



Genomic Evaluation for Feed Efficiency in Canadian Holsteins

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Feed Intake Data in Canada

- Efficient Dairy Genome Project (EDGP): 7 herds in 5 countries
 - Canada (3 herds)
 - Australia
 - Denmark
 - Switzerland
 - USA
- Lactanet – CDCB exchange
 - 7 US research herds
 - mostly historical data (at the moment)

Feed Efficiency Evaluation in Canada

- Overall aim is to:
 - Select for cows that use less feed at the same level of production and body size **after peak of lactation**
 - **Increase efficiency of turning feed into energy**
- Not aimed at reducing maintenance requirements by lowering body weight
- We do not target a reduction in feed intake in early lactation when animals usually have a negative energy balance

Genetic Evaluation Model for Feed Efficiency

- Use three traits in first lactation (weekly averages)
 - DMI: Dry Matter Intake
 - MBW: Metabolic Body Weight = $(\text{Body weight})^{0.75}$
 - ECM: Energy Corrected Milk
 - $0.25 * \text{Milk} + 12.2 * \text{Fat} + 7.7 * \text{Protein}$
- Each trait is defined within two time periods
 - Up to 60 days in milk
 - After 60 days in milk
- Single-Step evaluation:
 - Using MiX99

Measure for Feed Efficiency

Feed Efficiency is calculated from the 3 traits:

$$EBV_{FE} = EBV_{DMI} - a * EBV_{ECM} - b * EBV_{MBW}$$

- a and b are partial genetic regression coefficients of DMI on Energy Sinks (derived from genetic co-variance components)
- Genetically independent of energy sinks
- Equivalent to Genetic **Residual Feed Intake (RFI)**
- Accommodates missing data for DMI and energy sinks

Feed Efficiency Equations

- Early Lactation (5 – 60 DIM)

$$FE1 = DMI1 - 0.203 * ECM1 - 0.193 * MBW1$$

- Mid-late Lactation (61 – 305 DIM)

$$FE2 = DMI2 - 0.484 * ECM2 - 0.136 * MBW2$$

FE = FE2 is the principal selection criterion for Feed Efficiency

Heritabilities

- Early Lactation

- Energy Corrected Milk (ECM1) 0.34
- Metabolic Body Weight (MBW1) 0.57
- Dry Matter Intake (DMI1) 0.29
- Feed Efficiency (FE1) 0.10

- Mid-late Lactation

- Energy Corrected Milk (ECM2) 0.29
- Metabolic Body Weight (MBW2) 0.59
- Dry Matter Intake (DMI2) 0.27
- Feed Efficiency (FE2) 0.05

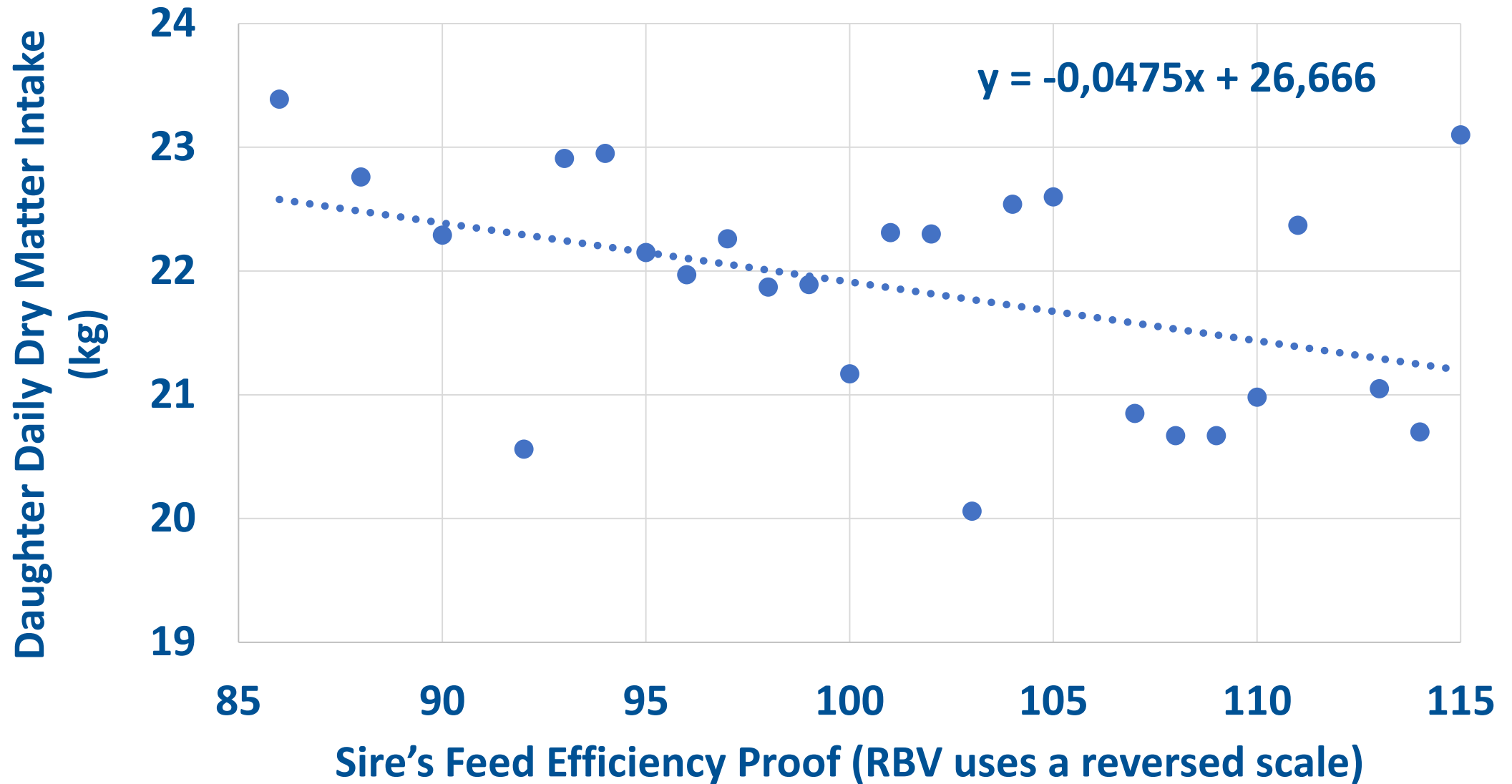
Genetic Correlations

	DMI1	FE1	DMI2	FE/FE2
ECM1	0.50	0.0		
MBW1	0.74	0.0		
DMI1		0.50	0.88	
FE1				0.63
ECM2			0.79	0.0
MBW2			0.44	0.0
DMI2				0.37

Results from the Feed Efficiency Evaluation

Only looking at proofs after 60 DIM

Daughter Dry Matter Intake



Feed Efficiency and Daughter Dry Matter Intake

- Per one point increase in Feed Efficiency RBV, we expect a decrease in daughter daily dry matter intake of 48 grams.
- A 5-point increase in Feed Efficiency RBV (1 Std Dev) has an expected decrease:
 - In daily dry matter intake of ~0.24 kg
 - Equates to a total of ~60 kg between 61–305 DIM
 - Approximately a 1% reduction in dry matter intake

Feed Efficiency Correlations with Other Traits

Bulls with a domestic LPI in Canada

	Feed Efficiency
LPI	0.09
Pro\$	0.09
Milk	0.04
Fat	0.09
Protein	0.09
Fat Percent	0.05
Protein Percent	0.10

Feed Efficiency Correlations with Other Traits

Bulls with a domestic LPI in Canada

	Feed Efficiency
Conformation	0.06
Rump	0.00
Mammary System	0.09
Feet and Legs	0.02
Dairy Strength	0.03
Stature	0.08
Body Condition Score	0.00

Feed Efficiency Correlations with Other Traits

Bulls with a domestic LPI in Canada

	Feed Efficiency
Herd Life	0.00
Milking Speed	0.01
Milking Temperament	0.06
Calving Ability	0.03
Daughter Calving Ability	0.02
Daughter Fertility	0.03
Days Open	0.00
Mastitis Resistance	-0.01
Metabolic Disease Resistance	0.13

Feed Efficiency Reliabilities

- Few bulls have daughters with Feed Intake data
- Reliabilities of feed efficiency are lower compared to other traits
- Top 100 Young GPA LPI bulls:
 - Average Reliability: 41%
 - Reliability range: 36% to 46%
- Top 100 Domestic LPI bulls:
 - Average Reliability: 51%
 - Most of these bulls around 46%

Conclusions

- Selection for Feed Efficiency will reduce Dry Matter Intake
 - It is designed to be independent of Energy Corrected Milk and Metabolic Body Weight
- Feed Efficiency has low correlations with the other traits we are currently evaluating
 - Indexes: LPI and Pro\$
 - Stature

EDGP Funders & Participating Organizations



A man in a green and white plaid shirt stands in the foreground, looking towards a large, modern barn in the background. The barn has a brown roof with several skylights and large glass windows. A pond in the foreground reflects the barn and the sky. The scene is set during the "blue hour" of twilight.

Lactanet

CANADIAN NETWORK FOR DAIRY EXCELLENCE

