Overview of today’s talk

- Introduction
- Biology of heifers interspersed with...
- Economics
- Benchmarking
- Future productivity
- Summary

Goal of The Replacement Program

The primary goal of all heifer programs is to raise the highest quality heifer that can maximize profits when the animal enters the lactating herd.

A quality heifer is an animal carrying no limitations – nothing that detracts from her ability to produce milk under the farm’s management system.

Optimize profits by obtaining the highest quality heifer at the lowest possible cost usually in the least amount of time.

Herd Replacement Objectives

- Focus on return on investment – over their productive life
- Minimize non-completion (animals that are born and never enter lactation)
- Optimize the productivity of the animal (manage them for their genetic potential starting at birth)
**Key Areas**

- **Quality**
  - Outstanding growth, few to no treatments, high quality environment, good airflow, low ammonia, minimize organic material contamination, meet all the growth benchmarks for optimum milk yield

- **Costs: 20 to 30% of costs to operate the business**
  - Total costs ($2,000 - $2,400)
  - Feed (53% if total heifer costs; $1.42-$2.05/d)
  - Labor
  - Non-completion/performance (10%)

- Number raised
- Capturing value of excess heifers

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**Quality of the Replacement**

- Meet benchmarks for growth and calving to optimize first and subsequent lactation milk yield

- Calving problems
  - Too heavy (fat)
  - Too light (frame)

- General condition of the animal
  - Mastitis
  - Feet and legs
  - Injury

- Prior treatment's – especially respiratory and timing is important – pre- vs post-weaning

- Replacement Heifer Management Snapshot

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**Snapshot Evaluation of the Potential Quality of The Replacement**

- 1st Calf Heifers “Treated” as Calf/Heifer* ≤30%
  - 24 hrs. → 3 mos. _____, 4 mos. → fresh _____

- DOAs in first calf heifers ≤7%
  - Male DOAs _____, Female DOAs _____

- 1st Calf avg. peak ≥80% of Mature
- 1st Calf lactation total yield ≥80% of Mature

- 1st Calf Culls ≤ 60 Days in Milk ≤5%
- 1st Calf ME’s ≥Mature
- 1st Calf “Treated” in Lactation* ≤15%
- 85% retention (any herd) to 2nd lactation ≥85%
- Lower #1 reason for 1st lact. culls(continuous improvement)

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**So When Does The Process of Creating a Quality Heifer Start?**
Dr. Katie Hinde, Harvard – Blog
“Mammals Suck… Milk!"

Holsteins Favor Heifers, Not Bulls: Biased Milk Production Programmed during Pregnancy as a Function of Fetal Sex

Hinde et al., – Mom’s favor heifers
Evaluated the effect of sex of offspring on subsequent milk yield

2.39 million lactations from 1.49 million cattle – U.S. herds

First lactation cattle giving birth to heifers produced 980 lb more milk over the first two lactations
- 490 lb per lactation for the first two lactations

Ettema and Ostergaard 2015
- $6 per lactation marginal return for average semen
- $12 per lactation marginal return for sexed semen

Pro-active Calf program goals:
1. Double birth weight by 56 days (minimum goal)
   84 lb birth weight → 168 lb @56 days

2. Calf mortality less than 5%

Holstein and Jersey are achieving 3x birth weight by 60-70 d!

Why do this?
Capture feed efficiency of early life
Achieve breeding weight at an earlier age
Potentially reduce AFC/increase BW@calving
Increase potential for Internal Herd Growth
Potentially increase milk yield and herd life
Effects of Neonatal Nutrition on Productivity

Review of Available Data Sets – Meta Analyses

Mixture of several publications
Journal papers, abstracts, and proceedings
Suckling, whole milk and milk replacer

Hypothesis: increased nutrient intake that results in greater growth rates positively impacts first lactation milk yield

Milk Yield Response to Increased Pre-weaning Milk or Milk Replacer Nutrient Supply

<table>
<thead>
<tr>
<th>Study</th>
<th>Milk yield, lb</th>
</tr>
</thead>
<tbody>
<tr>
<td>Foldager and Krohn, 1991</td>
<td>3,092</td>
</tr>
<tr>
<td>Bar-Peled et al., 1998</td>
<td>998</td>
</tr>
<tr>
<td>Foldager et al., 1997</td>
<td>1,143</td>
</tr>
<tr>
<td>Ballard et al., 2005 (@ 200 DIM)</td>
<td>1,543</td>
</tr>
<tr>
<td>Shamay et al., 2005 (post-weaning protein)</td>
<td>2,162</td>
</tr>
<tr>
<td>Rincker et al., 2006 (proj. 305@ 150 DIM)</td>
<td>1,100</td>
</tr>
<tr>
<td>Drackley et al., 2007</td>
<td>1,841</td>
</tr>
<tr>
<td>Raith-Knight et al., 2009</td>
<td>1,583 (NS)</td>
</tr>
<tr>
<td>Morrison et al., 2009 (no diff. calf growth)</td>
<td>0</td>
</tr>
<tr>
<td>Moallem et al., 2010 (post-weaning protein)</td>
<td>1,613</td>
</tr>
<tr>
<td>Soberon et al., 2012</td>
<td>1,556</td>
</tr>
<tr>
<td>Margerison et al., 2013</td>
<td>1,311</td>
</tr>
<tr>
<td>Kinzeback et al, 2015</td>
<td>0</td>
</tr>
</tbody>
</table>

Outcome of Meta-Analyses

Milk yield effect of early life nutrition – asking the Yes/no question, does feeding a calf improve long-term productivity?

<table>
<thead>
<tr>
<th>Difference in means, lb</th>
<th>SE, lb</th>
<th>Lower Limit, lb</th>
<th>Upper Limit, lb</th>
<th>Z-value</th>
<th>p-Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>435</td>
<td>117</td>
<td>205</td>
<td>664</td>
<td>3.72</td>
<td>&lt;0.001</td>
</tr>
</tbody>
</table>

Odds ratio of effect

<table>
<thead>
<tr>
<th>Odds Ratio</th>
<th>Lower Limit</th>
<th>Upper Limit</th>
<th>Z-value</th>
<th>p-Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.09</td>
<td>1.48</td>
<td>2.96</td>
<td>4.16</td>
<td>0.001</td>
</tr>
</tbody>
</table>

Meta Regression - Effect of Pre-Weaning ADG on Milk Yield Outcome

Equation: milk yield = -118.5 lb + 1,527 lb*ADG (lb), Z value = 2.42, P = 0.001
Example – 100 lb calf

• A traditional U.S. feeding rate of milk replacer would be 1.25 lb/d (20:20) - enough energy for approx. 0.4 lb/d gain under no stress conditions

• Feeding 2.2 lb/d (28:20) – energy for approx. 1.6 lb/d gain under no stress conditions

Difference in ADG = 1.2 lb/d, thus

\[(1,541 \text{ lb} \times 1.2) = 1,850 \text{ lb additional milk expected in the first lactation}\]

Additional Data on Early Life Management and Productivity

• Purina/LOL data on commercial herds: 2,740 lb additional milk in first lactation

• Zoetis analysis of two WI herds: 1,300 and 2,700 lb additional milk (ME milk)

Effect of early life nutrition on phenotypic milk yield

-3400 -2400 -1400 -400 600 1600 2600 3600

Genetic and phenotypic difference in milk yield

Soberon and Van Amburgh, 2013

Heat Stress and Performance of Calves

Calves are comfortable in this range – their thermo-neutral zone 68-82°F

Possible effect of feeding higher nutrient intake above maintenance to a lower genetic merit heifer on milk yield

Possible effect of feeding lower nutrient intake above maintenance to a higher genetic merit heifer on milk yield

Genetic and phenotypic difference in milk yield

Soberon and Van Amburgh, 2013
Summary of Feed Cost and Measured Gains During June and July 2014

<table>
<thead>
<tr>
<th>Feed Basis (As-Fed)</th>
<th>Farm A</th>
<th>Farm B</th>
<th>Farm C</th>
</tr>
</thead>
<tbody>
<tr>
<td>Housing Type</td>
<td>4</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>Milk Replacer fed/animal/day</td>
<td>1.50</td>
<td>1.82</td>
<td>1.25</td>
</tr>
<tr>
<td>Grain fed/animal/day</td>
<td>0.47</td>
<td>0.86</td>
<td>1.00</td>
</tr>
<tr>
<td>Average Daily Gain</td>
<td>2.00</td>
<td>1.88</td>
<td>0.67</td>
</tr>
<tr>
<td>Feed cost per animal per day</td>
<td>$3.01</td>
<td>$3.72</td>
<td>$2.65</td>
</tr>
<tr>
<td>Feed cost per pound of gain</td>
<td>$1.69</td>
<td>$1.97</td>
<td>$3.94</td>
</tr>
<tr>
<td>Gross Feed Efficiency (Gain:Feed)</td>
<td>1:0.99</td>
<td>1:1.43</td>
<td>1:3.36</td>
</tr>
</tbody>
</table>

Heat Stress/Management Impact

- Farm B fed more, and still achieved lower ADG
  - Maintenance requirements for Farm B calves were higher than Farm A, Farm C greater yet but lower intake

Management Effect

<table>
<thead>
<tr>
<th>Temperature Basis</th>
<th>Farm A</th>
<th>Farm B</th>
</tr>
</thead>
<tbody>
<tr>
<td>Average Low THI</td>
<td>61</td>
<td>62</td>
</tr>
<tr>
<td>Average High THI</td>
<td>76</td>
<td>83</td>
</tr>
<tr>
<td>Min THI</td>
<td>52</td>
<td>47</td>
</tr>
<tr>
<td>Max THI</td>
<td>86</td>
<td>100</td>
</tr>
<tr>
<td>Percent time below TNZ Min</td>
<td>23%</td>
<td>8%</td>
</tr>
<tr>
<td>Percent time above TNZ max</td>
<td>77%</td>
<td>92%</td>
</tr>
<tr>
<td>Percent time completely out of TNZ</td>
<td>0%</td>
<td>33%</td>
</tr>
</tbody>
</table>

Feed Basis

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Heat Humidity Index (THI): THI = Temperature Humidity Index; TNZ = Thermoneutral Zone (65-70 THI points)

The Need and Importance for Monitoring Body Weight Gain and Age at First Calving and Productivity
Growth Benchmarks to Optimize First and Subsequent Lactation Milk Yield

Birth to weaning: double body weight

Puberty: 45% mature weight

Breeding and Pregnancy: 55-60% mature weight

First lact. post-calving BW: 82 to 85% mature weight

Mature weight determined at middle of 3rd and 4th lactation – 80 to 200 days in milk on healthy cows, not cull cows

Current scenario for many herds – value of monitoring

2014-2015 – Milk price was high for most of those two years

   Cull cow prices were also high for same period

   Cull value was almost equal to heifer rearing costs

   Many herds now have more than 35% first lactation animals – upwards of 45% 1st lactation in some herds

   Little to no monitoring once pregnant – calving in at weights below the benchmark of 82% mature body weight

Current scenario for many herds – value of monitoring

Expected milk if target met: ~ 90 lb. at peak

Assume ~225 lb. for every pound at peak

   11.5 lbs. greater peak * 225 = 2,583 lb. unrealized milk due to not meeting the 82% mature size benchmark

   Net milk: $16.80/CWT

   $8.33 IOFC margin (Net milk – feed cost per CWT)

   $8.33 * 25.8 CWT = $215.20 per 1st lactation heifer IOFC

   800 cow herd * 40% 1st lactation heifers = 320 heifers * $215.20 IOFC =$68,852 IOFC not realized ($86/lact. cow)
Value of monitoring – $20 milk

Net milk: $20.80/CWT

$8.33 IOFC margin (Net milk – feed cost per CWT)

$12.33 * 25.8 CWT = $318.11 per 1st lactation heifer IOFC

800 cow herd * 40% 1st lactation heifers = 320 heifers *

$318.11 IOFC = $101,795.20 IOFC not realized ($127/ lact. cow)

How Early Should Heifers Calve to Optimize Lifetime Productivity?

Target weights

<table>
<thead>
<tr>
<th>Mature weight, lb</th>
<th>900</th>
<th>1,300</th>
<th>1,760</th>
</tr>
</thead>
<tbody>
<tr>
<td>% mature wt.</td>
<td>55%</td>
<td>495</td>
<td>715</td>
</tr>
<tr>
<td>Target weight, lb</td>
<td>495</td>
<td>715</td>
<td>1,496</td>
</tr>
</tbody>
</table>

pregnancy

1st lact. fresh

92% 828 1,196 1,619

2nd lact. fresh

96% 864 1,248 1,690

3rd lact. fresh

Input AFC – sets breeding age for you and breeding weight is a function of the mature size. Requirements are then calculated to meet the targets.
Within Herd Analysis of AFC on Productive Days, Milk Yield, Longevity

Lactation records from
2,519,232 first lactation cows
937 herds in the Northeast and California

Within herd analysis
Accounts for management, environment, and genetic differences among farms

Van Amburgh and Everett, unpublished

Within Herd Analysis of AFC on Productive Days, Milk Yield, Longevity

Retrospective assignment to AFC treatment groups
Herd avg. AFC was calculated each year
Heifers were assigned to one of 5 AFC age groups:
- Less than -63 days from herd avg. AFC
- -22 to -63 days from herd avg. AFC
- -21 to 21 days from herd avg. AFC
- 22 to 63 days from herd avg. AFC
- Greater than 63 days from herd avg. AFC

Van Amburgh and Everett, unpublished

Within Herd Analysis of AFC on Productive Days, Milk Yield, Longevity

Retrospective assignment to AFC treatment groups
Herd avg. AFC was calculated each year
Heifers were assigned to one of 5 AFC age groups:
1) 23.3 months AFC
2) 24.3 months AFC
3) 25.6 months AFC
4) 27.2 months AFC
5) 30.3 months AFC

Within Herd Analysis of AFC on Productive Days, Milk Yield, Longevity

Figure 1. Average number of productive days, difference from study herd mean AFC (25.6 month)

Opportunity Group, years

Productive days, difference from mean AFC

-23.3
-24.3
-25.6
-27.2
-30.3

Van Amburgh and Everett, unpublished
Within Herd Analysis of AFC on Productive Days, Milk Yield, Longevity

Figure 2. Average total milk production, lbs, difference from herd mean AFC (25.6 month)

Exit age (total days) by AFC and 2x or 3x milking stratified by herd milk yield

Herd life (days milked) by AFC and 2x or 3x milking stratified by herd milk yield

Study from Wisconsin – field/farm data from DHIA records evaluation of heifer calving in 2005

>69,000 heifers analyzed

Stratified herds by level of production –
- 3x milking high – 28,100 lb RHA,
- 3x milking medium -24,795 lb RHA,
- 2x medium – 24,795 lb RHA,
- 2x low – 20,387 lb RHA

Curran et al. Prof. Anim. Sci., 2013
Summary
Productive days and milk is greater for heifers with lower AFC
Economic analysis indicates that lower AFC is more advantageous
Lower AFC requires fewer replacements per year to maintain herd size and this inventory reduction has significant financial implications
The inventory is the larger cost of the decision to calve younger

Thank you for your attention.
When does the heifer pay for herself based on milk?

Figure 1. Cumulative net income for heifers calving at 24 and 30 mo of age at $1.45 rearing costs and a $3.00 milk margin.

Net Income

$2,000

$1,500

$1,000

$500

$0

($500)

($1,000)

($1,500)

Age in Months

12 18 24 30 36 42 48 54 60 66

Difference between the curve and zero defines the milk value required to break even.

Figure 1. illustrates cash flow incurred by heifers calving at 24 and 30 mo. While the heifer is being raised, the balance continues to decline until she calves and she begins to generate income. The climb out of deficit is not straight due to the shape of the lactation curve and dry periods. From this figure it easy to see why the heifer calving at 30 mo never catches up to the heifer calving at 24 mo.

Smith and Cady, 1996 NRAES Publication 74