Why Heifer Maturity Matters
The Peter Pan Problem

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The Trusted Experts In Nutrition & Health

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Heifer maturity – what does that mean?

- Heifer Maturity Definition*:* The phenotypic characteristics (frame and body weight) that allow full expression of genetic potential (e.g. milk production) over the animal's lifetime

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Economic incentives to breed heifers earlier

- **Begin** milk production earlier
- **Reduce** heifer inventory
- **Lower** heifer feed costs

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Heifers needed to maintain herd size at different culling rates and AGEFR

Age at first calving	Cull rate %	Total number of heifers/100 cows required to maintain herd size
24	40	88
23	40	84
22	40	80
21	40	77
24	35	77
23	35	74
22	35	70
21	35	67
24	30	67
23	30	63
22	30	60
21	30	58

Source: Terry Batchhelder, Ph.D in Progressive Dairymen, Dec 2018

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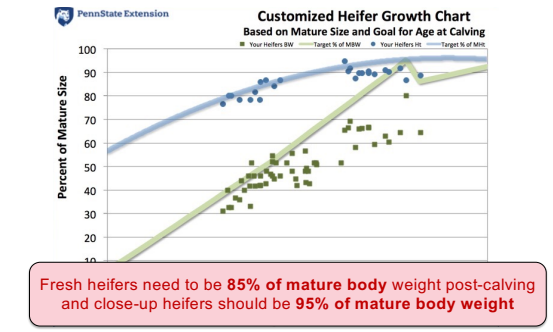
Mature heifer growth guidelines



Fresh heifers need to be **85% of mature body** weight post-calving and close-up heifers should be **95% of mature body weight**

Source: Pennsylvania State Extension

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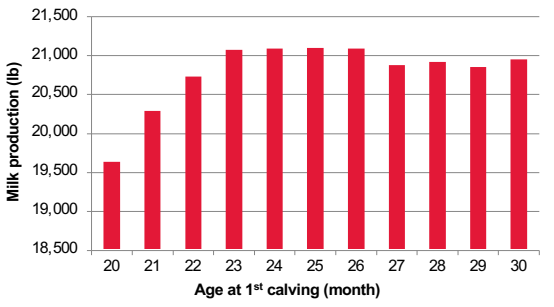
Age at calving impacts maturity



Source: Curran et al., 2013, Professional Animal Scientist 29:1-9

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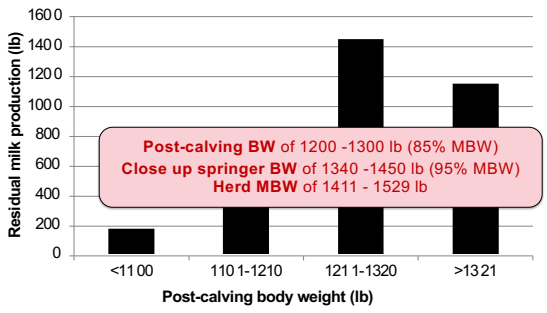
Weight at calving impacts maturity



 Source: Van Amburgh et al., 1998, JDS Feb 81: 527-538

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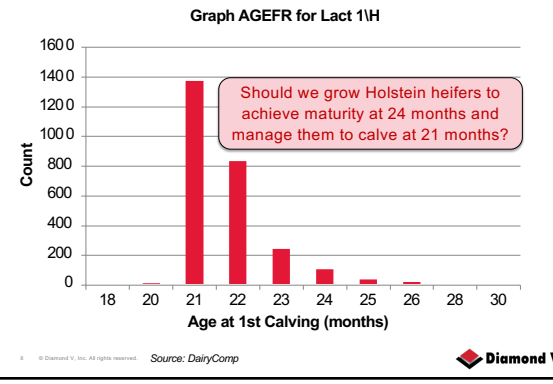
Average Daily Gain (lb/day) is critical



 Source: DairyComp

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Anecdotal evidence: a tale of two dairies

Dairy A: rBST

Dairy B: no rBST

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Dairy A: rBST supplementation

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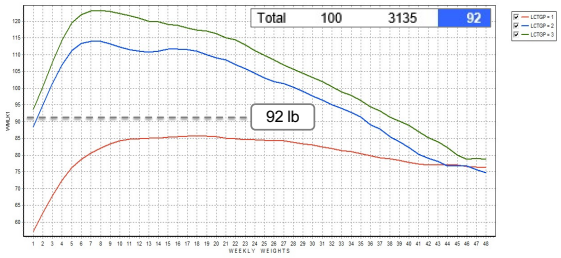
Dairy A: Holstein, 3X, with rBST supplement



Source: DairyComp

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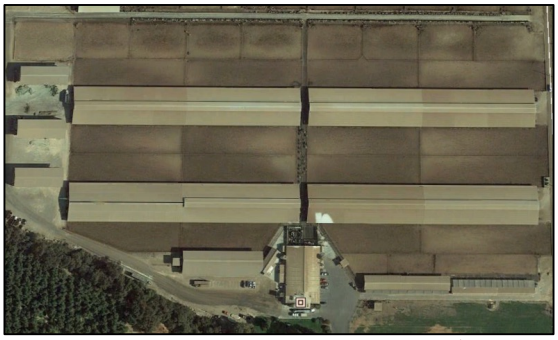
Dairy B: no rBST supplement



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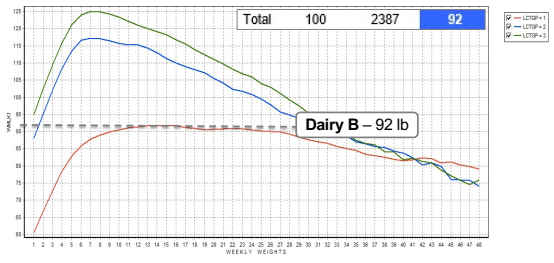
Dairy B: Holstein, 3X, no rBST supplement



 Source: DairyComp

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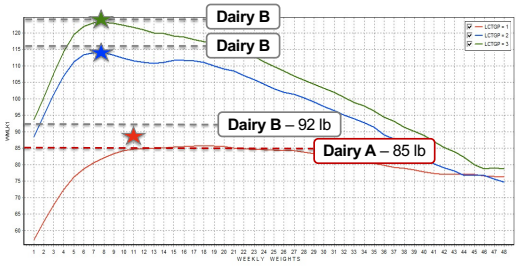
Dairy A (with **Dairy B** lctgp production)



 Source: DairyComp

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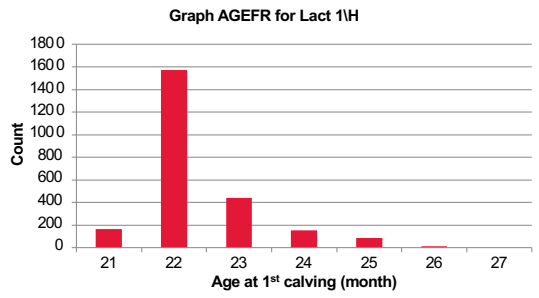
Dairy B (No rBST)
(Age at 1st breeding virgin heifers)



 Source: DairyComp

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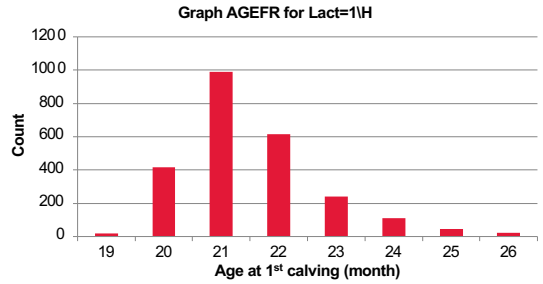
Dairy A (rBST)
(Age at 1st breeding virgin heifers)



 Source: DairyComp

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Observations 1-4

1 2 3 4

- Week 10 Lact 1 milk approximates herd annual avg. milk
- The difference in milk between Lact 1 and Lact 2 animals at Week 5 of lactation is 30 pounds (for Holsteins)
- AGEFR impacts Lact 1 milk production
- AGEFR impacts Lact 2 milk production

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Observation 1

1

- **Week 10 Lact 1 milk approximates herd annual avg. milk**
- The difference in milk between Lact 1 and Lact 2 animals at Week 5 of lactation is 30 pounds (for Holsteins)
- AGEFR impacts Lact 1 milk production
- AGEFR impacts Lact 2 milk production

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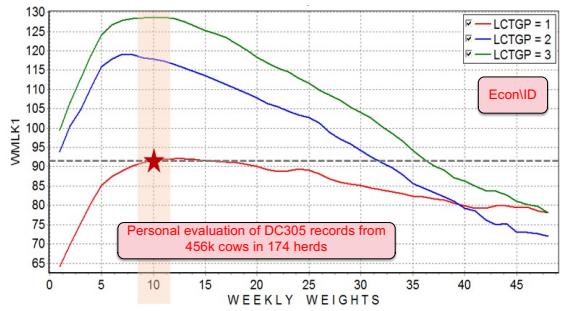
Observation 1

1

Week 10 Lact 1 milk approximates herd annual avg. milk



Source: DairyComp

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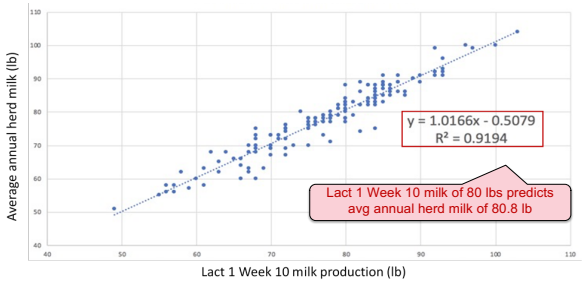
Lact 1 Week 10 & annual herd milk

1



Source: DairyComp, sample of 401,000 cows in 149 herds

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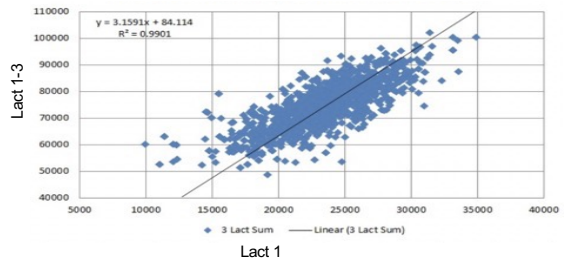
Lact 1 milk impacts later lactations

1

M305 (Sum of Lact 1-3, same cows) versus M305 (Lact 1)



Source: Dr.Todd Birkle, DVM

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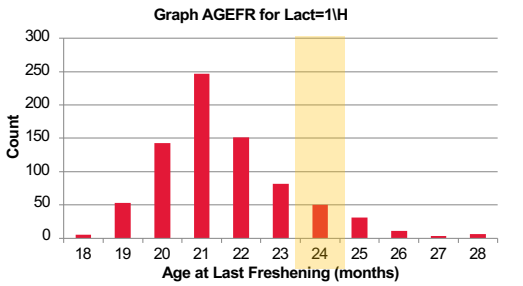
Example: age at calving and milk production



Peter Pan Problem?

 Source: Dr. David Vagnoni, Ph.D, Cal Poly; DairyComp

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Implications of Observation 1

1

- Predict average annual milk for the ENTIRE herd from one single value (and vice versa)
- Lact 1 milk production sets “ceiling” for whole herd
- Herd cannot outperform production level set by Lact 1
  - Example: a herd with 75 lb Lact 1 “peaks” (Week 10 milk) will not be capable of reaching 85 lb herd avg

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Observation 2

2

- Week 10 Lact 1 milk approximates herd annual avg. milk
- **The difference in milk between Lact 1 and Lact 2 animals at Week 5 of lactation is 30 pounds (for Holsteins)**
- AGEFR impacts Lact 1 milk production
- AGEFR impacts Lact 2 milk production

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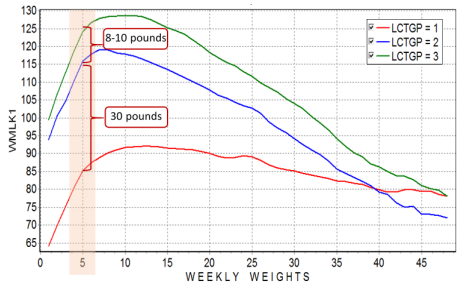
Observation 2

2

The difference in milk between Lact 1 and Lact 2 animals at Week 5 of lactation is 30 pounds (for Holsteins)



Source: DairyComp

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Implications of Observation 2

2

- Lact 2 and 3 production tightly linked to Lact 1 production
- For Holsteins at Week 5:
  - the difference between Lact 1 and Lact 2 is **30 lb**
  - the difference between Lact 2 and Lact 3 is **8-10 lb**
- This difference appears to be independent of the level of production or milking frequency.

"A rising tide lifts all boats"

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Observation 3

3

- **Week 10 Lact 1 milk approximates herd annual avg. milk**
- **The difference in milk between Lact 1 and Lact 2 animals at Week 5 of lactation is 30 lb (for Holsteins)**
- **AGEFR impacts Lact 1 milk production**
- **AGEFR impacts Lact 2 milk production**

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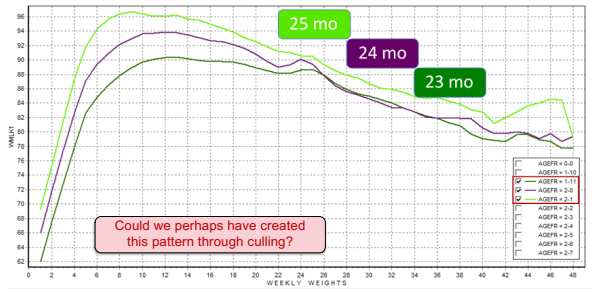
Observation 3

3

AGEFR impacts Lact 1 milk production



Source: DairyComp

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Heifer breeding and age at calving

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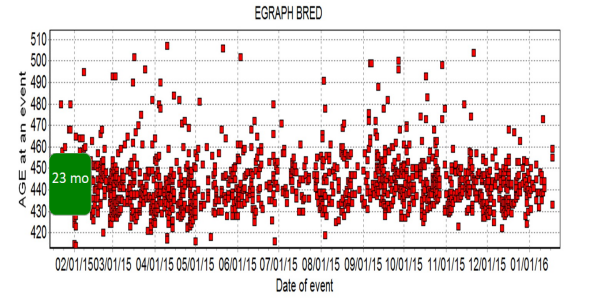
1st heifer breeding and 23 month age at calving cohort



Source: DairyComp

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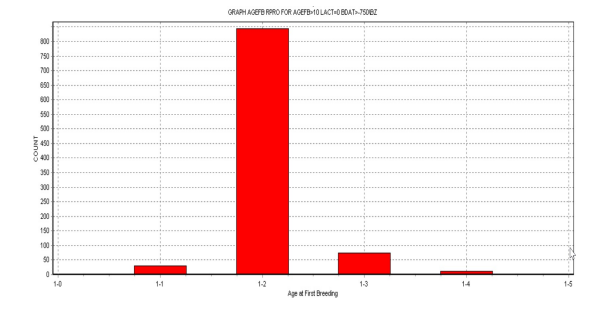
Breeding Heifers – on **AGE**

3



Source: DairyComp

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Heifer breeding and age at calving

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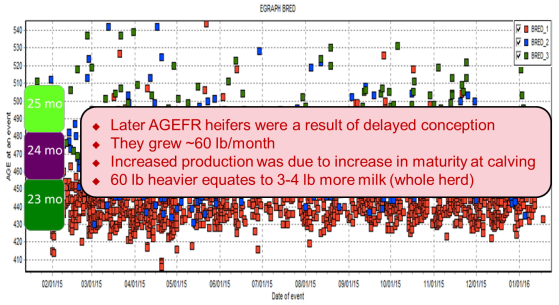
Multiple heifer breedings and age of calving cohorts



- Later AGEFR heifers were a result of delayed conception
- They grew ~60 lb/month
- Increased production was due to increase in maturity at calving
- 60 lb heavier equates to 3-4 lb more milk (whole herd)

 Source: DairyComp

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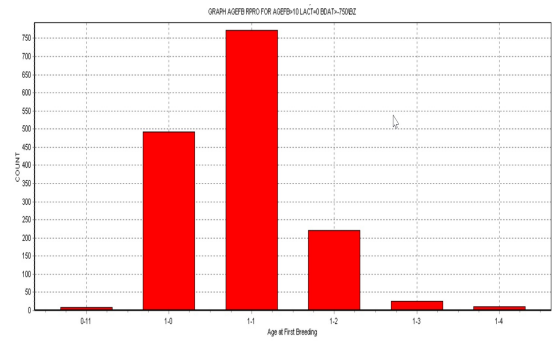
Breeding Heifers – on **SIZE**

3



 Source: DairyComp

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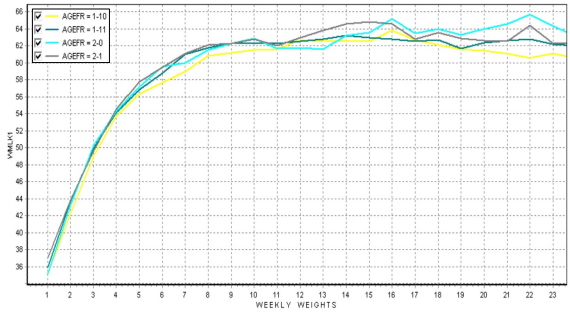
Selecting Heifers – on **SIZE**

3



 Source: DairyComp

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Observation 4

4

- Week 10 Lact 1 milk approximates herd annual avg. milk
- The difference in milk between Lact 1 and Lact 2 animals at Week 5 of lactation is 30 pounds (for Holsteins)
- AGEFR impacts Lact 1 milk production
- **AGEFR impacts Lact 2 milk production**

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Observation 4

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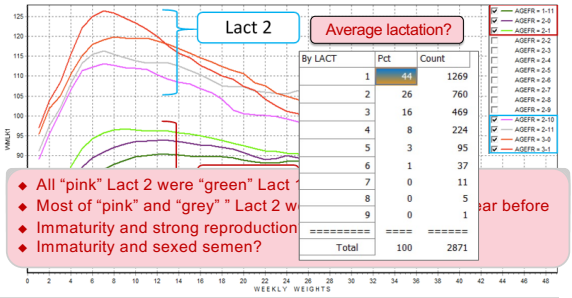
AGEFR can impact Lact 2



- All "pink" Lact 2 were "green" Lact 1
- Most of "pink" and "grey" " Lact 2 w ear before
- Immaturity and strong reproduction
- Immaturity and sexed semen?

 Source: DairyComp

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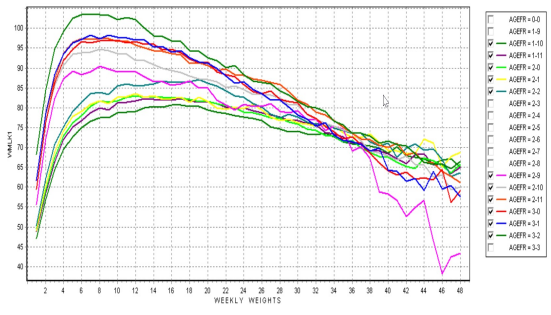
Lact 1 and 2 by AGEFR (3X, Hol)

4



 Source: DairyComp

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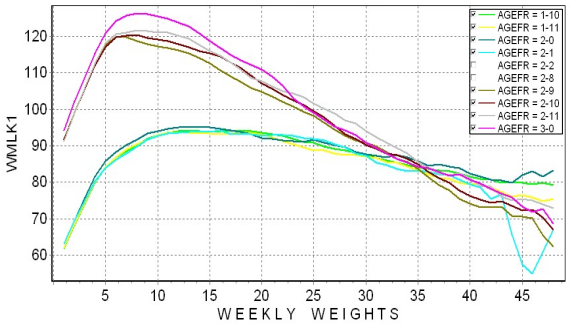
Heifer breeding on Size and Lact2 lactation curves

4



 Source: DairyComp

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Observations 1-4

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- AGEFR impacts Lact 1 milk production
- AGEFR impacts Lact 2 milk production

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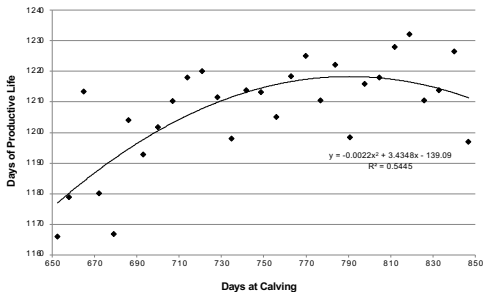
Productive Life by AGEFR



Productive life: days from first calving to culling

 Source: Dr Albert de Vries, Ph.D, University of Florida
DHIA data: calvings in New York State, 2009; sample of 246,286 cows

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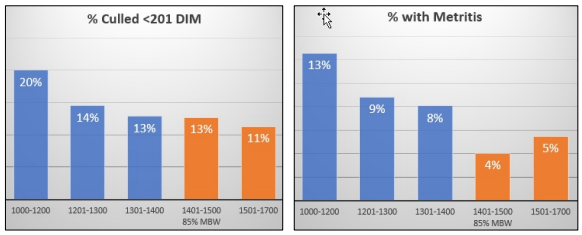
Weight at calving – survival / disease



Sample of 1,880 cows
Animals weighed approximately 1-12 hrs post-calving

 Source: Dr. Todd Birkle, DVM

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Corroborating articles

J. Dairy Sci. 103:4466–4474
https://doi.org/10.3168/jds.2019-17545
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Body weight of dairy heifers is positively associated with reproduction and stayability

R. C. Handcock,[1]* N. Lopez-Villalobos,[1] L. R. McNaughton,[2] P. J. Back,[1] G. R. Edwards,[3] and R. E. Hickson[1]
[1]School of Agriculture and Environment, Massey University, Palmerston North 4442, New Zealand
[2]Livestock Improvement Corporation, Hamilton 3240, New Zealand
[3]Faculty of Agriculture and Life Sciences, Lincoln University, Lincoln 7647, Christchurch, New Zealand

J. Dairy Sci. 102:4577–4589
https://doi.org/10.3168/jds.2018-15229

Positive relationships between body weight of dairy heifers and their first-lactation and accumulated three-parity lactation production

R. C. Handcock,[1]* N. Lopez-Villalobos,[1] L. R. McNaughton,[2] P. J. Back,[1] G. R. Edwards,[3] and R. E. Hickson[1]
[1]School of Agriculture and Environment, Massey University, Private Bag 11-222, Palmerston North 4442, New Zealand
[2]Livestock Improvement Corporation, Private Bag 3018, Hamilton 3240, New Zealand
[3]Faculty of Agriculture and Life Sciences, PO Box 85084, Lincoln University, Lincoln 7647, Christchurch, New Zealand

 Source: Journal of Dairy Science 2019-2020

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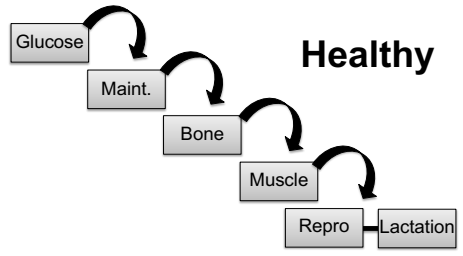
Energy Partitioning – growth priorities



If an animal does **not** reach the required level of maturity **BEFORE** calving, she will reach it **DURING** lactation … at the expense of production

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Growing during lactation is costly

Heifer Growth Stage and % Mature Wt.	Mature Bodyweight 1,000[1] Target Wt. Lbs.	1,000[1] Approx. ADG to Next Target Lbs.	1,400[2] Target Wt. Lbs.	1,400[2] Approx. ADG to Next Target Lbs.	1,800[3] Target Wt. Lbs.	1,800[3] Approx. ADG to Next Target Lbs.
Birth	60	1.1	80	1.4	90	1.6
Weaning 56 days	120	1.7	160	2.0	180	2.4
First breeding 55%	550	1.0	770	1.4	990	1.8
Post-calving, 1st calf 85%	850	0.3	1,190	0.3	1,530	0.4

Energetic cost of growth

- 2.3 Mcal/lb growth
- 0.3 Mcal/lb milk
- Nets out to **8:1 ratio**

Pre-calving maturity deficit will be **paid back in lactation**
Every missing lb BW will **cost 8 lbs milk** ("Heifer Shrink")
Growth will be **7x slower** after calving than before

Source: Dairy Calf and Heifer Association 2016 Gold Standards

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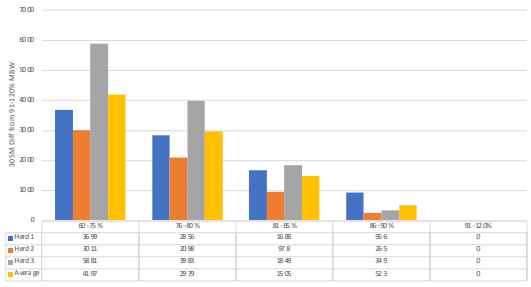
Difference in 305M for Lact=1 at different % MBW (post-calving) compared to animals at 91-120% MBW



	60 - 75 %	76 - 80 %	81 - 85 %	86 - 90 %	91 - 120%
Herd 1	36 99	28 56	16 88	95 6	0
Herd 2	30 11	20 98	97 8	26 5	0
Herd 3	58 81	39 88	18 49	34 9	0
Average	41 97	29 79	15 05	52 3	0

Source: Dr. Todd Birkle, DVM

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Field Example
(Holstein, Post-calving Lact 1 Weights)

Command ? SUM W8MK BY WEIGH FOR LACT=1 WEIGH>1040\Q4

SUM W8MK

By WEIGH	Pct	Count	Av W8MK
1172	25	56	71.6
1261	25	56	79.1
1330	26	59	83.2
1428	25	57	88.7
==========	====	=======	========
Total	100	228	80.3

Source: DairyComp

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Field Example
(Holstein, Pre-calving Lact 1 Weights)

ADG	By CUWGT	Pct	Count	Av W8MK	AvAGEFR	Av AGED
1.5 lb/d	1144	24	10	60.4	23	838
1.6 lb/d	1220	26	11	61.3	23	839
1.7 lb/d	1299	26	11	68.2	23	833
1.9 lb/d	1412	24	10	68.5	23	840
	Total	100	42	64.6	23	837

 Source: DairyComp

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Field Example
(Jersey, Lact 1-3 M305, same animals)

Backup Date	8/1/2017 Suggested
L1 FDAT Max	5/1/2014 5/1/2014
L1 FDAT Min	5/1/2013

Inclusion 8%

Age Fresh 1 >	Age Fresh 1 <=	#	%	1st 305M	2nd 305M	3rd 305M	Sum	Deviation from Avg. for Sum
19	21	40	12.0%	16151	18838	21893	56882	-1154
21	22	163	49.1%	16876	18761	21591	57228	-808
22	23	102	30.7%	17644	18954	22085	58683	648
23	24	39	11.7%	17784	19695	21871	59350	1314
24	25	19	5.7%	FALSE	FALSE	FALSE		FALSE
25	26	2	0.6%	FALSE	FALSE	FALSE		FALSE
26	27	4	1.2%	FALSE	FALSE	FALSE		FALSE
27	28	3	0.9%	FALSE	FALSE	FALSE		FALSE
28	29	0	0.0%	FALSE	FALSE	FALSE		FALSE
	SUM	372				Avg	58036	

 Source: Dr. Todd Birkle, DVM

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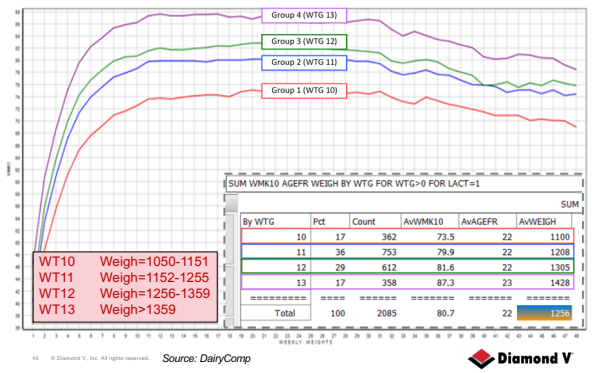
Field Example
(Holstein, 6k, Post-calving Lact 1 weights) by WGT



 Source: DairyComp

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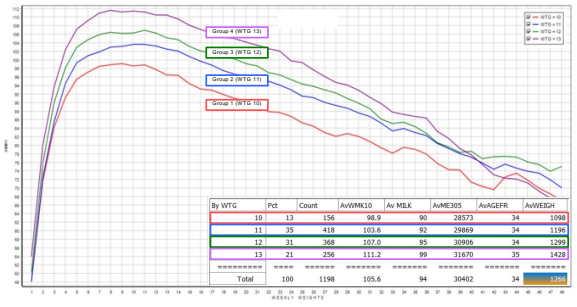
Field Example
(Holstein, Post-calving Lact 2) by WGT



By WTG	Pct	Count	AvWMK10	Av MILK	AvME305	AvAGEFR	AvWEIGH
10	13	156	98.9	90	28573	34	1098
11	35	418	103.6	92	29869	34	1196
12	31	368	107.0	95	30906	34	1299
13	21	256	111.2	99	31670	35	1428
Total	100	1198	105.6	94	30402	34	1268

 Source: DairyComp

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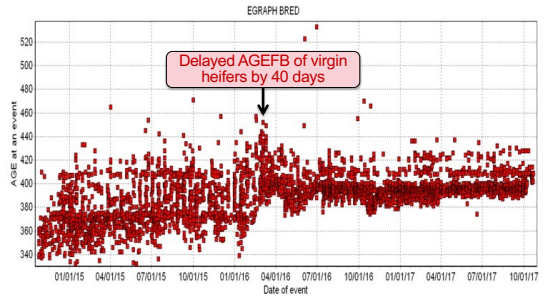
What happened at **Dairy A**?
(AGEFB in days of age)



 Source: DairyComp

Diamond V

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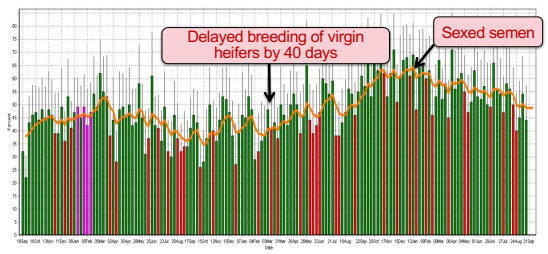
Dairy A: Virgin Heifer Conception Rate
(3 years rolling average)



Virgin heifer CR increased by **20 percentage points** (conventional semen)

 Source: DairyComp

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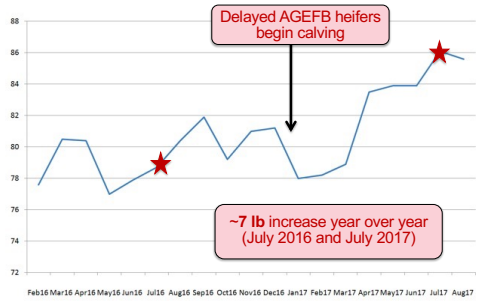
Dairy A: Milk Production
(Wk 6 Milk by MYFSH for Lact 1)



 Source: DairyComp

Diamond V

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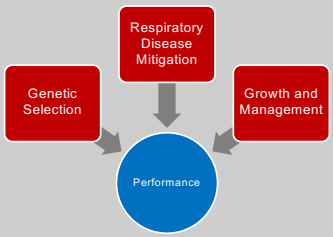
Three key areas impact heifer performance



 Source: Dr. Todd Birkle, DVM

Diamond V

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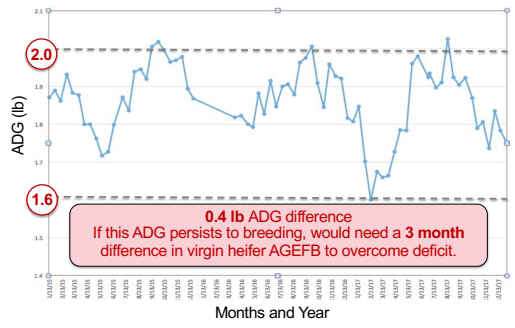
Graph of Seasonal Fluctuation in ADG
(Heifers of 4-5 months age, average bodyweight of cohort)



 Source: Dairy A

Diamond V

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Has Calving Immature Heifers been Successful?

- No! ... Why not?
- Calved heifers earlier without changing management.
- Immaturity affects entire productive life not just Lact 1
- Lact 1 do not “catch up” (there is no compensatory growth, no “reset to factory settings”!).

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Has Calving Immature Heifers been Successful?

- Focus on heifer health (mortality), not on growth.
- Focus on raising heifers cheaply with little regard to growth.
- Common management practices e.g. overcrowding
- No or little actionable, objective monitoring (weights, heights).

A profound disconnect between growth rate (ADG) and AGEFR has occurred on many dairies

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So what’s the solution?

(Caveat: FRAME not just weight)

- Weigh Lact 3 and Lact 4 cows (80-120 DIM) - MBW
- Weigh Springers (DCC>260) (Goal: 95% MBW) or fresh cows (Goal: 85% MBW). May need to do several times (seasonality)
- Calculate weight difference between desired and actual weights
- Calculate ADG that heifer raising system is achieving
- Determine ADG or AGEFB required to achieve maturity at critical stages (esp. at breeding of heifers)
- Set heifer health and growth goals for all key stages of growth from birth to calving (Colostrum to Calving)
- **Goal is to calve mature heifers as early as possible**

Manage and Monitor for **Maturity.**

Diamond V

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