Developing a Quality Heifer: Management, Economic and Biological Factors to Consider

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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

Quality of the Replacement

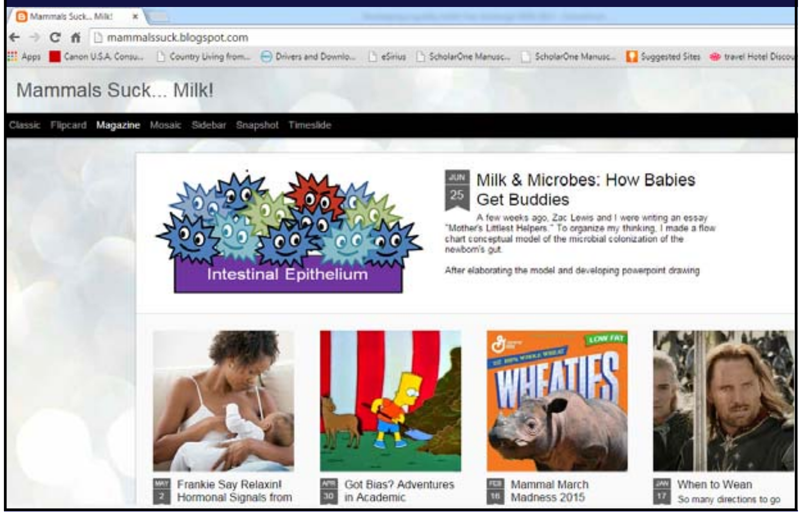
- Meet benchmarks for growth and calving to optimize first and subsequent lactation milk yield
- Calving problems
  - Too heavy (fat)
  - Too light (frame)
- General condition of the animal
  - Mastitis
  - Feet and legs
  - Injury
- Prior treatment's – especially respiratory and timing is important – pre- vs post-weaning
- Replacement Heifer Management Snapshot

Snapshot Evaluation of the Potential Quality of The Replacement

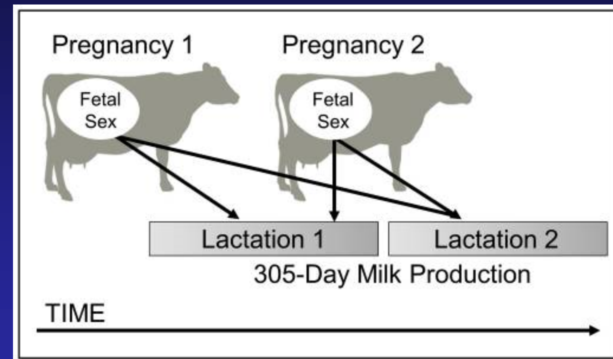
- 1st Calf Heifers "Treated" as Calf/Heifer* ≤30%
  24 hrs. → 3 mos. ____, 4 mos. → fresh ____
- DOAs in first calf heifers ≤7%
  Male DOAs. ____, Female DOAs ____
- 1st Calf avg. peak ≥80% of Mature
  1st Calf lactation total yield ≥80% of Mature
- 1st Calf Culls ≤ 60 Days in Milk ≤5%
- 1st Calf ME's ≥Mature
- 1st Calf "Treated" in Lactation* ≤15%
- 85% retention (any herd) to 2nd lactation ≥85%
- Lower #1 reason for 1st lact. culls(continuous improvement)

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. PLosOne 2014 10.1371/journal.pone.0086169

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

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

Study	Milk yield, lb
Foldager and Krohn, 1991	$3{,}092^{s}$
Bar-Peled et al., 1998	998^{t}
Foldager et al., 1997	$1{,}143^{t}$
Ballard et al., 2005 (@ 200 DIM)	$1{,}543^{s}$
Shamay et al., 2005 (post-weaning protein)	$2{,}162^{s}$
Rincker et al., 2006 (proj. 305@ 150 DIM)	$1{,}100^{ns}$
Drackley et al., 2007	$1{,}841^{S}$
Raith-Knight et al., 2009	$1{,}583^{NS}$
Morrison et al., 2009 (no diff. calf growth)	0
Moallem et al., 2010 (post-weaning protein)	$1{,}613^{s}$
Soberon et al., 2012	$1{,}556^{s}$
Margerison et al., 2013	$1{,}311^{s}$
Kinzeback et a, 2015	0

Outcome of Meta-Analyses

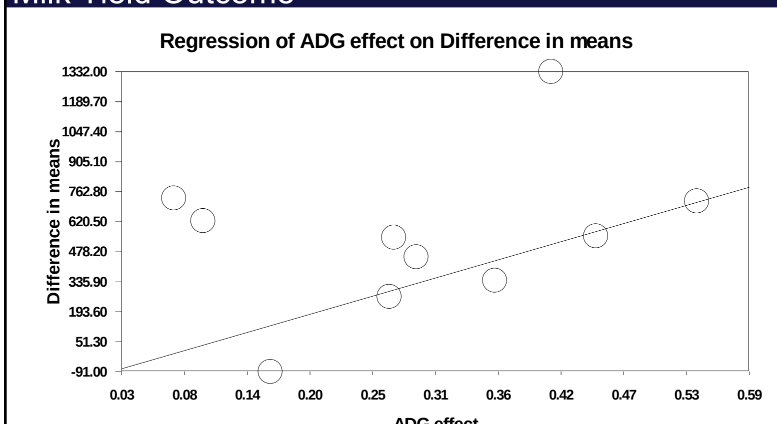
Milk yield effect of early life nutrition – asking the Yes/no question, does feeding a calf improve long-term productivity?

Difference in means, lb	SE, lb	Lower Limit, lb	Upper Limit, lb	Z-value	p-Value
435	117	205	664	3.72	<0.001

Odds ratio of effect

Odds Ratio	Lower Limit	Upper Limit	Z-value	p-Value
2.09	1.48	2.96	4.16	0.001

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

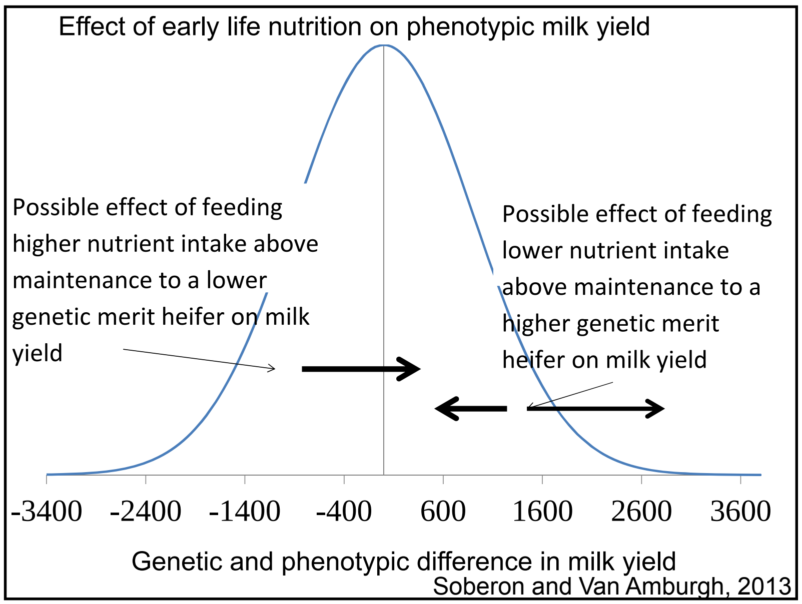
Difference in ADG = 1.2 lb/d, thus

(1,541 lb* 1.2) = 1,850 lb additional milk expected in the first lactation

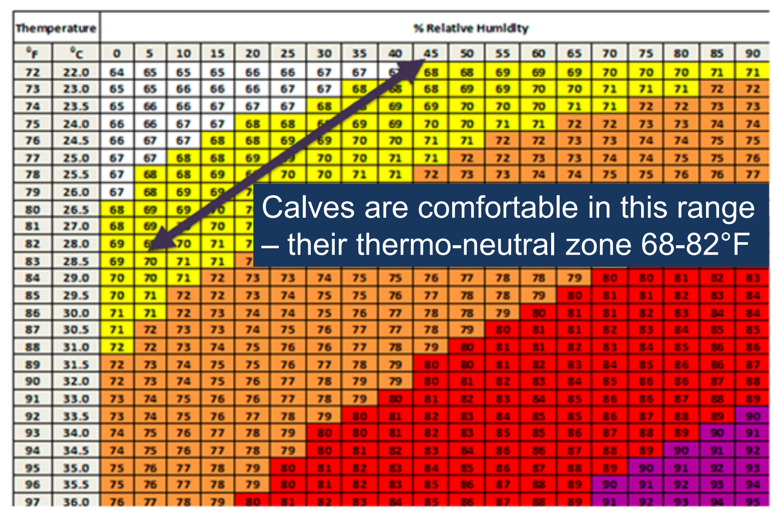
Additional Data on Early Life Management and Productivity

- 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)



Heat Stress and Performance of Calves



Summary of Feed Cost and Measured Gains During June and July 2014			
Feed Basis (As-Fed)	Farm A	Farm B	Farm C
Housing Type	Barn with mechanical ventilation	Barn with natural ventilation	Hutches, back propped up for increased ventilation
Pounds Milk Replacer fed per calf	1.50	1.82	1.25
Pounds grain fed per calf	0.47	0.86	1.00
Average Daily Gain (ADG)	2.00	1.88	0.67
Feed cost per animal per day	$3.01	$3.72	$2.65
Feed cost per pound of gain[1]	$1.69	$1.97	$3.94
Gross Feed Efficiency (Gain:Feed)	1 : 0.99	1 : 1.43	1 : 3.36

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

Themperature		% Relative Humidty																		
°F	°C	0	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90
72	22.0	64	65	65	65	66	66	67	67	67	68	68	69	69	69	70	70	70	71	71
73	23.0	65	65	66	66	66	67	67	68	68	68	69	69	70	70	71	71	71	72	72
74	23.5	65	66	66	67	67	67	68	68	69	69	70	70	70	71	71	72	72	73	73
75	24.0	66	66	67	67	68	68	68	69	69	70	70	71	71	72	72	73	73	74	74
76	24.5	66	67	67	68	68	69	69	70	70	71	71	72	72	73	73	74	74	75	75
77	25.0	67	67	68	68	69	69	70	70	71	71	72	72	73	73	74	74	75	75	76
78	25.5	67	68	68	69	69	70	70	71	71	72	73	73	74	74	75	75	76	76	77
79	26.0	67	68	69	69	70	70	71	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	74	75	76	76	77	77	78
80	26.5	68	69	69	70	70	71	72	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	75	76	76	77	78	78	79
81	27.0	68	69	70	70	71	72	72	73	73	74	75	75	76	77	77	78	78	79	80
82	28.0	69	69	70	71	71	72	73	73	74	75	75	76	77	77	78	79	79	80	81
83	28.5	69	70	71	71	72	73	73	74	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	79	80	80	81	82
84	29.0	70	70	71	72	73	73	74	75	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	80	80	81	82	83
85	29.5	70	71	72	72	73	74	75	75	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	81	81	82	83	84
86	30.0	71	71	72	73	74	74	75	76	77	78	78	79	80	81	81	82	83	84	84
87	30.5	71	72	73	73	74	75	76	77	77	78	79	80	81	81	82	83	84	85	85
88	31.0	72	72	73	74	75	76	76	77	78	79	80	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	86	86
89	31.5	72	73	74	75	75	76	77	78	79	80	80	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	86	87
90	32.0	72	73	74	75	76	77	78	79	79	80	81	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	87	88
91	33.0	73	74	75	76	76	77	78	79	80	81	82	83	84	85	86	86	87	88	89
92	33.5	73	74	75	76	77	78	79	80	81	82	83	84	85	85	86	87	88	89	90
93	34.0	74	75	76	77	78	79	80	80	81	82	83	85	85	86	87	88	89	90	91
94	34.5	74	75	76	77	78	79	80	81	82	83	84	86	86	87	88	89	90	91	92

FARM A

FARM B

FARM C

Management Effect

Temperature Basis	Farm A	Farm B
Average Low THI	61	62
Average High THI	76	83
Min THI	52	47
Max THI	86	100
Percent time below TNZ Min	23%	8%
Percent time above TNZ max	77%	92%
Percent time completely out of TNZ	0%	33%

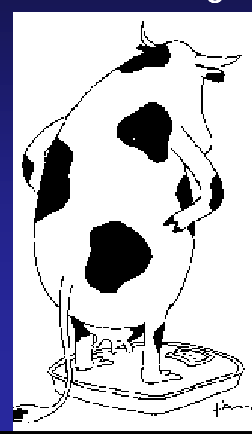
Feed Basis	Farm A	Farm B
Pounds MR fed/calf	1.50	1.82
Pounds grain fed/calf	0.47	0.86
ADG	2.00	1.88
Cost per lb of gain	$0.51	$0.92
Gross Feed Efficiency (Feed:Gain)	0.99:1	1.43:1

Farm A and B are neighboring farms and had near identical ambient weather conditions for the entire observed period.

For this example, Farm A and B Milk Replacers and calf starters were iso-nutritive

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

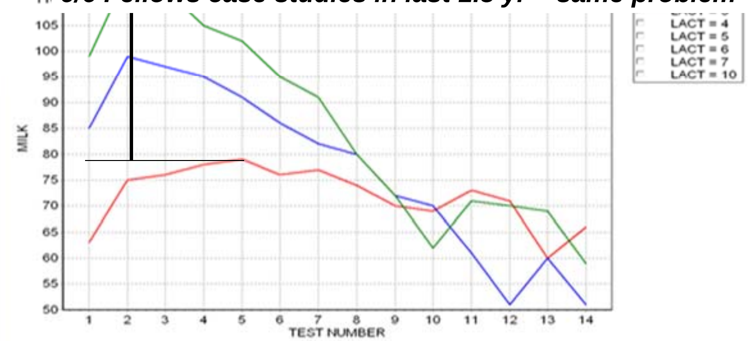
Mature weight determined at middle of 3rd and 4th lactation – 80 to 200 days in milk on healthy cows, not cull cows

PLOT MILK BY LACT

Peak ~ 69% mature cows

Overall lactation ~ 69% of mature cows

6/6 Fellows case studies in last 1.5 yr – same problem



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)

Target weights

	% mature wt.	Mature weight, lb 900	1,300	1,760
		Target weight, lb		
pregnancy	55%	495	715	968
1st lact. fresh	82%	765	1,105	1,496
2nd lact. fresh	92%	828	1,196	1,619
3rd lact. fresh	96%	864	1,248	1,690

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.

How Early Should Heifers Calve to Optimize Lifetime Productivity?

- Dairy Comp 305 ------------- A REAL Dairy -------------------- Page 1
- SUM AFC LFMPL LFMLK ME305 LACT FOR AFC=(18-31) BY AFC\TA

AFC	%COW	#COW	Av AFC	AvLFMPL	AvLFMLK	AvME305	Av LACT
1-7	3	26	19	21185	49389	23090	3.5
1-8	7	67	20	24173	60433	31994	2.4
1-9	21	207	21	22320	63008	27643	2.7
1-10	21	205	22	22024	70268	27712	2.9
1-11	12	120	23	17488	51059	26357	2.4
2-0	8	83	24	17266	46157	26026	2.2
2-1	4	42	25	13202	33566	27024	1.9
2-2	4	42	26	11077	21363	27133	1.4
2-3	4	39	27	11273	19609	28507	1.2
2-4	3	32	28	13003	15868	28699	1.1
2-5	3	30	29	15817	22281	28268	1.2
2-6	3	28	30	17731	19186	28472	1.0
2-7	2	21	31	17013	19652	27440	1.1
Total	100	980	23	18767	50307	27575	2.3

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:

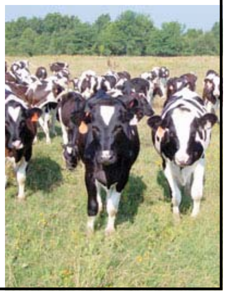
23.3 months AFC

24.3 months AFC

25.6 months AFC

27.2 months AFC

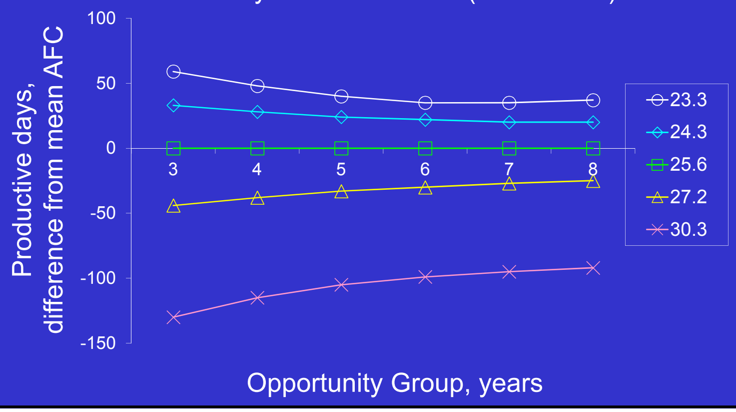
30.3 months AFC



Van Amburgh and Everett, unpublished

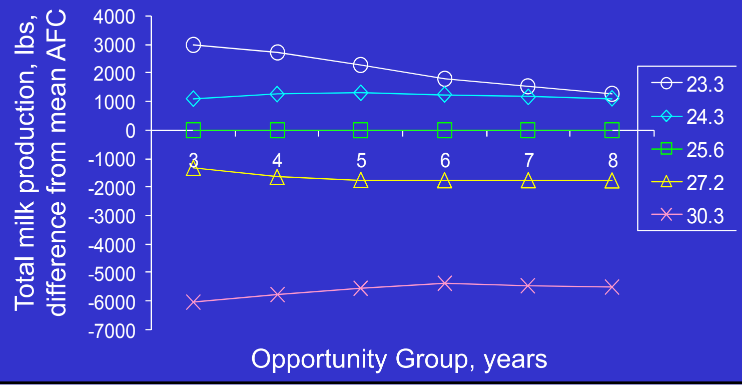
Within Herd Analysis of AFC on Productive Days, Milk Yield, Longevity

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



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)



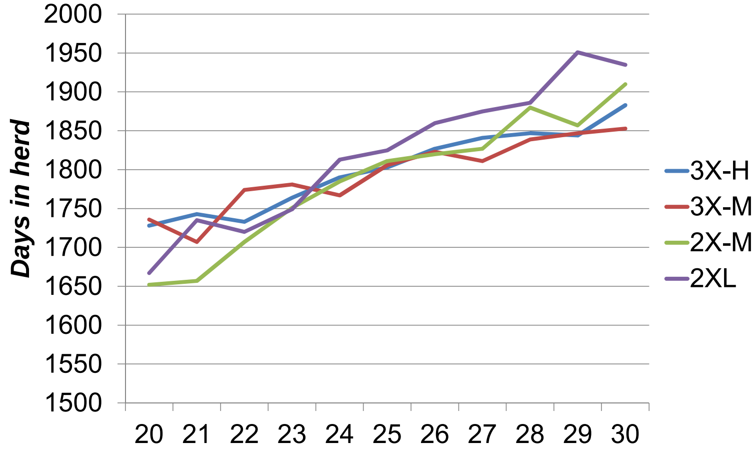
Study from Wisconsin – field/farm data from DHIA records evaluation of heifer calving in 2005

>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

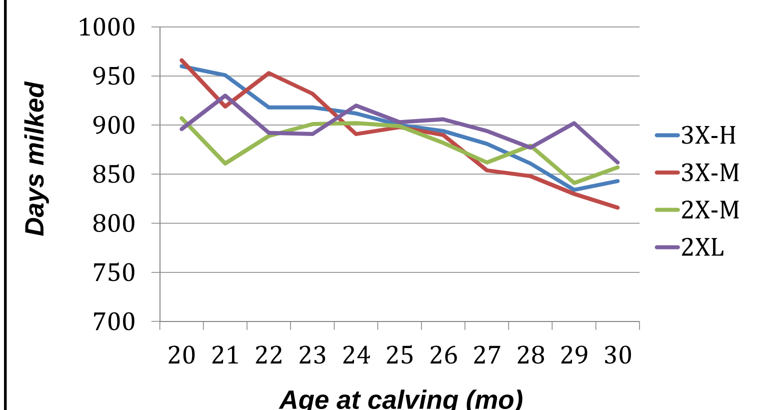
Curran et al. Prof. Anim. Sci., 2013

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



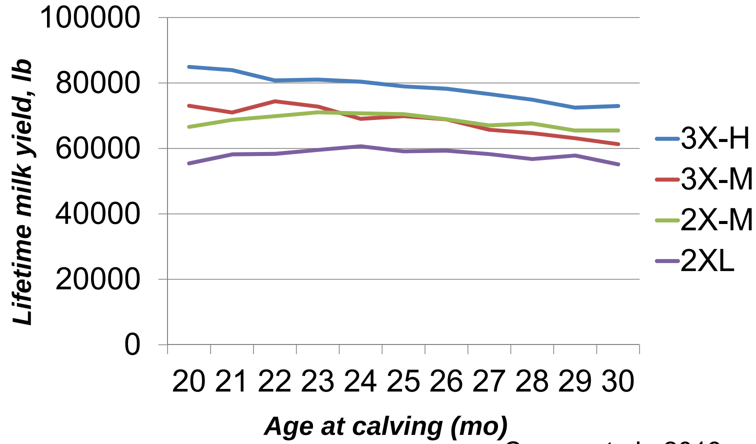
Curran et al., 2013

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



Curran et al., 2013

Lifetime milk (lb) by AFC and 2x or 3x milking stratified by herd milk yield



Curran et al., 2013

Analyzing Profitability by Calving Age within Herd

AFC	Cost to 1st Lact.	Breakeven Milk Prod. lbs	Actual Milk Prod., lbs	Cost of 1st Lact.	Milk revenue	Profitability
20	$1,806	8,738	20,796	$2,411	$4,299	**$82**
22	$1,986	9,609	21,368	$2,477	$4,417	**$-49**
24	$2,167	10,484	22,910	$2,656	$4,736	**-$87**
24.8	$2,235	10,813	24,533	$2,844	$5,071	**-$8**
28	$2,528	12,231	23,927	$2,774	$4,946	**-$356**
30	$2,709	13,106	21,844	$2,532	$4,516	**-$725**
35.9	$3,239	15,670	22,250	$2,579	$4,600	**-$1,218**

- Cost per day to lactation 1 is assumed to be $2.995 based on Karszes, 2012
- Net milk price is assumed to be $20.67 based off of the 2013-2014 Federal Milk Marketing Order averages
- 30.14 days per month assumed for calculations
- Cost in lactation 1 is calculated by using standardized cost per cwt of milk produced used from 112 farm averages as published in the 2013 DFBS for large herd farms (300+ Cows), Karszes et al.
  - $11.59/cwt cost to produce milk includes costs for:
    - Purchased and homegrown feed, breeding, veterinary medicine, milk marketing, bedding, milking supplies, livestock professional services and other

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.

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

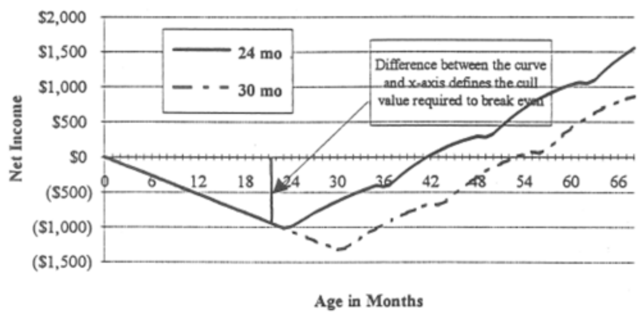


Figure 1. illustrates cash flow incurred by heifers calving at 24 and 30 mo. While the heifer is being raised, the balance continues to decline until she calves and she begins to generate income. The climb out of deficit is not straight due to the shape of the lactation curve and dry periods. From this 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

When does the heifer pay for herself based on milk?