

Genetics of Body Condition Score

What's a geneticist doing at a nutrition workshop?

"Face it, Chad – You're lost!"

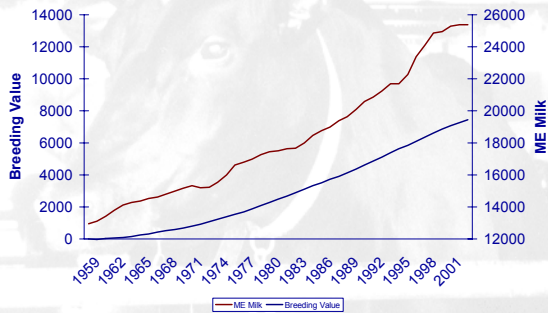
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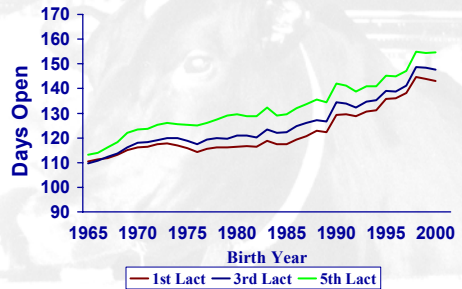
1. Genetics impact nutrition and management
2. Management and nutrition impact genetic selection goals

Profitable dairy production depends on complementary genetics and environments

Selection Success

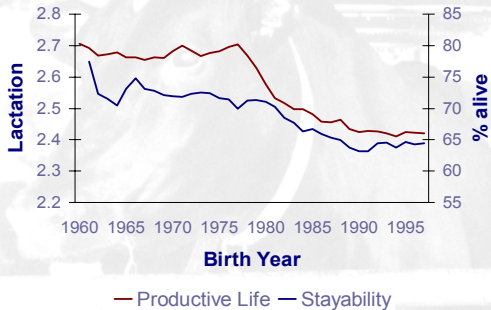


Has Come at a Cost



VanRaden et al., 2002

Herd Life



USDA, Cornell

Culling Practices

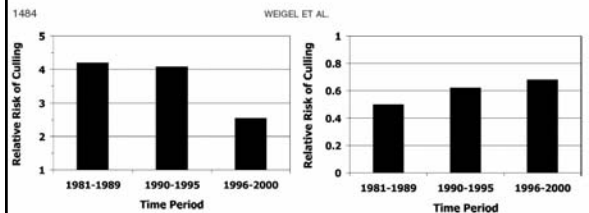


Figure 1. Change in risk of culling for low-producing cows over time, relative to risk of culling for average-producing cows.

Figure 2. Change in risk of culling for high-producing cows over time, relative to risk of culling for average-producing cows.

- Selection has been largely successful for productive efficiency
 - Reproduction and cow health has suffered
 - Less voluntary culling
 - More “problem” cows

Problems created for nutritionists?

Selection for Higher Yield

- No evidence of genetic variation for digestive efficiency
 - Changes must be nutrient intake and partitioning
 - More toward production
 - Less fat
 - Maintenance?

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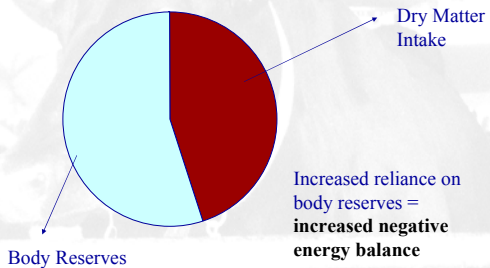
SHOOT FOR THE MOON

Genetic Correlations paint a different Picture!

New studies show high milk production doesn't increase stress on your cows—and that good management is the key to unlocking your herd's potential.
PAGE 28



More Milk = More Nutrients



Not Just Yield

- High Dairy Form = Angular & Thin
 - Fat cows: “will to milk”
- Have direct yield observations
 - PTA for DF unnecessary
 - Driven by type



Results of Selection

- Higher production, but
 - Thinner
 - Greater negative energy balance
 - Metabolic disease
 - Reproductive function

Management Changes

- Less individual cow management
 - Same diet – different production
- Wet Concrete
 - Foot health
 - Estrus expression



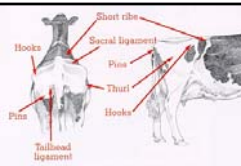
New Selection Needs

- Still want higher production
 - Not at all cost
- More vigorous
- Less intensive management

Could we use BCS genetic evaluations to select for more vigorous cows?

Heritability Estimates

- Producer recorded
 - 0.07 to 0.20
- Linear classification
 - 0.22 for BCS
 - Higher in Europe
 - 0.29 for Dairy Form



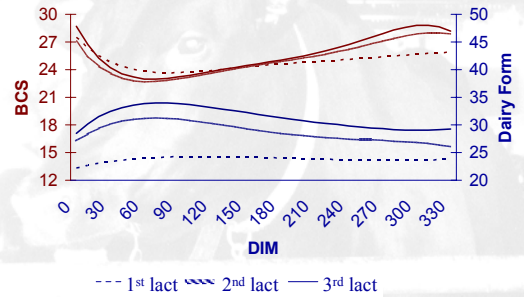
BCS at Different Lactation Stages

- Genetic correlations
 - DIM 0, 70, 305
 - Lactation 1-3
- Range: **0.77 to 0.99**
 - Within lactation: ≥ 0.90
 - Within DIM: ≥ 0.88
- Phenotypic correlations
 - Range: **0.09 to 0.41**

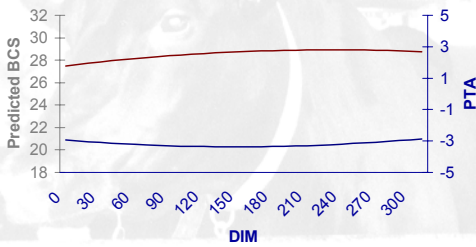
BCS Loss

- Heritability estimates low
 - <math>< 0.10</math>
 - Some variation does exist
- Highly correlated with level of BCS
 - Lower level – more BCS lost

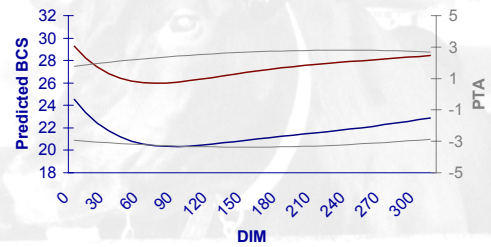
Average BCS & Dairy form



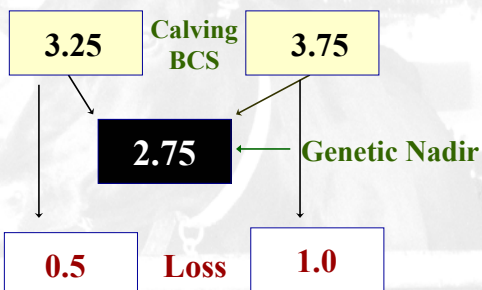
PTAs



PTAs



BCS – BCS Loss



??

- Overconditioned at calving: primarily a management and environment issue?
- Should calving BCS recommendations depend on genotype?

BCS Selection

- **BCS moderately heritable**
 - Effectively for higher nadir
 - BCS at different stages the same genetically
- **Early lactation loss less heritable**
 - Selection for higher level will limit

Genetic Relationship Between BCS and:

**Production
Type Traits
Reproduction
Disease**

Production

- **Higher BCS correlated with lower milk, fat and protein yield**
 - Producer recorded at preg check
 - -0.22 to -0.43
 - Linear type classification
 - -0.25
- **More BCS loss = Higher production**
 - Producer recorded
 - 0.17 to 0.50

Type Traits

- **Higher BCS**
 - Lower dairy form: -0.72
 - More strength: 0.69
 - Final Score: 0.08

Stature			3.28 T
Dairy Form			2.23 O
Strength			1.14 S

Reproduction

- **Higher BCS**
 - Fewer days to first service at preg check
 - -0.42 to -0.63
 - Relationship to SPC not as strong
 - -0.08 to -0.33
 - Days open (or calving interval) intermediate
 - -0.30

Days Open (DPR)

	BCS	Dairy Form
Days Open	-0.30	0.48
Milk Adjusted	-0.24	0.38

Luteal Activity

- **Increased negative energy balance**
 - More days to commencement of luteal activity
 - -0.60
- **Higher BCS**
 - Earlier ovulation
 - Milk progesterone testing
 - -0.84

US Health Correlations

	BCS		Dairy Form	
	r_g	r_p	r_g	r_p
DA	-0.72	-0.10	0.52	0.01
Metabolic	-0.78	-0.09	0.71	-0.03
Foot	0.21	-0.13
Mastitis	0.14	-0.08	-0.03	0.08

Denmark Health Correlations 1st Lactation

	BCS	Dairy Form
Reproductive	0.16	0.13
Metabolic	-0.36	0.40
Foot & Leg	-0.09	0.44

Genetic Relationships

- **Selection for \uparrow BCS or \downarrow dairy form**
 - Less metabolic disease
 - Fewer days open
- **Adjustment for yield: minimal effect**
 - **Given level of production during lactation: fatter cow healthier and more reproductively fit**

Intermediate Optimum?

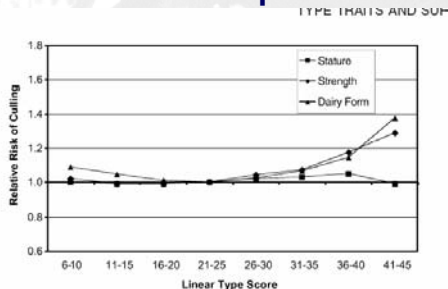


Figure 3. Relative risk of culling by classes of linear scores for body traits (risk ratio for score 21 to 25 was constrained to 1).

How Do We Use This?

- **#1: Stop selecting for higher dairy form**
- **Look for high PTAM with low dairy form**
 - **Select pool of bulls: select lowest dairy form from pool**
- **Include in indices?**
 - **Sub-indices**

O MAN

7H006417 O-BEE MANFRED JUSTICE-ET EXCELLENT (92)
MANFRED X ELTON
TV TL



Do those bulls exist?

Dairy Form STA = -1.16

Production USDA (PTA-Lbs)		Type (PTA)		Calving Ease	
Milk	1618	Type	0.99	%DBH (Srv. Sire)	5
Protein	75	% Reliability	88	%Rel Obs.	80/372
% Protein	0.11	Dtrs/Herds	96/52	%DBH (Dir.)	5
Fat	103	TPI	1915	%Rel Obs.	64/85
% Fat	0.18	Udder Comp	0.95	Somatic Cell Score	2.89
% Reliability	92	Feet & Leg Comp	1.91	SCS % Reliability	80
Dtrs/Herds	196/101	Body Comp	1.35	Productive Life	3.8
Net Merit \$	857	Dairy Comp	-0.34	PL % Reliability	72
Fluid Merit \$	764	Cowmry	138A	DPR	1.6
Cheese Merit \$	907	Reg. No.	122358313	DPR % Reliability	68

Herd Dependant?

- High Index
 - Likely thin
 - Already have “will to milk”
- Intensively managed
 - May have management capabilities to handle

Do we need BCS evaluations?

- Highly correlated with dairy form
 - Dairy form definition could change
 - BCS is BCS
- More people know what BCS is

BCS to select for greater feed efficiency?

Feed Efficiency

- Selection for greater feed efficiency?
 - More production / feed consumed
- Most feed efficient diet not always most economical diet
- How do we determine most efficient?
 - Need individual DMI!

Smaller Size?

- Select for smaller cows
 - Less feed to maintenance
 - Same level of production = greater efficiency
 - CRITICAL ASSUMPTION
 - No difference in negative energy balance
 - If incorrect – more harm than good
 - DMI as % of body weight differences exist



**Small Cow + High Production +
High BCS = High DMI**

Keep Genetic Selection in Perspective

- **Heritabilities**
 - Production and type traits: Moderate
 - Fitness traits: Low
- **Low h^2**
 - Selection results take time
 - Can accumulate over time
 - Management changes more immediate

Summary & Conclusions

- **Selection has resulted in higher production**
 - Higher N.E.B
 - Lower BCS

} Reduced cow fitness
- **BCS**
 - Level: moderately heritable
 - Loss: low heritability

Summary & Conclusions

- **BCS**
 - Unfavorable correlations with yield
 - Not strong
 - Favorable correlation with fitness
 - Moderate
- **Selection tool**
 - Still need good management

References

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