Proceedings

Dairy Day
at
Miner Institute

Wednesday, December 11, 2019
10:00 AM - 3:00 PM
Chazy, New York
Dairy Day at Miner Institute  
Wednesday, December 11, 2019  
10:00AM -3:00 PM

10:10-11:00  **Dr. Rick Grant**, Miner Institute, “Happy Herd, Happy Life: Forages and Feeding Management to Make Your Cows Smile”

11:00-11:45  **Dr. Sarah Morrison**, “Kick the Cold-Winter Management and Feeding of Calves.”

11:45-1:00  **Hot Lunch** available for $5, Door Prizes

1:00-1:45  **Dr. Heather Dann**, “Start the Lactation Off with a Bang – Focus on Transition Cow Management”

1:45-2:30  **Katie Ballard**, “Beat the Heat – Are North Country cows susceptible to heat stress?”

2:30-3:00  **Laura Klaiber**, “Miner Institute Edge-of-Field Water Quality Research Update”

3:30-5:00  Tour of Miner Institute Dairy and Research facilities

5:00-6:00  Dinner at BERC Auditorium courtesy of Poulin

6:00 PM  **Dr. Tom Overton and Dr. Kristan Reed**, Cornell Feed Dealer Meeting-The latest research information on dairy cattle nutrition
Happy Herd, Happy Life: Forages and Feeding to Make Your Cows Smile

Rick Grant
William H. Miner Agricultural Research Institute
Chazy, NY

Cows respond to high quality forage...

When cows consume highly digestible fiber...

- Higher milk components
- Less metabolic disorders
- Fewer foot problems
- Greater cow longevity
- Less purchased grain
- Greater IOFC: +30%

(Haest, 2012)

Highest profit dairy herds can manage forages!

- High vs low profit herds
  - Ability to manage forage quality and inventory
  - Harvest at optimal maturity regardless of weather
  - Have back-up plans when things don’t work...
  - 9% less in feed cost

(Ishler, Penn State University)

Forage Quality is More Important than Forage Type

Forage NDF digestibility and cow performance

For every 1%-unit increase in NDF digestibility:
- +0.40 lb/d DMI
- +0.55 lb/d 4%FCM (Oto and Allen, 1999)

>40% corn silage in diet:
- +0.26 lb/d DMI
- +0.31 lb/d 3.5%FCM (Jung et al., 2018)
Response to forage digestibility varies by milk production level…

...so, target its use

Response to high-NDFD corn silage by milk production level (Ivan et al., 2004)

- Overall, DMI increased by 1.4 lb/d and milk by 2.0 lb/d

Targeted allocation of forages is critical for efficient use...

- Cow’s biology requires forage segregation
- Assessment of forage composition and digestibility (NDF and starch) allows forages to be targeted to appropriate group of cows
- Allocation of forage by production level gets more milk from forage!

Targets for forage NDF and NDF digestibility...

<table>
<thead>
<tr>
<th>Nutrient</th>
<th>Alfalfa, Mean</th>
<th>Alfalfa, Normal range</th>
<th>Grass, Mean</th>
<th>Grass, Normal range</th>
</tr>
</thead>
<tbody>
<tr>
<td>NDF, % of DM</td>
<td>43.7</td>
<td>38.2 - 49.3</td>
<td>56.7</td>
<td>49.9 - 63.4</td>
</tr>
<tr>
<td>Lignin, % of DM</td>
<td>7.4</td>
<td>6.1 - 8.6</td>
<td>5.2</td>
<td>3.5 - 6.8</td>
</tr>
<tr>
<td>30-h NDFD, %</td>
<td>51.5</td>
<td>45.4</td>
<td>63.3</td>
<td>56.4 - 70.3</td>
</tr>
</tbody>
</table>

1 Mean plus/minus one standard deviation. Source: DairyOne Forage Lab, Ithaca, NY.

Need to target higher NDFD to maximize response to forages!

Making the most of highly digestible forages...

Low quality forage GUARANTEES low milk production.
But, high quality forage DOES NOT ASSURE high milk production.
Laboratory analysis should measure the potential nutritive value of forage, but poor feeding management reduces this potential—especially in competitive feeding environments.

Example: Excess competition at feedbunk and bare bunk disease
(Campbell and Grant, 2016)

- Overcrowding and feed restriction (1:00 am to 6:00 pm):
  - Up to 9 h/d greater sub-acute rumen acidosis (pH < 5.8)
  - Reduces NDF digestion rate by up to 50%
- High NDFD forage is wasted...

Cow response to forage is function of:
* Nutritive value
* Management

Importance of management environment (Bach et al., 2008)
- 47 herds with similar genetics were fed same TMR
- Mean milk yield = 65 lb/d
  - Range: 45 to 74 lb/d
- Non-dietary factors accounted for 56% of variation in milk yield
  - Feeding for refusals (64.1 vs 60.6 lb/d)
  - Feed push-ups (63.7 vs 55.0 lb/d)
  - Stalls per cow

Feed and Feeding Environment
Stocking Density, Feed Restriction, and Dietary Fiber: Focus on Rumen pH
(Mac Campbell, 2016; 2017)

Low rumen pH:
Stocking density >> diet
- 100 versus 142% stocking density
  - 1.4 to 2 h/d greater sub-acute acidosis (SARA; pH<5.8)
- Dietary changes (pNDF, uNDF, feed restriction)
  - 0.3 to 0.9 h/d greater SARA
- Overcrowding and feed restriction
  - Up to 9 h/d SARA
- Bottom line: Feeding environment affects rumen pH as much as (more than) diet itself.
(Campbell and Grant, 2019)
Perfect recipe for low rumen pH...

- High dietary starch; low peNDF, uNDF240
- Overcrowding, especially >120% of stalls
- Empty bunk

(Campbell and Grant, 2016)

Recumbent rumination reduces SARA - especially under competitive environments

\[ y = -20.70x + 21.06 \]
\[ R^2 = 0.44 \]

Overcrowded environment

Forage quality influences eating behavior...

- As ration fiber content increases:
  - Increased time spent eating
  - Longer meal length
  - More sorting

- ~5% of energy provided by feed can be used for chewing with higher NDF, lower digestibility forages.

[Alhadrami and Huber, 1991]

Overlooked component of forage quality ...

- Time spent eating at bunk
  - Forage %, NDF digestibility, and particle size
- Particle size in TMR versus particle size in swallowed bolus

Behavior responses to increasing diet forage content (Jiang et al., 2017)

<table>
<thead>
<tr>
<th>Item</th>
<th>40%</th>
<th>50%</th>
<th>60%</th>
<th>70%</th>
<th>Difference</th>
</tr>
</thead>
<tbody>
<tr>
<td>DMI (lb/d)</td>
<td>49.3</td>
<td>47.3</td>
<td>44.7</td>
<td>41.1</td>
<td>-3.7 kg/d</td>
</tr>
<tr>
<td>Eating, min/d</td>
<td>286</td>
<td>282</td>
<td>342</td>
<td>393</td>
<td>+107 min/d</td>
</tr>
<tr>
<td>Ruminating, min/d</td>
<td>428</td>
<td>484</td>
<td>471</td>
<td>461</td>
<td>+35 min/d</td>
</tr>
<tr>
<td>Total chewing, min/d</td>
<td>712</td>
<td>785</td>
<td>813</td>
<td>833</td>
<td>+141 min/d</td>
</tr>
<tr>
<td>Resting, min/d</td>
<td>748</td>
<td>659</td>
<td>627</td>
<td>587</td>
<td>-141 min/d</td>
</tr>
</tbody>
</table>

- Corn silage and alfalfa hay, primarily.
- Increased chewing time (mostly longer eating time) at expense of resting time.
- Eating time ~5 h/d encourages natural feeding behavior (Grant and Albright, 2001).
Particle size reduction during eating

<table>
<thead>
<tr>
<th>Sieve size (mm)</th>
<th>19 mm</th>
<th>13.2 mm</th>
<th>9.5 mm</th>
<th>6.7 mm</th>
<th>4.75 mm</th>
<th>3.35 mm</th>
<th>Mean particle size (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Diet</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Low/Low NDF, uNDF</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>%</td>
<td>12%</td>
<td>27%</td>
<td>29%</td>
<td>16%</td>
<td>9%</td>
<td>6%</td>
<td>10.62</td>
</tr>
<tr>
<td>Mean</td>
<td>9.19</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Low/High NDF, uNDF</td>
<td>10%</td>
<td>21%</td>
<td>22%</td>
<td>15%</td>
<td>11%</td>
<td></td>
<td>9.19</td>
</tr>
<tr>
<td>High/High NDF, uNDF</td>
<td>22%</td>
<td>13%</td>
<td>17%</td>
<td>20%</td>
<td>11%</td>
<td>7%</td>
<td>11.65</td>
</tr>
<tr>
<td>High/Low NDF, uNDF</td>
<td>32%</td>
<td>11%</td>
<td>22%</td>
<td>29%</td>
<td>20%</td>
<td>16%</td>
<td>7.95</td>
</tr>
<tr>
<td><strong>Bolus</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Low/Low NDF, uNDF</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>%</td>
<td>11%</td>
<td>11%</td>
<td>38%</td>
<td>26%</td>
<td>14%</td>
<td>10%</td>
<td>7.95</td>
</tr>
<tr>
<td>Mean</td>
<td>7.46</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Low/High NDF, uNDF</td>
<td>3%</td>
<td>11%</td>
<td>22%</td>
<td>29%</td>
<td>20%</td>
<td>16%</td>
<td>7.46</td>
</tr>
<tr>
<td>High/High NDF, uNDF</td>
<td>13%</td>
<td>12%</td>
<td>19%</td>
<td>28%</td>
<td>21%</td>
<td>14%</td>
<td>7.76</td>
</tr>
</tbody>
</table>

**Particle size of ingested feed** (Schadt et al., 2011)

<table>
<thead>
<tr>
<th>Forage type</th>
<th>NDF % of DM</th>
<th>Feed size, mm</th>
<th>Bolus size, mm</th>
<th>Chews /g NDF</th>
</tr>
</thead>
<tbody>
<tr>
<td>Long rye grass hay</td>
<td>57.1</td>
<td>10.3</td>
<td>2.6</td>
<td></td>
</tr>
<tr>
<td>50-mm rye &quot;hay&quot;</td>
<td>58.6</td>
<td>42.2</td>
<td>9.9</td>
<td>3.5</td>
</tr>
<tr>
<td>19-mm PSPS hay</td>
<td>57.9</td>
<td>43.5</td>
<td>10.7</td>
<td>2.2</td>
</tr>
<tr>
<td>8-mm PSPS hay</td>
<td>59.1</td>
<td>25.1</td>
<td>10.8</td>
<td>1.7</td>
</tr>
<tr>
<td>1.18 PSPS hay</td>
<td>54.2</td>
<td>9.7</td>
<td>8.5</td>
<td>1.9</td>
</tr>
<tr>
<td>Grass silage</td>
<td>53.1</td>
<td>13.8</td>
<td>11.6</td>
<td>6.4</td>
</tr>
<tr>
<td>Corn silage</td>
<td>48.1</td>
<td>12.0</td>
<td>11.2</td>
<td>0.7</td>
</tr>
<tr>
<td>TMR</td>
<td>37.7</td>
<td>13.1</td>
<td>12.5</td>
<td>0.6</td>
</tr>
</tbody>
</table>

**Suggested PSPS targets:** Miner Institute (2017)

<table>
<thead>
<tr>
<th>Screen, mm</th>
<th>PSPS 2013 %</th>
<th>Miner 2017 %</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Top 10</td>
<td>&lt;5</td>
<td>&lt;5</td>
<td>Sorted material, too long, increases time needed for eating, especially if &gt;10%</td>
</tr>
<tr>
<td>Mid 1</td>
<td>5-20</td>
<td>5-20</td>
<td>Sortable material, too long, increases time needed for eating, especially if &gt;10%</td>
</tr>
<tr>
<td>Mid 2</td>
<td>20-30</td>
<td>20-30</td>
<td>Functions as pef sieve, no recommendation for amount to retain here other than total on the top 3 sieves = pef</td>
</tr>
<tr>
<td>Pan</td>
<td>30-40</td>
<td>&lt;5</td>
<td>40-50% grain diet results in at least 25-30% in the pan</td>
</tr>
</tbody>
</table>

**Recommended particle size distributions:** work in progress...

<table>
<thead>
<tr>
<th>Screen, mm</th>
<th>TMR Corn stage</th>
<th>Alfalfa stage</th>
<th>Grass stage</th>
</tr>
</thead>
<tbody>
<tr>
<td>D0-mm</td>
<td>&lt;5</td>
<td>1-3</td>
<td>5-35</td>
</tr>
<tr>
<td>5-mm</td>
<td>5-20</td>
<td>5-40</td>
<td>25-50</td>
</tr>
<tr>
<td>10-20</td>
<td>&lt;5</td>
<td>1-3</td>
<td>5-35</td>
</tr>
<tr>
<td>25-30</td>
<td>&lt;5</td>
<td>&lt;5</td>
<td>&lt;5</td>
</tr>
<tr>
<td>TLC</td>
<td>1/8 - 1/4</td>
<td>1/2-3/4</td>
<td>1/4-3/8</td>
</tr>
</tbody>
</table>

- Considerable variation between TLC and silage particle size distribution.
- GOAL: chop length should ensure good packing in silo to reduce DM losses.

**The Ideal Situation...**

- Particle size, NDFD, and forage % to allow 3 to 5 h/d eating time and meet cow requirements
- Populate rumen with 2nd screen (8-10 mm) of PSPS
- stimulates rumination
- Access to stalls to encourage recumbent rumination
- Feed available 24/7 and pushed up!
Carrying on William Miner’s vision: “Science in the Service of Agriculture.”
1. Double birth weight by 56 days
   Ex. 85 lbs (38.5 kg) → 170 lbs (77.1 kg)
   → 1.5 lbs/d (0.68 kg/d)

2. Morbidity (medical treatments)
   – Diarrhea <15%
   – Respiratory infections <10%

3. Mortality <3%

**Thermal Neutral Zone**
- 59 to 82°F (15 to 28°C) for calf under 3 week of age
  - Cold Stress
- Prioritization of nutrients
  1. **Maintenance**
     - Thermal regulation
     - Immune system
     - Stress response
  2. **Growth**

**Meeting Requirements is More Challenging in Cold Temperatures**

<table>
<thead>
<tr>
<th>Temperature, °F</th>
<th>Nutrient source</th>
<th>59</th>
<th>50</th>
<th>41</th>
<th>32</th>
<th>23</th>
<th>14</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Temperature, °F</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Whole milk, qt.</td>
<td>2.2</td>
<td>2.7</td>
<td>3.1</td>
<td>3.4</td>
<td>3.6</td>
<td>3.9</td>
<td>4.1</td>
<td></td>
</tr>
<tr>
<td>Milk replacer, qt. (20% CP; 20% Fat)</td>
<td>2.7</td>
<td>3.4</td>
<td>3.8</td>
<td>4.1</td>
<td>4.5</td>
<td>4.9</td>
<td>5.2</td>
<td></td>
</tr>
</tbody>
</table>

Estimated from values in NRC, 2001 for 88-lb calf.

**Energy (ME) and Protein Requirements for BW Gain in a 110 lbs Calf**

<table>
<thead>
<tr>
<th>Rate of gain (lbs/d)</th>
<th>DMI (lbs/d)</th>
<th>ME (Mcal/d)</th>
<th>CP (g/d)</th>
<th>CP (% of DM)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.44</td>
<td>1.21</td>
<td>2.36</td>
<td>94</td>
<td>18.0</td>
</tr>
<tr>
<td>0.88</td>
<td>1.48</td>
<td>2.89</td>
<td>150</td>
<td>22.4</td>
</tr>
<tr>
<td>1.32</td>
<td>1.76</td>
<td>3.52</td>
<td>207</td>
<td>26.6</td>
</tr>
<tr>
<td>1.76</td>
<td>2.12</td>
<td>4.36</td>
<td>253</td>
<td>27.4</td>
</tr>
<tr>
<td>2.20</td>
<td>2.47</td>
<td>4.83</td>
<td>318</td>
<td>28.6</td>
</tr>
</tbody>
</table>

*NRC (2001)* Assumes milk replacer with 2.14 Mcal ME/lb DM.

**Growth Rate and First Lactation Milk Decreased by Temperature at Time of Birth**

Columns with different letters differ (P < 0.05)
How to Increase Nutrients Provided

1. Increase solids fed per day
   • More milk per feeding
   • An additional feeding
   • Increase solids concentration
2. Increase the energy density
   • “Arctic” or Winter blend
   • Fat Supplementation
3. Increase starter intake

Other Factors Influencing Maintenance Requirements

• Housing design
• Feeding management
• Bedding type
• Calf jackets
• Wind
• Newborn management
• Colostrum

Objective of NNYADP Study

Assess impact of increasing nutrients (milk or milk replacer) fed during winter months in different housing systems on growth and health of dairy calves in NNY

Farms that Participated

January and April of 2019

Farm A
• Non-heated barn, natural and PPT ventilation
• Group pens
• Auto feeder
• Bedded pack of sawdust and straw

Farm B
• Hutches
• Fed in buckets 2x/d
• Bedded with sawdust and straw

Calf jackets were used on both farms

Farms Feeding Programs

Calves born on each farm were randomly assigned to 1 of 2 feeding levels specific to each farm (20 calves/feeding level)

Farm A
• Commercial milk replacer 23% Protein, 22% Fat
• 15% solids
• Maximum feeding level of either:
  • 11.6 qt/d (11 L; Low)
  • 13.6 qt/d (13 L; High)

Farm B
• Whole saleable milk
• Milk balancer (0.25 lbs/gal)
• Maximum feeding level of either:
  • 4.8 qt/d (4.5 L; Low)
  • 8.8 qt/d (8.3 L; High)

Actual intake of milk or milk replacer not measured
Commercial starter (22% CP) and water for ad libitum intake

Volume of Milk or MR Offered

0 2 4 6 8 10 12 14 16
Day 0 7 14 21 28 35 42 49 56
Quarts offered per day

Low-Farm A
High-Farm A
Low-Farm B
High-Farm B
Solids from MR Offered Farm A

Analyzed Milk Composition Farm B

**23% reduction in ADG preweaning with variable solids intake- Hill et al., 2008

Analyzed Milk Composition Farm B

Solids from Milk Offered Farm B

Total Solids from Milk and Balancer Farm B
Measurements Collected on Farm

- **Environmental conditions.** Temperature
- **Feed.** Samples of milk, milk replacer and starter collected weekly and analyzed for nutrient composition.
- **Growth.** Body weight, hip height, and BCS measured at birth, 4 and 8 week of age.
- **Blood Measurements.** Initial serum protein determined the first week of age
- **Bedding score.** Bedding score evaluated weekly
- **Health.** Any health events or medications recorded for calves. Calves scored once weekly to evaluate signs of diarrhea and respiratory disease.

Results

### Observed Environmental Temperature

**Farm A**

![Graph showing observed temperature for Farm A]

**Farm B**

![Graph showing observed temperature for Farm B]

### Estimating Maintenance Requirements

![Image of a cow wearing a coat]
Body Weight

- Farm A: Week 8 BW
  - High: 186 lbs
- Farm B: Week 8 BW
  - High: 194 lbs

Goal for Body Weight by 56 days:
- Farm A: 86 lbs to 172 lbs
- Farm B: 89 lbs to 180 lbs

P-Values:
- Trt: 0.41
- Week: <0.001
- Trt x Week: 0.86

Body Condition Score

- Farm A Overall ADG
  - Low: 1.54 lbs/d
  - High: 1.58 lbs/d
- Farm B Overall ADG
  - Low: 1.74 lbs/d
  - High: 2.14 lbs/d

Goal for Body Weight by 56 days:
- Farm A: 1.53 lbs/d
- Farm B: 1.59 lbs/d

P-Values:
- Trt: 0.05
- Week: <0.001
- Trt x Week: 0.95

Hip Height

- Farm A Overall HH Gain
  - Low: 4.2 in
  - High: 5.7 in
- Farm B Overall HH Gain
  - Low: 3.9 in
  - High: 4.3 in

Goal for Hip Height Growth by 56 days:
- 4-5 inches (10-12.7 cm)

P-Values:
- Trt: 0.71
- Week: <0.001
- Trt x Week: 0.42

Nasal Discharge Scores

- Farm B: Low 2.7x more likely to have elevated nasal score
**Eye Scores**

Scores:
- 1: Normal
- 2: Mild amount of ocular discharge
- 3: Moderate amount of bilateral ocular discharge
- 4: Severe amount of bilateral ocular discharge

Farm A and Farm B comparisons are shown.

**Ear Scores**

Scores:
- 1: Normal
- 2: Ear tick or head shake
- 3: Slight ear irritation
- 4: Head tilt of bilateral drop

Farm A and Farm B comparisons are shown.

**Fecal Scores**

Scores:
- 1: Normal
- 2: Semiformed, pasty
- 3: Loose, but not runny
- 4: Watery

Farm A and Farm B comparisons are shown.

**Days Medicated Preweaning**

Days medicated for each farm are shown.

**Pre-Weaning Health Can Have an Impact on Future Production**

- Either diarrhea OR antibiotic treatment decreased gain by 0.06 lb/d (Not significant)
- Calves that had both diarrhea AND antibiotic treatment decrease in ADG (0.11 lb/d) (Soberon et al., 2012)
- Number of days sick and treatment with antibiotics is linked to decreased lactation performance (Heinrichs and Heinrichs, 2011)

**Bedding Scores**

Scores:
- 1: Legs emaciated
- 2: Legs partially emaciated
- 3: Legs generally emaciated

Farm A and Farm B comparisons are shown.
Take Away Tips to Kick the Cold!

Minimize the Time a Between Birth and when a Newborn Calf is Dry

- Hair coat has no insulating effect when wet
- Large surface area
- Low body fat reserves

Track Temperature at Mixing and Feeding

<table>
<thead>
<tr>
<th>Temperature at Mixing</th>
<th>Temperature at Eating</th>
</tr>
</thead>
<tbody>
<tr>
<td>Follow Bag Instructions</td>
<td>First, Middle, and Last Calf!</td>
</tr>
<tr>
<td>105-130°F</td>
<td>&gt;105 °F</td>
</tr>
<tr>
<td>40.5-54.4°C</td>
<td>&gt;40.5 °C</td>
</tr>
</tbody>
</table>

How to Increase Nutrients Provided

1. Increase solids fed per day
   - More milk per feeding
   - An additional feeding
   - Increase solids concentration
2. Increase the energy density
   - “Arctic” or Winter blend
   - Fat Supplementation
3. Increase starter intake

Water Intake to Starter Intake Ratio (4:1)

- 1 lb starter requires 4 lb (1/2 gallon) water intake
- Without water
  - Slower rumen development
  - Reduces feed conversion rates

<table>
<thead>
<tr>
<th>Age (months)</th>
<th>Water (gal)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1.3-2</td>
</tr>
<tr>
<td>2</td>
<td>1.5-2.0</td>
</tr>
<tr>
<td>3</td>
<td>2.1-2.6</td>
</tr>
<tr>
<td>4</td>
<td>3.0-3.6</td>
</tr>
</tbody>
</table>

Bedding Management Important to Minimize Heat Losses to the Calf

Calf Rearing Guide by S. J. Charlton
Tips for Bedding Management

1. Must keep calves clean and dry
2. ‘Kneel test’
   - Soiled knees= insufficient bedding, risk of bacterial challenge
   - Wet knees= insufficient bedding, taking heat from calf
3. Target: minimum 3 inches clean dry bedding between calf and clean floor.
4. Type depends on availability and time of year
   - Wheat straw ideal for winter
5. Nesting Score

Influence of Nesting Score and Solid Barriers Between Pens

Calf Jackets Allow Calves to Retain More Heat

Calf Jackets Allow Calves to Retain More Heat

Influence “Microclimates” of Your Calves

- What external factors are holding the calves back from meeting your replacement animal goals?
  - Time of year
  - Nutrients required and how they are delivered
  - Management
- Think of these factors as your Insurance Policy for the investment in nutrition
THANK YOU VERY MUCH TO THE PARTICIPATING FARMS!!!

Questions?
morrison@whminer.com
whminer.org
Start the Lactation Off with a Bang

Focus on Transition Cow Management

Heather Dann, Ph.D.
2019 Dairy Day

Start the Lactation with a Bang

• The cow is...
  – Healthy
  – Produces a large quantity of milk with good components
  – Able to reproduce at the appropriate time

• The dairy is...
  – Profitable and sustainable

What are the Challenges?

- Energy balance & subclinical ketosis
- Subclinical hypocalcemia (milk fever)
- Subacute ruminal acidosis (SARA)
- Lameness
- Mastitis and metritis

Implementation of Practices that Focus on Prevention of Health Problems

• Clinical vs. subclinical problems

• Removal of stressors

• Optimization of nutrient intake
  – Driven by DMI

Tip #1

Focus on Nutrition and Management During the Dry and Fresh Periods...

Dictates the Success or Failure of the Lactation
The Best Formulated Diets Cannot Overcome Suboptimal Management Practices

Implement management practices that allow access to good quality feed while minimizing social and environmental stressors and promoting cow comfort

Cow Comfort is a Function of the Cow’s Management Environment

Physical Environment

Social Environment

Resting ↔ Ruminating ↔ Feeding

Productivity, Health, & Wellbeing

Cooling Cows During the Dry Period Improves Milk Production

Providing Prepartum Evaporative Cooling Only in the Early or Late Dry Period Does NOT Rescue Milk Yield in Subsequent Lactation

Cooling Cows During the Dry Period

- Improves immune function (Amaral et al., 2009)
- Increases colostrum yield and IgG content (Amaral et al., 2009)
- Increases apparent efficiency of absorption of IgG (Fabris et al., 2019)
- Increases birth weight and weaning weight of offspring (Fabris et al., 2019)
Cooling dry cows is affordable
- Remodeling an existing barn
- Building a new barn

U.S. default scenario: the benefit to cost ratio and payback period was 3.2 and 0.3 years when a dry cow barn was remodeled to cool cows and 1.5 and 5.7 years if a dry cow barn needed to be built.

Social Behavior May Play an Important Role in Disease Susceptibility
- Stress from aggression may negatively affect the immune system of a transition cow
- During the 2 wk before calving healthy cows displaced others from the feed bins on average 16.8 times/d compared with severely metritic cows who only displaced others on average 12.2 times/d (P = 0.06)
- Multiparous cows were more aggressive at the feed bunk, displacing others on average 17.9 times/d relative to primiparous cows that displaced others on average 11.5 times/d (P = 0.002)

Overstocking During the Transition Period
- Overstocking stalls (0.5 vs 1 stall/cow) and feed bunk space (13 vs 26”/cow) increases NEFA and fecal cortisol metabolites in far-off COWS (Chebel et al., 2016)
- Headlock stocking density >80-90% or manger space <30”/cow in close-up pen:
  - reduces feed intake
  - increases DA incidence
  - reduces milk yield in first-calf heifers (J.Dairy Sci. 90:3220–3233)
- <100 ft²/cow in close-up pen reduces lying & rumination times, increases incidence of milk fever (Cook et al., 2004)
- >100% stocking density of bunks in fresh pen increases eating rate (Arends et al., 2012)

Common Social Stressors Faced by Transition Animals
- Overstocking
- Regrouping
- Commingling heifers with mature cows
The Maternity Pen is an Important Facility Since it Affects the Well-being of the Cow and Newborn Calf

Goals: 1) low stress environment, 2) low health risk for cow and calf, 3) convenience for people, & 4) opportunity for seclusion

Everyone is Watching...

Cows Seek Isolation at Calving

Cows Prefer the Corner when Provided with a Barrier

Secluded Maternity Areas Offer Protection from Herd Members

Use of Barrier with Low (150 ft²/cow) and High (100 ft²/cow) Stocking Density

Less interactions with herd members, less calves suckling an alien cow, and stronger acute maternal response to cow-calf separation

Jensen et al., 2019
Cows in barrier pens tended to have shorter labor duration

![Graph showing duration of stage II labor with and without barrier.](image)

Cows in barrier pens tended to have shorter labor duration compared to those without a barrier. The graph shows a significant difference in duration of stage II labor, with barriers reducing the time by approximately 20 minutes. The probability value is P = 0.08.

Stocking density did not impact labor duration

![Graph showing the impact of stocking density on stage II labor duration.](image)

Stocking density did not have a significant impact on the duration of stage II labor. The graph indicates no difference in duration between low and high stocking densities, with a probability value of P = 0.93.

Tip #4: Use a Fresh Pen

Use a Fresh Pen

Use of a Fresh Pen Continues to Grow in Popularity

- Facilitates monitoring of health problems with less “lock up time”
- Allows for increased milking frequency
- Minimizes social stress when stocked and managed appropriately
- Provides a diet specifically formulated for fresh cows

Time To First Meal After Calving

Does she have access to feed and water?

![Image of a cow and calf, with a calf feeding.]
**Cows Benefit From a Fresh Pen**

- 6 commercial dairies with freestalls
  - Fresh pen for 30 d after calving (space for 10% of herd)
  - Comingled lactating pen

- Primiparous cows housed in the fresh pen
  - Produced ~506 lb more ECM during 1st 305 DIM
  - Had less ketosis treatments (HR = 0.33)

- Multiparous cows did not benefit from separate housing

- Did not use a “fresh cow diet”…probably see more benefit of fresh pen; length of stay too long?

Østergaard et al., 2010

**How Long Do or Should Cows Remain in the Fresh Pen?**

- 10 to 42 DIM with 14 to 21 DIM the most common

- The optimal duration of stay in a fresh pen is unknown…it most likely varies among farms and cows

**Don’t Leave Cows on the Fresh Diet for Too Long**

<table>
<thead>
<tr>
<th>Days postpartum</th>
<th>Dry Matter Intake, lb/d</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>35</td>
</tr>
<tr>
<td>14</td>
<td>37</td>
</tr>
<tr>
<td>28</td>
<td>39</td>
</tr>
<tr>
<td>42</td>
<td>40</td>
</tr>
<tr>
<td>56</td>
<td>41</td>
</tr>
<tr>
<td>70</td>
<td>42</td>
</tr>
<tr>
<td>84</td>
<td>43</td>
</tr>
</tbody>
</table>

1.28 d postpartum 27% forage NDF (11% NDF, 26% starch)
29-84 d postpartum 20% forage NDF (12% NDF, 28% starch)

Data Courtesy of M. Allen

**Check Ketones**

Intake Limited by Gut Fill/Forage Digestibility Resulted in Increased BHB

**Dry and Fresh Cow Nutrition Continues to Evolve**

- Use integrated strategies to support...
  - Energy metabolism
  - Protein metabolism
  - Mineral metabolism
  - Immune function
  - Rumen function

Optimize Nutrient Intake

- Control Energy Intake in Dry Period
- Focus on Ration Fermentability in Fresh Period
- Supply Metabolizable Protein and AA
- Adjust DCAD
- Meet Mineral and Vitamin Needs

• Different approaches dictated by...
  – Facilities and grouping
  – Management philosophy and ability
  – Feed availability and quality

How much TMR are the cows eating?

Does the dairy know?
Does the dairy measure it?

Higher Forage, Lower Energy Dry Diets
Controlling Energy Intake while Meeting Other Nutrient Needs

• Often based on corn silage and straw (or haylage)
  – Feeding characteristics
  – 100 to 110% of ME
  – 10-18% starch; >40% NDF (gut fill); 0.7-0.8% of BW as forage
  – 1,000 to 1,300 g MP (85-100 g MP/kg DM)
  – DCAD
• Fine tune based on...
  – Fermentable carbohydrates
  – Cow response (intake, health, performance)

Overfed Dry Cows Cause Headaches

• Abdominal fat deposition
• Insulin resistance
• Blood NEFA and BHBA
• Liver triglyceride
• Body weight/condition loss after calving
• Chronic inflammation
• Health problems

Intake is Critical for Success
Controlled by Physical and Chemostatic Mechanisms
Influenced by Feeding Management, Social Interactions, and Environment

Formulate Diets in the Context of Each Other

Rapid Increase ≥30 lb/d
≥1 Headlock Diet Formulation

Far-off Close-up Fresh Early Lactation

Week of Lactation

Overfed Dry Cows Cause Headaches
Fresh Cow Diet Frequently Based on the High Cow Diet

- Less starch & more fiber
- More physically effective fiber (peNDF)
  - Usually < 1-2 kg of chopped straw/hay
- Additional rumen undegradable protein/amino acids
- Additional rumen inert fat
- Strategic addition of other nutrients and additives
  - Monensin, yeast products, & RP-choline

Fresh Cows - Use a Mix of Carbohydrates

Have a mix of carbohydrates
- 18 to 26% starch (16 to 22% fermentable starch)
- 4 to 8% sugar
- 28 to 36% NDF
- ≥ 21% peNDF

- Consider total fermentable carbohydrate; measure digestibility of starch & NDF
- Need to adjust mix of carbohydrates for each herd’s situation

Key Things to Remember to Improve Feeding Behavior in Fresh Cows

- Fresh cow diets should be formulated to maximize eating time and DMI
- Maximize the opportunities for cows to go to the bunk across the day
- Controlling feed sorting, meal size, and meal frequency
  - Overcrowding must avoided for fresh cow pens
- Minimize group changes & keep 1st lactation separate to decrease social stress

Increased Risk of Ruminal Acidosis (SARA) in Fresh Cow

- Large changes in dietary composition and intake during the transition period
  - Fermentable carbohydrate
- Feeding behavior changes associated with calving, stocking density, grouping, and pen movement strategies
  - Heifers may be more susceptible
- SARA
  - Negatively affects ability of rumen epithelium to absorb volatile fatty acids (VFA)
  - Decreases fiber digestion through changes in the microbial population
  - Causes inflammation

Potential Responses to Inflammation

Increased Feeding Frequency May Reduce Severity of SARA in Higher-Risk Cows

- Cows at higher risk of SARA ate longer after feeding compared with those at lower risk
- Feeding 3x/d decreased the time spent eating after the first feeding and increased time spent eating later in the day
  - Reduced severity of SARA by higher risk cows with no negative impact on performance of lower risk cows
- Increased feeding frequency...increased milk fat yield

DeVries, 2017 CNC/WDMC
Fairfield et al., 2007; Herzer et al., 2007; Aschenbach et al., 2011; Williams et al., 2015
Bradford et al., 2015
Macmillan et al., 2017
Metabolizable Protein and Amino Acids are an Opportunity

- CP vs MP for dry cows
  - Quality of CP and AA, availability of fermentable carbohydrates for microbial growth
- Dry cows: 12 to 15% CP... 1,000 to 1,300 g/d... 85 to 100 g MP/kg DM; Met and Lys

Fresh cows: prevent protein mobilization before calving, promote DMI, provide sufficient fermentable carbohydrates and RDP for microbial growth, supplement RUP and RPAA

Amino Acid Balancing is Beneficial for Transition Cows

- Lys and Met are assumed to be first limiting; glutamine may be a conditionally essential AA during fresh period
- Supplementing Lys, Met, or both starting before calving and continuing into lactation can increase milk yield, milk components, or both and improve immune function (Hu et al., 1995; Socha et al., 2005; Ordway et al., 2009; Osorio et al., 2013)
- Responses are dependent on CP, MP supply, and intestinal digestibility of RUP supplements
- ~75 g Lys/d and ~25 g Met/d for milk protein response
- Need for BCAA: Leu, Ile, Val

Strategies to Minimize Risk of Hypocalcemia

- Maintain intake before calving and encourage intake after calving (#1)
- Prophylactic treatment with oral or SQ calcium following calving
- Feeding strategies for close-up or 1 group dry diets
  - Feed low calcium or a calcium binder
  - Feed low potassium
  - Adjust dietary cation anion difference (DCAD)

Evaluate and Adjust Dietary Cation-Anion Difference (DCAD) for Close-Up Cows

- DCAD = (mEq Na⁺ + mEq K⁺) − (mEq Cl⁻ + mEq S²⁻)
- -10 to -15 mEq/100 g to help accommodate biological variation among animals

<table>
<thead>
<tr>
<th>Mineral</th>
<th>Recommendation, %DM</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ca</td>
<td>Variable approach</td>
</tr>
<tr>
<td>Mg</td>
<td>0.35 to 0.40</td>
</tr>
<tr>
<td>K</td>
<td>&lt; 1.3</td>
</tr>
<tr>
<td>P</td>
<td>0.3 to 0.4</td>
</tr>
<tr>
<td>S</td>
<td>0.2 to 0.4</td>
</tr>
<tr>
<td>Cl</td>
<td>~0.5% less than K</td>
</tr>
</tbody>
</table>

Fats are More than Just Energy

- Dietary fat is typically 2-3% in dry diet and 4-6% in fresh diet
- Supplementing fat and changing fatty acid content (PUFA; CLA) of fat source positively affects reproductive performance (de Veth et al., 2009; Rodney et al., 2015)
- Fatty acids can modify immune function (Bradford et al., 2015; Sordillo, 2016)
- Fatty acids can affect milk composition and body weight (Lock 2017)

Tip #6

Use Cow- and Herd-Level Monitoring Systems to Identify Challenges/Opportunities
Health Related Technologies:
Allows Us to Spend More Time with Sick Cows

- Milk weight deviations
- Milk composition changes
- Cow-side tests
- Video surveillance
- Rumination and activity monitors

We are More Likely to Start the Lactation Off with a Bang If...

- Focus on Nutrition and Management During the Dry and Fresh Periods
  - Formulate diets in the context of one another to provide a smooth transition
  - Prepare cow for next lactation before lactation ends
- Remove or Reduce Environmental, Social, and Nutritional Stressors
  - Avoid potential impact on physiology and intake

We are More Likely to Start the Lactation Off with a Bang If...

- Purposely Manage the Maternity Pen
  - Support behavior that promotes intake
- Use a Fresh Pen
  - Reduce stressors and targeted diet
- Optimize Nutrient Intake
  - Different goals during dry and fresh periods
- Use Cow- and Herd-Level Monitoring Systems to Identify Challenges/Opportunities
Beat the Heat
Are North Country cows susceptible to heat stress?

Effect of Heat Stress on the Dairy Industry in New York State

- Cows in New York spend 8.2% of their hours during the year heat stressed
- Less than the national average of 14.1%
- Equal to $23 million per year in losses for New York alone
- Due to loss in dry matter intake, milk production, fertility, increased cull rate and death rate
  (St-Pierre et al., 2003)

How do we evaluate/define an environment that causes heat stress?

- Temperature humidity index (THI) calculated based on relative humidity and dry bulb temperature
- THI of 72 - previously used threshold for heat stress
  - Low producing cows < 70 lbs (32 kg), Ravagnolo et al., 2000
  - Cows producing at least 77 lbs (35 kg) per day drop in production by 6.3% when THI is over 68 (Collier et al., 2012)
  - Greater metabolic heat generated the higher the production level

Heat Stress Levels – Lactating Dairy Cows

- Heat Stress Threshold – THI 68-71 milk losses begin, repro losses detectable, Body temp exceeds 101.3°F (38.5°C).
- Mild/Mod Heat Stress – THI 72-79 Body temp exceeds 102.2°F (39°C).
- Mod/Severe Heat Stress – THI 80-89 Body temp exceeds 104°F (40°C).
- Severe Heat Stress – THI >90 Body temp exceeds 106°F (41°C).
  (Collier et al., 2012)

But what makes our cows different in the North Country?

Heat Acclimation

- According to Collier et al. (2006), heat acclimation is a **biphasic pattern** that can be divided into two periods:
  1. **Acute or short-term heat acclimation (STHA)**
  2. **Chronic or long-term heat acclimation (LTHA)**
1. Acute/STHA

- Heat stress causes changes in cellular signaling pathways which disrupts cellular homeostasis
- In effect, cells "reprogram" to become adapted to the effects of heat stress

2. Chronic/LTHA

- The heat-acclimated phenotype of the cellular changes is now expressed after chronic exposure to heat stress
- Alterations in various hormonal secretions and signals must take place in addition to changes in the response of target tissues to specific hormones
- Increase in receptor populations
- Examples of hormones involved: thyroid hormones, prolactin (PRL), somatotropin (ST), glucocorticoids, and mineralocorticoids

3. Heat Acclimation

- It takes weeks, as opposed to days, to complete both acclimation phases
- The North Country does not typically have heat events lasting weeks
- Animals’ bodies may not become acclimated to the heat without day after day exposure
- Result: deleterious effects on animal well-being

4. How do cows regulate body temperature?

- Body temperature increases 2x rate while lying down
- Cows must stand longer to control body temperature homeostasis

5. Heat Abatement Systems

- Air
  - Ventilation
  - Airflow
- Water
  - Misters
  - Soakers
  - Drinking water availability
- Shade
  - Protect from solar radiation
Objective

Assess the impact of episodic heat stress on farms with different degrees of heat abatement on behavioral, lameness, and productive responses of dairy cattle from July through September in Northern New York State.

Year 1

- Four farms selected with varying degrees of heat abatement/management
  - All freestall farms used water/fans in holding areas
  - Measurements taken between July 1st and September 30th, 2017
  - Bulk tank yield and milk composition evaluated
  - Cow comfort assessed two hours before and after milking and averaged daily – Stall Standing Index

<table>
<thead>
<tr>
<th>Herd Size</th>
<th>Breed</th>
<th>Barn</th>
<th>Bed</th>
<th>Stocking Density</th>
<th>Heat Abatement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Farm A</td>
<td>287</td>
<td>Holstein</td>
<td>Freestall</td>
<td>Sand</td>
<td>106 %</td>
</tr>
<tr>
<td>Farm B</td>
<td>650</td>
<td>Holstein</td>
<td>Freestall</td>
<td>Sand</td>
<td>130-142 %</td>
</tr>
<tr>
<td>Farm C</td>
<td>57</td>
<td>Jersey</td>
<td>Tiestall</td>
<td>Stall mats/sawdust</td>
<td>Fans</td>
</tr>
<tr>
<td>Farm D</td>
<td>465</td>
<td>Holstein</td>
<td>Freestall</td>
<td>Mattresses/sawdust</td>
<td>Fans – Stalls</td>
</tr>
</tbody>
</table>

- Thirty focal cows selected
  - Lameness scored at beginning and end of study
  - Lying time/bouts – Leg-mounted data loggers attached weekly

Year 1 – Results – Average THI by Farm

Year 1 – Results – Farm A

Lying time relative to minutes THI > 68
Year 1 – Results – Farm B
Lying time relative to minutes THI > 68

Year 1 – Results – Farm C
Lying time relative to minutes THI > 68

Year 1 – Results – Farm D
Lying time relative to minutes THI > 68

Year 1 – Results
Comparison between lying time on Cool vs Hot days

<table>
<thead>
<tr>
<th></th>
<th>COOL</th>
<th>HOT</th>
<th>SE</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>THI (mean ± sd)</td>
<td>60.9 ± 3.7</td>
<td>72.3 ± 1.1</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Minutes THI ≥ 68 (mean ± sd)</td>
<td>74 ± 127</td>
<td>1279 ± 155</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Lying Time (h/d)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Farm A</td>
<td>12.8</td>
<td>10.3</td>
<td>0.34</td>
<td>&lt;0.01</td>
</tr>
<tr>
<td>Farm B</td>
<td>11.5</td>
<td>10.3</td>
<td>0.31</td>
<td>&lt;0.01</td>
</tr>
<tr>
<td>Farm C</td>
<td>12.8</td>
<td>11.1</td>
<td>0.34</td>
<td>&lt;0.01</td>
</tr>
<tr>
<td>Farm D</td>
<td>10.3</td>
<td>8.6</td>
<td>0.30</td>
<td>&lt;0.01</td>
</tr>
</tbody>
</table>

~ 3 lbs milk loss/hr reduced lying time

Year 1 – Results
Lameness Score Change

Year 1 – Results
Stall Standing Index
Year 1 – Results

Relationship between THI and milk true protein (%)

Year 1 - Summary

- Dairy cows in Northern NY are adversely impacted by episodic bouts of heat stress.
- All farms were impacted by heat stress to varying degrees, regardless of heat abatement system.
- Cows with minimal heat abatement were particularly susceptible during heat events.
  - Decreased lying time
  - Increased lameness
  - Decreased milk protein content

Year 2

- Farm A, B and D same as Year 1, Farm C added because of additional heat abatement used
- Measurements taken between July 1st and Sept. 30th, 2018
- Bulk tank yield and milk composition evaluated

<table>
<thead>
<tr>
<th>Herd Size</th>
<th>Breed</th>
<th>Barn</th>
<th>Bed</th>
<th>Heat Abatement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Farm A</td>
<td>300</td>
<td>Holstein</td>
<td>Freestall</td>
<td>Sand</td>
</tr>
<tr>
<td>Farm B</td>
<td>700</td>
<td>Holstein</td>
<td>Freestall</td>
<td>Sand</td>
</tr>
<tr>
<td>Farm C</td>
<td>420</td>
<td>Holstein</td>
<td>Freestall</td>
<td>Mattresses/sawdust</td>
</tr>
<tr>
<td>Farm D</td>
<td>475</td>
<td>Holstein</td>
<td>Freestall</td>
<td>Mattresses/sawdust</td>
</tr>
</tbody>
</table>

Farm Profits

Year 2 – Results

Comparison between lying time on Cool vs Hot days

<table>
<thead>
<tr>
<th></th>
<th>Days In Mil</th>
<th>Milk Yield (lb/d)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Farm A</td>
<td>69 ± 29</td>
<td>112 ± 15</td>
</tr>
<tr>
<td>Farm B</td>
<td>87 ± 18</td>
<td>123 ± 24</td>
</tr>
<tr>
<td>Farm C</td>
<td>64 ± 20</td>
<td>130 ± 19</td>
</tr>
<tr>
<td>Farm D</td>
<td>53 ± 24</td>
<td>111 ± 11</td>
</tr>
</tbody>
</table>

Year 2 – Results

Comparison between lying time on Cool vs Hot days

<table>
<thead>
<tr>
<th></th>
<th>COOL</th>
<th>HOT</th>
<th>SE</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Days In Milk</td>
<td>64.5 ± 2.8</td>
<td>76.0 ± 2.0</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Minutes THI ≥ 68 (mean ± sd)</td>
<td>450 ± 290</td>
<td>1430 ± 30</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Minutes THI ≥ 72 (mean ± sd)</td>
<td>50 ± 110</td>
<td>1310 ± 180</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Minutes THI ≥ 75 (mean ± sd)</td>
<td>0 ± 10</td>
<td>790 ± 290</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Lying Time (h/d)</td>
<td>12.0</td>
<td>9.3</td>
<td>0.31</td>
<td>&lt;0.01</td>
</tr>
<tr>
<td>Farm A</td>
<td>11.7</td>
<td>9.4</td>
<td>0.38</td>
<td>&lt;0.01</td>
</tr>
<tr>
<td>Farm B</td>
<td>10.6</td>
<td>8.6</td>
<td>0.62</td>
<td>&lt;0.01</td>
</tr>
<tr>
<td>Farm D</td>
<td>10.4</td>
<td>7.9</td>
<td>0.38</td>
<td>&lt;0.01</td>
</tr>
</tbody>
</table>
Year 2 – Results  
Lameness Score Change

Year 2 – Results – Milk fat (%)

Year 2 – Results – Milk protein (%)

Year 2 - Summary
- Confirmed Year 1 results - dairy cows in Northern NY are adversely impacted by episodic bouts of heat stress.
- All farms were impacted by heat stress to varying degrees, regardless of heat abatement system.
  - Decreased lying time
  - Increased lameness
  - Decreased milk protein content

Year 3 – 2019 – Same Farms
- Farm A – No changes in heat abatement.
- Farm B – Changed angle of fans, and closed doors at north-end of pen to create more air movement within pens. Reduced over crowding.
- Farm C – Used mist-system attached to fans in feed alley and stall beds.
- Farm D – No changes in heat abatement

What additional information is needed to better understand heat stress and its impact on dairy cows in the North Country?
Year 3 – 2019 – Measures

- Leg loggers for lying time
- Lameness scoring
- Bulk tank milk sample analyses

NEW MEASURES
- Wind speed throughout pen – Feed alley, Stalls-standing and lying
- Body temperature
- Rumen pH
- Drinking behavior
- Activity

SmaXtec

- Classic bolus (top) – measures reticular temperature, drinking bouts, & activity
  - Given to 25 out of 30 cows
- Premium bolus (bottom) – measures body temperature, activity, & reticular pH
  - Given to the 5 highest-producing, lowest DIM cows

Reticular Temperature

*For all data analysis, median reticular temperature will be used; Ammer et al. (2006) showed the median is more highly correlated with vaginal & rectal temperature than arithmetic mean

Reticular pH

Year 3 - Preliminary Results

Average THI by Farm

Year 3 - Preliminary Results

MR Temperature relative to minutes THI ≥ 72
Year 3 - Preliminary Results
MR Temperature relative to minutes THI ≥ 72

Year 3 - Preliminary Results
MR Temperature relative to minutes THI ≥ 72

Air Movement
Average windspeed (mph) by farm

<table>
<thead>
<tr>
<th>Farm</th>
<th>Stall (Standing)</th>
<th>Stall (Lying)</th>
<th>Feed Alley</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>0.5</td>
<td>0.6</td>
<td>0.8</td>
</tr>
<tr>
<td>B</td>
<td>2.5</td>
<td>3.1</td>
<td>2.1</td>
</tr>
<tr>
<td>C</td>
<td>2.3</td>
<td>2.3</td>
<td>3.2</td>
</tr>
<tr>
<td>D</td>
<td>1.8</td>
<td>1.8</td>
<td>1.5</td>
</tr>
</tbody>
</table>
Take Home Message

- **Yes**, heat stress is an issue for our dairy cows in the North Country
- Minimizing heat stress on a budget
  - Invest in fans that move air - 4-6 mph continuous air speed recommended
  - Position fans that move air across cows when they’re standing and lying
  - Maintain existing fans to maximize peak efficiency
  - Turn fans on
  - Drinking water availability is important...cool water *cools* cows.
  - During heat stress cows increase water intake 50-60 gal/cow/day
Next Steps

• Summarize data from all three years to provide producers with the economic impact of heat stress
• Which heat abatement system is most effective?
• What about the dry cows?
**Water Quality 101**

- Phosphorus (P) is limiting nutrient in freshwater systems
  - Soil solution P necessary for plant growth is 0.2 – 0.3 mg/L
  - P concentration in lakes > 0.02 – 0.03 mg/L → accelerated eutrophication, harmful/nuisance algal blooms (HABs, HNABs)
  - P is relatively immobile when given time to interact with soil
  - P fractions: SRP (bioavailable, manure/commercial fertilizers), organic P (manure) particulate P (erosion)

- Nitrogen (N) is highly mobile, easily lost (leaching, atmosphere)
  - Nitrate-N (bioavailable, soluble, easily lost in leachate)
  - Organic N and ammonium-N: primary N forms in manure, higher levels in surface runoff
  - Denitrification (gaseous loss from saturated soils), volatilization (organic N → ammonia)
  - N levels may contribute to toxicity of HABs

**Nutrient Loss Pathways**

**Preferrential flow pathways aka Macropores**

Macropores develop from:
- Shrink/swell clays
- Earthworm burrows
- Root channels

**Extreme Events**

**More soil P = More risk**
Quantifying water quality impacts of nutrient management practices

• Edge-of-field monitoring studies
  • Paired fields
    • Calibration period (~2 years)
    • Treatment period (3-4 years)
  • Characterize runoff pathways (surface vs. tile)
• Quantify nutrient (P and N) and sediment losses in runoff
• Impact on crop yield
• Miner Institute EOF studies
  • Drainage water management (4 yr)
  • No-tillage (1 yr)

Timing (and method) of Manure Application

<table>
<thead>
<tr>
<th>Source</th>
<th>Manure</th>
<th>DRP</th>
<th>TP</th>
<th>TSS</th>
<th>Nitrate-N</th>
<th>Amm-N</th>
<th>TN</th>
<th>Field P Loss</th>
<th>A1 Loss</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>lb/ac</td>
<td>lb/ac</td>
<td>lb/ac</td>
<td>lb/ac</td>
<td>lb/ac</td>
<td>lb/ac</td>
<td>lb/ac</td>
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<tr>
<td>R20B Tile</td>
<td>20.8</td>
<td>0.20</td>
<td>0.33</td>
<td>15.64</td>
<td>21.06</td>
<td>0.45</td>
<td>25.00</td>
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<td>DB6 Tile</td>
<td>19.4</td>
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<td>1.32</td>
<td>31.87</td>
<td>35.77</td>
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<td>45.19</td>
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<td>0.864</td>
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<td>26.64</td>
<td>0.24</td>
<td>0.72</td>
<td>1.92</td>
<td>0.858</td>
<td>0.779</td>
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<tr>
<td>DB6 Surface</td>
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<td>0.15</td>
<td>0.22</td>
<td>9.06</td>
<td>0.07</td>
<td>0.27</td>
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<td>Field R20B</td>
<td>25.6</td>
<td>0.59</td>
<td>0.93</td>
<td>42.28</td>
<td>21.30</td>
<td>1.17</td>
<td>26.92</td>
<td>1.170</td>
<td>1.000</td>
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<tr>
<td>Field DB6</td>
<td>21.2</td>
<td>1.09</td>
<td>1.54</td>
<td>40.92</td>
<td>35.84</td>
<td>1.76</td>
<td>45.76</td>
<td>1.760</td>
<td>1.629</td>
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<td>R20B Total</td>
<td>0.815</td>
<td>0.343</td>
<td>0.353</td>
<td>0.370</td>
<td>0.989</td>
<td>0.387</td>
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</tr>
<tr>
<td>DB6 Total</td>
<td>0.914</td>
<td>0.864</td>
<td>0.858</td>
<td>0.779</td>
<td>0.998</td>
<td>0.848</td>
<td>0.988</td>
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</tr>
</tbody>
</table>

Field P Loss: 3.1% 14.4% 5.0% 24.5%

Take-home Messages

• Most P loss occurring in surface runoff
• No evidence (so far) of tile drainage increasing P losses
• Tile drainage significantly increases N loss
• Improved drainage increases yield and nutrient efficiency (drawdown)
• Greater risk for tile drain exports in fields with higher P content
• Vast majority of P and N lost during the nongrowing season
  • Cover crops can immobilize nutrients, limit erosion
  • Drainage water management
• Incorporating manure (esp. liquid) reduces nutrient losses
• Late fall manure applications pose greater risk (increased runoff)