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CANADIAN NETWORK FOR DAIRY EXCELLENCE

Including Second Lactation Data in Canadian Feed Efficiency Evaluation

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Feed Efficiency Evaluation in Canada

- Introduced in April 2021 for the Holstein breed

- International data: EDGP (3 Canadian herds) + CDCB exchange

- 1st lactation: weekly averages of ECM, MBW and DMI, defined within 2 intervals: 5 – 60 and 61 – 305 dim

- Model:
  - Multiple-trait linear animal model (MiX99)
  - Single-Step approach: **H** = (pedigree + genotypes) based relationships

- Selection criterion:
  - FE = Genetic RFI in 61 – 305 dim, with ECM and MBW as sinks

Feed Efficiency Data in Canada

Lactation	% of all DMI data
1	47
2	30
3	16
>3	7
1 – 2	77
1 – 3	93

(Lactations 1 and 2) or (Lactations 1, 2 and 3)?

- Use lactations 1 and 2 in a multiple-trait model
  - More reasonable/simpler modelling
  - Not too many benefits (data-wise) from including 3rd lactation data
  - More acceptable estimates of genetic parameters
  - Good agreement between FE EBV from using 2nd only vs. combined 2nd and 3rd lactations data

- The model:
  - ECM, MBW and DMI: different but correlated traits across lactations and 5 – 60 and 61 – 305 dim intervals
  - Genetic RFI: within lactation and dim intervals
  - Same model & assumptions as in the current implementation

Genetic Parameters

- Same model but w/o genomic info (**A** only)

- MC-EM-REML (implemented in MiX99)

- August 2021 data

Lactation	Weekly Records	Cows
1	123,743	5,307
2	84,689	3,786
All	208,432	7,302

Relative Impact (%) of Energy Sinks on DMI

Lactation	Energy Sink	5 – 60 dim	61 – 305 dim
1	ECM	37	64
	MBW	63	36
2	ECM	55	60
	MBW	45	40

Heritability (61 – 305 dim)

	Lactation 1	Lactation 2
ECM	0.28	0.16
MBW	0.53	0.50
DMI	0.24	0.15
RFI	**0.06**	**0.03**

Genetic Correlations (61 – 305 dim)

	Lactation 1	Lactation 2
ECM – DMI	0.78	0.75
MBW – DMI	0.44	0.50
RFI - DMI	0.44	0.42

- Correlations between lactations 1 and 2:
  - ECM: 0.70
  - MBW: 0.92
  - DMI: 0.79
  - RFI: **0.25**

Genomic Evaluation: December 2021 Data

Lactation	Phenotyped Cows	Cows with DMI (%)	Sires
1	6,777	89	1,475
2	4,885	85	1,330
All	8,927	92	1,775

Genomic Evaluation: December 2021 Data

	All	Genotyped	% Genotyped
Cows with phenotypes	8,927	7,218	81
Sires of cows	1,755	1,465	83
Animals in pedigree	27,203	12,942	48

Genotypes: December 2021 Data

|	Lactation 1	Lactations 1 and 2	Relative Increase
Cows with phenotypes	5,643	7,218	28%
Sires of cows	1,248	1,465	12%
Animals in pedigree (Reference Population)	11,517	12,942	17%

Genomic Evaluation Results

- FE1 = RFI in 61 – 305 dim, 1st lactation

- FE2 = RFI in 61 – 305 dim, 2nd lactation

- FE = 0.5*(FE1 + FE2): Feed Efficiency Index

- Evaluations expressed as RBV (mean = 100, SD = 5 for base bulls) with reversed sign (higher RBV of FE = better feed efficiency)

- **Young animals**:
  - 50,000 genotyped individuals, born in 2021

- **Proven sires** (N = 479):
  - Min. 5 daughters with DMI
  - Min. reliability of FE = 50%

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Reliabilities (%): Young Animals

	Average	SD	Min	Max
FE1	51	3.3	18	64
FE2	50	3.3	17	62
FE	50	3.3	18	62

Change in Reliability of FE1 for Young Animals (Lactations 1 and 2) - (Lactation 1)
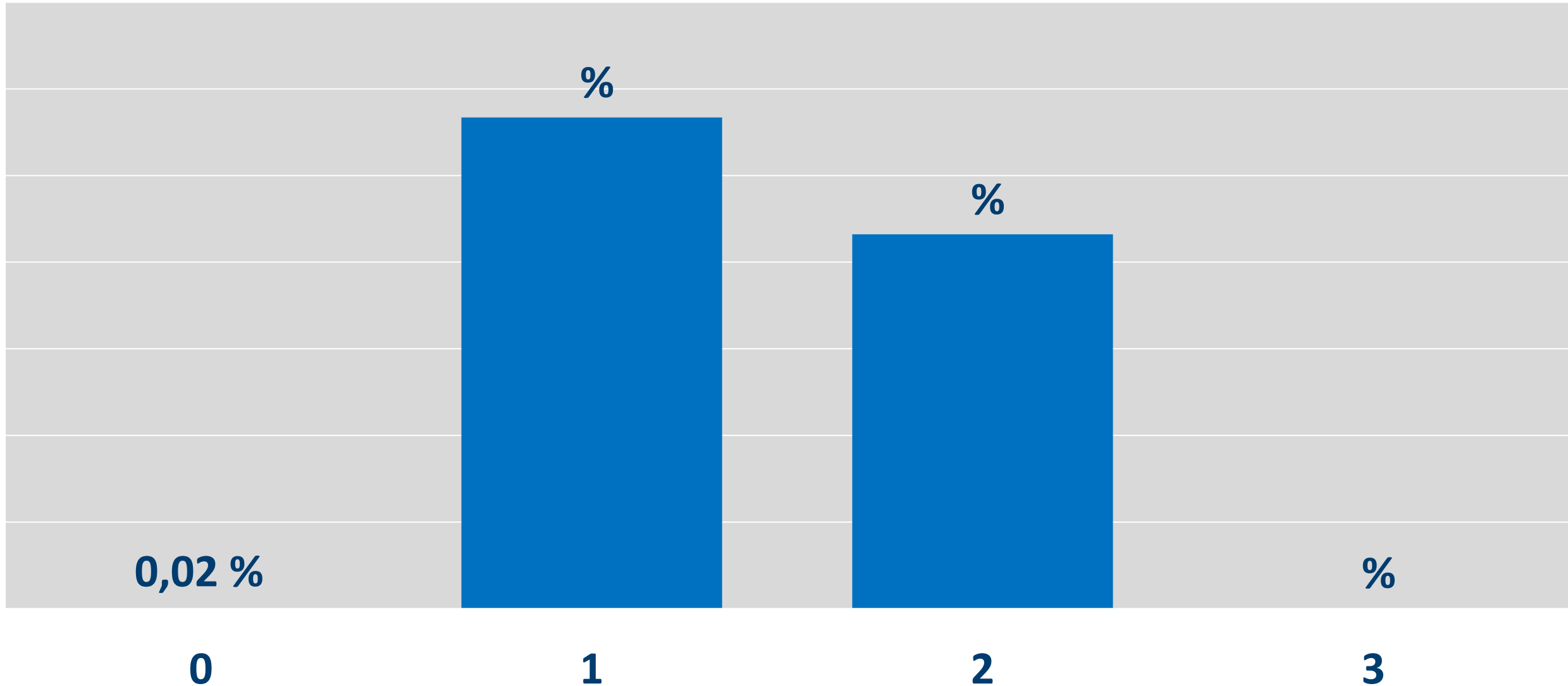
Proof Correlations

	Young Animals (N = 50,000)	Proven Sires (N = 479)
FE1 – FE2	0.47	0.34
FE – FE1	0.86	0.83
FE – FE2	0.81	0.83

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Proof Correlations: (Lactations 1 + 2) vs. Lactation 1

- Young Animals:

    FE1 (Lact 1 + 2) – FE1 (Lact 1): 0.97
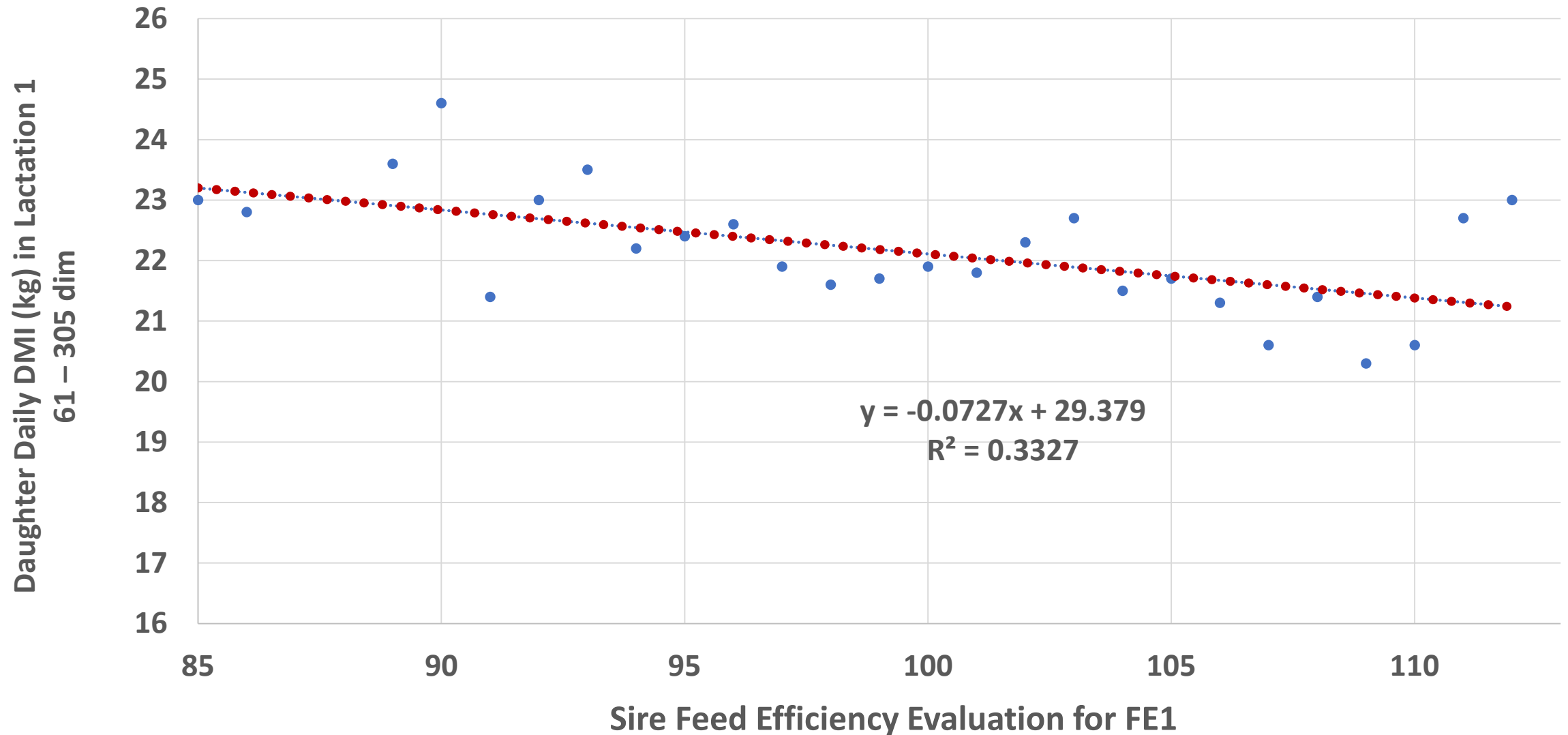
    FE   (Lact 1 + 2) – FE1 (Lact 1): 0.84

- Proven Sires:

    FE1 (Lact 1 + 2) – FE1 (Lact 1): 0.97

    FE   (Lact 1 + 2) – FE1 (Lact 1): 0.80

Feed Efficiency and Daughter DMI

Daughter Daily DMI (kg) in Lactation 1
61 – 305 dim

Sire Feed Efficiency Evaluation for FE1

$y = -0.0727x + 29.379$
$R^2 = 0.3327$

- **1-point** increase in FE RBV will results in a decrease in daughter daily feed intake:
  - ~0.07 kg/d - 1st lactation
  - ~0.10 kg/d - 2nd lactation
- **5-point** increase in FE RBV will have an expected decrease in daughter feed intake:
  - ~80 kg   - 1st lactation
  - ~120 kg - 2nd lactation
  - **Approximately a 2% reduction in feed intake per lactation**

Summary

- Feed Efficiency model for lactations 1 and 2 now developed

- Low heritabilities of FE and weak genetic correlations between FE in lactations 1 and 2

- Increase in reliability of FE1 (by 1.5 points) for young genomic animals, compared with lactation 1 only model

- FE index: high correlations with within lactation FE

- Good agreement between FE from the current (1st lactation only) and the new model (1st and 2nd lactation)

- Implementation: August 2022, with LPI and Pro$ adjustments