<td>Respiratory frequency, respir/min</td>
<td>51.4 ± 1.2</td>
<td>38.9 ± 1.1</td>
<td>0.13</td>
</tr>
</tbody>
</table>

1000 h

<table>
<thead>
<tr>
<th>Variables</th>
<th>SH (±SEM)</th>
<th>SHF (±SEM)</th>
<th>P - value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Air velocity, m/sec</td>
<td>0.43 ± 0.05</td>
<td>1.19 ± 0.06</td>
<td>&lt; 0.01</td>
</tr>
<tr>
<td>Air temperature, °C</td>
<td>32.9 ± 0.1</td>
<td>32.7 ± 0.1</td>
<td>0.09</td>
</tr>
<tr>
<td>Rectal temperature, °C</td>
<td>39.2 ± 0.03</td>
<td>39.1 ± 0.03</td>
<td>0.43</td>
</tr>
<tr>
<td>Hyperthermia, %</td>
<td>32.1 ± 4.4</td>
<td>56.4 ± 4.6</td>
<td>0.37</td>
</tr>
<tr>
<td>Respiratory frequency, respir/min</td>
<td>51.4 ± 1.3</td>
<td>41.7 ± 1.3</td>
<td>0.15</td>
</tr>
</tbody>
</table>

1600 h
Effects of heat abatement strategy on body measures after weaning

<table>
<thead>
<tr>
<th>Variable</th>
<th>SH</th>
<th>SHF</th>
<th>P – value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Body weight, kg (±SEM)</td>
<td>2.73 ± 0.14</td>
<td>2.54 ± 0.14</td>
<td>0.85</td>
</tr>
<tr>
<td>Average daily gain, kg/d</td>
<td>12.5 ± 0.14</td>
<td>12.3 ± 0.14</td>
<td>0.86</td>
</tr>
</tbody>
</table>

Effects of heat abatement strategy on reproductive responses of heifers

<table>
<thead>
<tr>
<th>Variable</th>
<th>SH</th>
<th>SHF</th>
<th>P – value</th>
</tr>
</thead>
<tbody>
<tr>
<td>First insemination</td>
<td>0.30</td>
<td>0.44</td>
<td></td>
</tr>
<tr>
<td>Pregnancy at 35 d, % (n)</td>
<td>55.3 (114)</td>
<td>48.2 (95)</td>
<td></td>
</tr>
<tr>
<td>Pregnancy at 88 d, % (n)</td>
<td>53.5 (114)</td>
<td>45.9 (95)</td>
<td></td>
</tr>
<tr>
<td>Pregnancy loss, % (n)</td>
<td>3.2 (63)</td>
<td>4.9 (41)</td>
<td></td>
</tr>
</tbody>
</table>

Effects of treatment on BW and age at calving and calf characteristics

<table>
<thead>
<tr>
<th>Variable</th>
<th>SH</th>
<th>SHF</th>
<th>P – value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Starting 1st lactation, %</td>
<td>86.4</td>
<td>76.2</td>
<td>0.27</td>
</tr>
<tr>
<td>Age at calving, mo (±SEM)</td>
<td>22.2 ± 0.14</td>
<td>22.3 ± 0.16</td>
<td>0.85</td>
</tr>
<tr>
<td>BW at calving, kg (±SEM)</td>
<td>613.7 ± 6.6</td>
<td>619.0 ± 6.9</td>
<td>0.52</td>
</tr>
<tr>
<td>Dystocic calving, %</td>
<td>8.3</td>
<td>5.2</td>
<td>0.46</td>
</tr>
<tr>
<td>Calf characteristics</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male, %</td>
<td>22.2</td>
<td>27.3</td>
<td>0.48</td>
</tr>
<tr>
<td>Twins, %</td>
<td>0.93</td>
<td>0.00</td>
<td>0.40</td>
</tr>
<tr>
<td>Stillbirth, %</td>
<td>0.93</td>
<td>2.60</td>
<td>0.45</td>
</tr>
<tr>
<td>Body weight at birth, kg (±SEM)</td>
<td>38.7 ± 0.42</td>
<td>38.3 ± 0.52</td>
<td>0.52</td>
</tr>
</tbody>
</table>

Effects of treatment on milk yield

<table>
<thead>
<tr>
<th>Variable</th>
<th>SH</th>
<th>SHF</th>
<th>P – value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Test, month</td>
<td>0.01</td>
<td></td>
<td></td>
</tr>
<tr>
<td>TRT: P &lt; 0.01</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Test x TRT: P = 0.10</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

SH: Shade; SHF: Shade + fans
**Effects of treatment on hazard of pregnancy**

<table>
<thead>
<tr>
<th>Responses</th>
<th>SH</th>
<th>SHF</th>
<th>P - value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hazard of pregnancy</td>
<td>Ref. 0.67 (0.49, 0.93)</td>
<td>0.02</td>
<td></td>
</tr>
</tbody>
</table>

**Effect of treatment on lifetime hazard of removal**

<table>
<thead>
<tr>
<th>Responses</th>
<th>SH</th>
<th>SHF</th>
<th>P - value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hazard of removal</td>
<td>Ref. 1.79 (1.11, 2.90)</td>
<td>0.02</td>
<td></td>
</tr>
</tbody>
</table>

SH: Shade; SHF: Shade + fans

**Effect of heat abatement strategy on wither height**

Piccione et al., 2003

**Development of thermoregulatory ability**

vs
Effect of heat abatement strategy on survival

Take Home Message

- Exposure of calves to outdoor conditions during summer in southern GA affected calf thermoregulation and comfort ($\beta$)
- Provision of shade+fan marginally increased wither height at weaning compared with housing outdoors ($\gamma$)
- Within a barn, provision of fans did not affect pre-weaning performance and impaired survival to the second lactation ($\zeta$)
- Unless calves/heifers will be housed throughout their lives inside a barn, the current data does not support benefits to the use of fans during the pre-weaning phase

Thank you!

Ana Beatriz Montevvecchio DVM, MS
montevvecchio.bea@ufl.edu

Ricardo Chebel rcchebel@ufl.edu
ALLEVIATING HEAT STRESS: WHO GETS COOLED AND WHY?

G. E. Dahl
Department of Animal Sciences
56th UF Dairy Production Conference
1 December 2022
gdahl@ufl.edu

OUTLINE

• Effective cooling approaches
• Water use estimates
• Priority for cooling?
  - Which group first?
    Lactating? Dry? Calves?
• Summary

EFFECTIVE COOLING

• Goal is 38.6 °C for core temperature
• Combination of water soakers and fans most effective
• Acute versus long term responses – will they match?

WATER USE

• 25 -30 % under soakers at any time
• 233 L/cow/d; over half wasted
• “Blue” water – highest value, lowest supply
HEAT STRESS REDUCES PRODUCTION OF EARLY LACTATION COWS

Milk Production, kg/d

Weeks in Trial

Heat Stress
Cooling

Tao and Dahl, Unpublished

HEAT STRESS REDUCES PRODUCTION OF MID AND LATE LACTATION COWS

Milk Yield, kg/d

Week relative to treatment

CL
NON-CL

Weng and Tao, Unpublished

HEAT STRESS DURING LACTATION

• Depresses DMI
• Reduces milk yield
• Recent studies suggest additional metabolic effects beyond DMI
• Recovery dependent on duration, stage of lactation

What about dry cows?

DAM vs. DAUGHTER

Late gestation

Milk yield?
Metabolism?
Fetal growth?
Thermoregulation?
DAM

What else?

Calf health?
Calf growth?
Heat growth?
Reproduction?

Late gestation

Cow performance?
Survival?
DAM

UF/IFAS
Gainesville, Florida, USA
- Sand bedded free stalls
- Fans over stalls
- Soakers over feedline
- Fans on at 70°F (21.1°C)
- Soakers on 1 min every 5 min at 72°F

HEAT STRESS INCREASES MEAN RECTAL TEMPERATURE

COOLING DRY COWS INCREASES MILK
HEAT STRESS DECREASES ALVEOLI NUMBER

H&E Stain

DRY IN COOL MONTHS IMPROVES PERFORMANCE

Table 1. Milk production and reproductive performance of cows killed during HOT months (Jun, Jul, Aug) or COOL months (Dec, Jan, Feb) in the first 60 DIM of the subsequent lactation on a commercial farm in Florida.

<table>
<thead>
<tr>
<th>Item</th>
<th>Before HOT months (Jun, Jul, Aug)</th>
<th>Before COOL months (Dec, Jan, Feb)</th>
<th>P-value S</th>
</tr>
</thead>
<tbody>
<tr>
<td>Milk production (kg)</td>
<td>236 ± 8.8</td>
<td>255 ± 12.3</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td>Weight (kg)</td>
<td>620 ± 12</td>
<td>610 ± 14</td>
<td>0.16</td>
</tr>
<tr>
<td>Respiratory system (%)</td>
<td>22 ± 2</td>
<td>23 ± 2</td>
<td>0.22</td>
</tr>
<tr>
<td>Pregnancy rate (%)</td>
<td>153 ± 2</td>
<td>155 ± 3</td>
<td>0.36</td>
</tr>
<tr>
<td>Stillbirth rate (%)</td>
<td>6 ± 1</td>
<td>4 ± 1</td>
<td>0.15</td>
</tr>
<tr>
<td>Birth weight (kg)</td>
<td>38 ± 2</td>
<td>40 ± 2</td>
<td>0.27</td>
</tr>
</tbody>
</table>

DRY IN COOL MONTHS IMPROVES REPRODUCTIVE PERFORMANCE

EFFECTS ON FIRST CALF HEIFERS: COOLING INCREASES YIELD
Calf health?
Calf growth?
Heifer growth?
Reproduction?
Cow performance?
Thermoregulation?
Survival?

Late gestation
Milk yield?
Metabolism?
Immune function?
Placental function?

Cooling increases calf birth weight

Treatment effect: $P < 0.01$

36.7 kg
42.4 kg

Heat stress
Cooling

In utero HT reduces weaning weight

$P = 0.04$

Weaning BW, Kg

Heat stress
Cooling

Cooling improves total IgG and AEA

Days of Age

Total IgG (mg/dl)
IN UTERO HT ACCELERATES GUT CLOSURE


Heat Stress Experiments 2007 - 2011

<table>
<thead>
<tr>
<th></th>
<th>Bulls</th>
<th>Heifers</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cooling</td>
<td>31</td>
<td>41</td>
<td>72</td>
</tr>
<tr>
<td>Heat Stress</td>
<td>30</td>
<td>44</td>
<td>74</td>
</tr>
<tr>
<td>Total</td>
<td>61</td>
<td>85</td>
<td>147</td>
</tr>
</tbody>
</table>


BIRTH WEIGHT

Birth Weight, kg

trt: \( P < 0.001 \)

gender: \( P = 0.002 \)

44.8 kg

**IN UTERO HEAT STRESS DECREASES Calf Bodyweight to Puberty**

![Graph showing the effect of in utero heat stress on calf bodyweight to puberty.](image)


**IN UTERO HEAT STRESS DECREASES Calf Survival**

<table>
<thead>
<tr>
<th>Preparation</th>
<th>CT</th>
<th>CT+</th>
<th>CT+HS</th>
<th>Pct</th>
</tr>
</thead>
<tbody>
<tr>
<td>N</td>
<td>28</td>
<td>24</td>
<td>24</td>
<td>0.05</td>
</tr>
<tr>
<td>Heat death</td>
<td>0</td>
<td>0</td>
<td>3</td>
<td>0.03</td>
</tr>
<tr>
<td>Heat death by stage of age</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>0.05</td>
</tr>
</tbody>
</table>


**IN UTERO HEAT STRESS DECREASES REPRODUCTIVE PERFORMANCE**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>CL</th>
<th>HT</th>
<th>SEM</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>AGE at first AI, mo</td>
<td>13.6</td>
<td>13.8</td>
<td>0.2</td>
<td>0.32</td>
</tr>
<tr>
<td>Survives per pregnancy d' 30</td>
<td>2.4</td>
<td>2.4</td>
<td>0.2</td>
<td>0.03</td>
</tr>
<tr>
<td>Age at first AI, mo</td>
<td>16.1</td>
<td>16.9</td>
<td>0.3</td>
<td>0.07</td>
</tr>
<tr>
<td>Services per pregnancy d' 30</td>
<td>2.3</td>
<td>2.6</td>
<td>0.2</td>
<td>0.02</td>
</tr>
<tr>
<td>Age at calving, mo</td>
<td>24.8</td>
<td>25.0</td>
<td>0.4</td>
<td>0.72</td>
</tr>
</tbody>
</table>


**IN UTERO HEAT STRESS REDUCES MILK PRODUCTION**

![Graph showing the effect of in utero heat stress on milk production.](image)

IN UTERO HEAT STRESS DOES NOT AFFECT MATURE BODYWEIGHT


LP = .03

In Utero Heat Stress Alters Lifetime Yield

Monteiro et al., J. Dairy Sci. 103:7555-7568.

IN UTERO HEAT STRESS REDUCES SURVIVAL IN HERD

Laporta et al., J. Dairy Sci. 103:7555-7568.

- In utero HT induces fetal programming
- Alters methylation patterns in multiple tissues, ages
- Phenotype persists to F2
TAKE HOME MESSAGES

• Cooling needed for all mature cows – lactating and dry
• Heifers need to be cooled pre-partum to improve yield, protect calf
• Water conservation – esp. “Blue water” - increasingly important consideration for cooling