

GENETIC ASSOCIATIONS BETWEEN METHANE EMISSION AND OTHER ECONOMICALLY IMPORTANT TRAITS



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geno



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Genetic association to methane (CH₄)

AIM:

estimate genetic associations between daily CH₄ emission and traits currently included in the routine genetic evaluation of Norwegian Red dairy cows



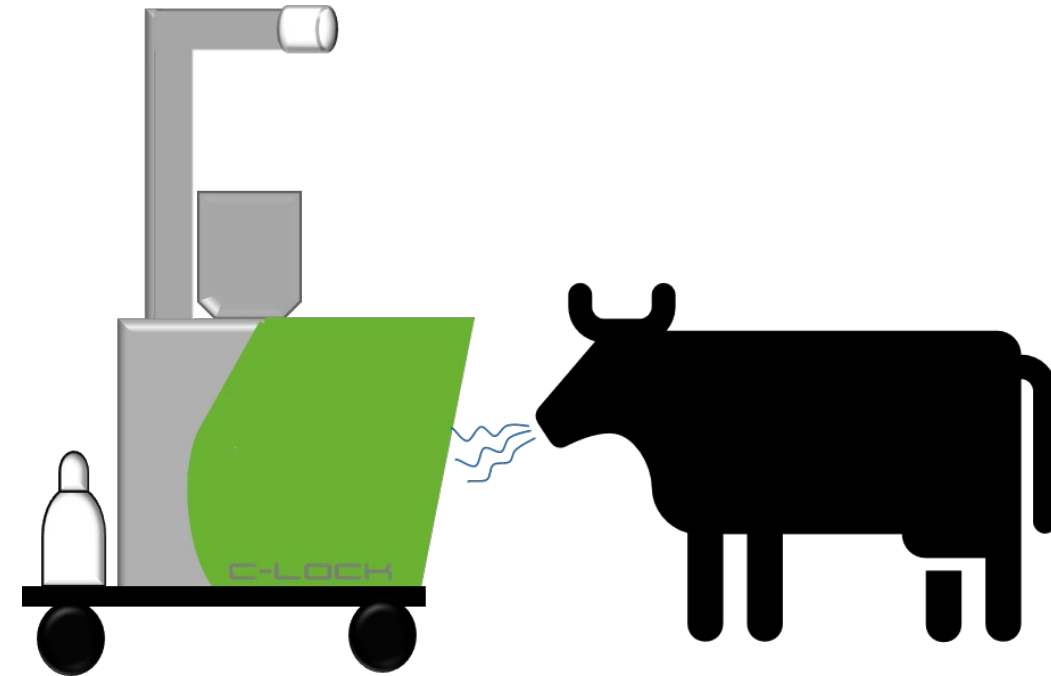
Phenotyping methane and feed intake



GreenFeed equipment

Record methane for individual cows

- 2-5 visits per day
- Offer small amounts of concentrates for motivation
- Time restrictions: Minimum time since last visit
- Require minimum 2 minutes with correct head position for good data (accepted record)
- From each visit an estimate of the cow's methane emission grams per day

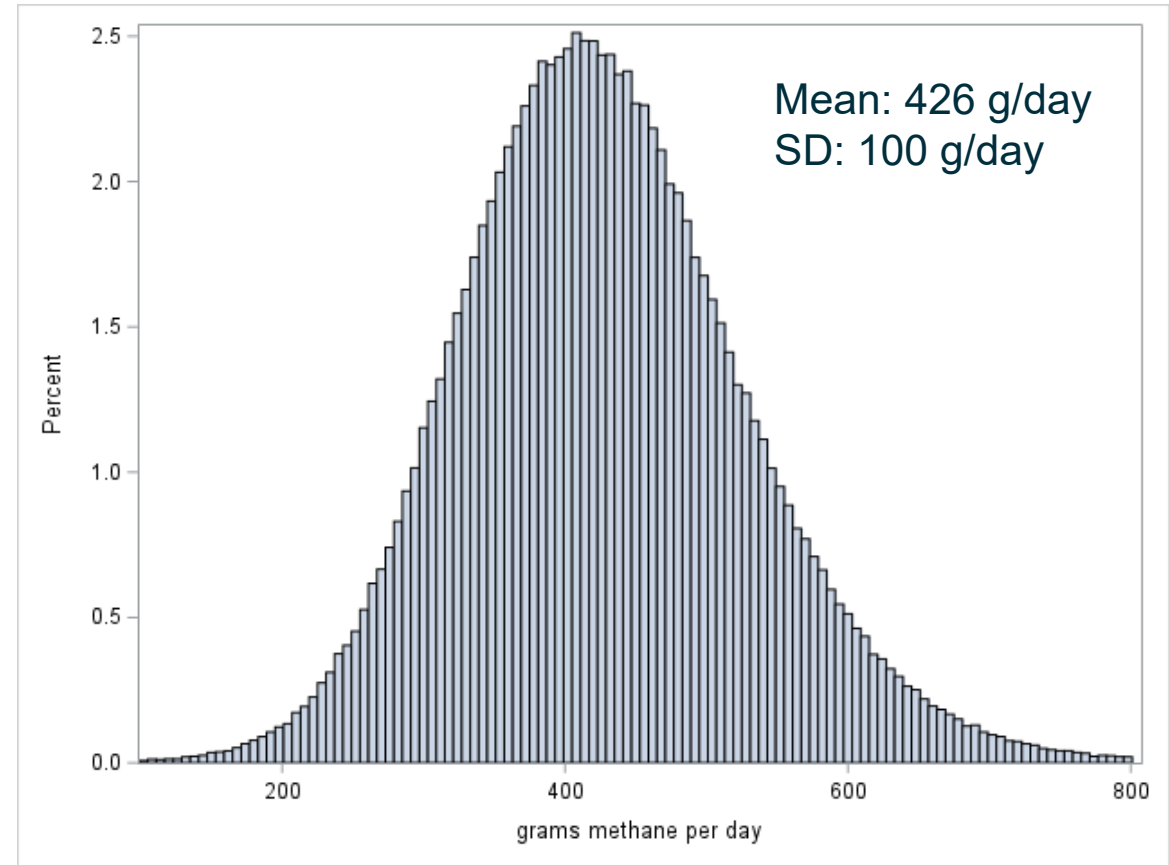


From: <https://www.c-lockinc.com/>

Methane emission per cow per day

Methane measures from GreenFeed
Average per cow per day

Data from
 14 GreenFeed units
 2,387 NRF kyr
 > 500,000 daily records of CH₄



Genetic variation for methane emissions



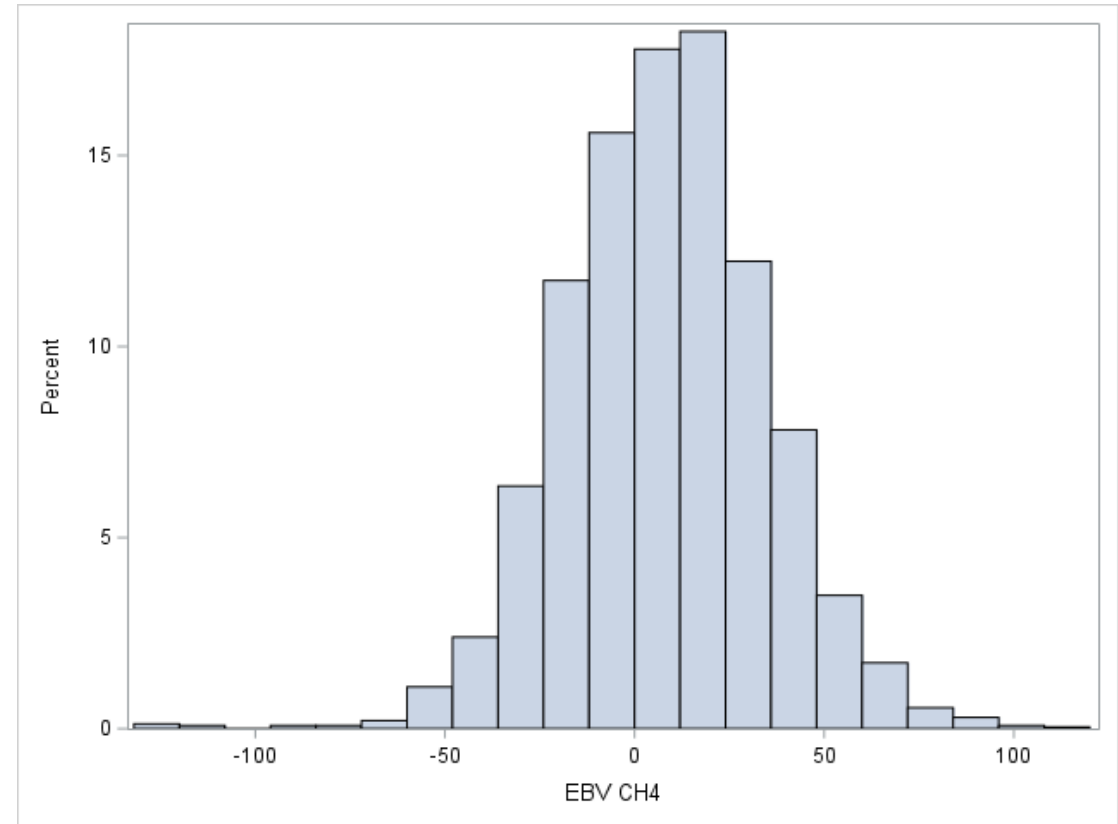
Trait: Methane gram/day

(average per cow per day)

Breeding values range from **-130** to **117**

(standard error from 22 to 32)

Breeding values (EBV) for cows with CH₄ phenotype



EBV given as gram CH₄ per day

Genetic variation for methane emissions – bulls with daughters

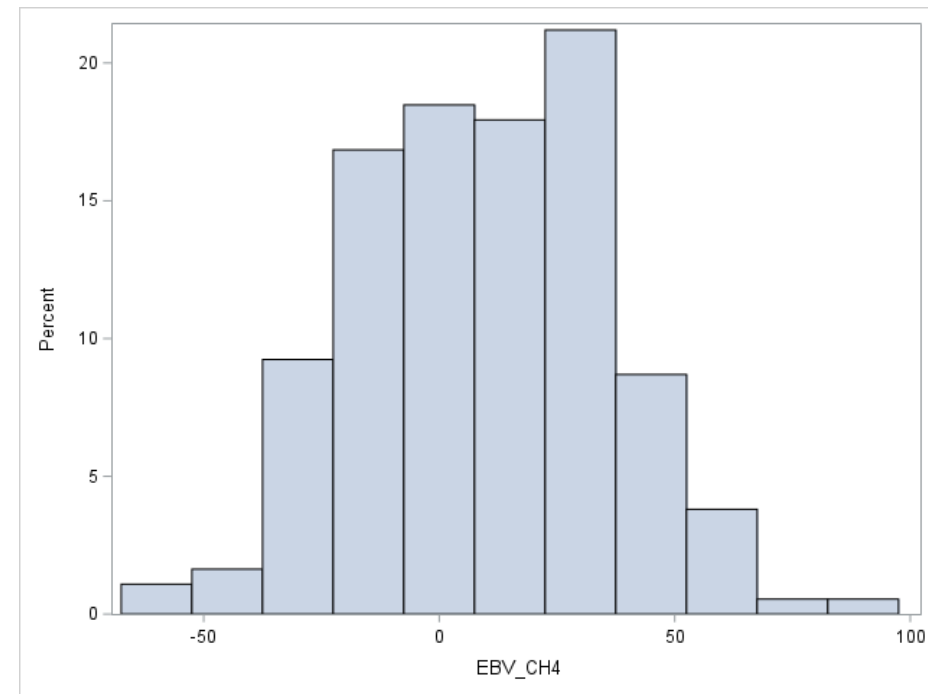


Trait: Methane gram/day
(average per cow per day)

184 Norwegian Red sires with ≥ 5
daughters with CH₄ phenotype

Breeding values range from **-60** to **91**
(standard error from 17 to 27)

Breeding values (EBV) for sires with ≥ 5 daughters
with CH₄ phenotype



EBV given as gram CH₄ per day

Genetic associations between CH₄ and other traits

Index-correlations approximate genetic correlations

EBV for CH₄ multiplied by -1 so that higher values indicate lower CH₄

GEBV for all traits included in the routine genetic evaluations of Norwegian Red available from Geno

Index correlations calculated for cows with CH₄ phenotype





Genetic associations between CH₄ and other traits

Traits with strongest unfavorable	Correlation to CH ₄
Angularity ¹	-0.35
Body Depth ¹	-0.35
Body Total Score ¹	-0.32
HeartGirth ¹	-0.30
Milk yield, kg fat 305d	-0.29
Stature ¹	-0.29
Milk yield, kg protein 305d	-0.26
ChestWidth ¹	-0.23
Milk yield, kg Milk 305d	-0.22

¹ Trait not included in the Norwegian total merit index

- Correlations between EBV for CH₄ and indexes from routine genetic evaluations for all other traits
- 2,387 cows with CH₄ phenotype
- Unfavorable genetic associations to body conformation traits related to cow size and to milk production traits



Genetic associations between CH₄ and other traits

Traits with strongest favorable	Correlation to CH ₄
Calf Size, Direct ^{1,2}	0.28
Bone Quality ³	0.26
No Inseminations (Cows 1-4)	0.26
Calving Ease, Direct	0.23
Hock Quality	0.22
Stillbirth, Direct	0.20
TopLine ¹	0.18
Clinical Mastitis (7 traits)	0.09 to 0.18
Somatic Cell Count, 305d	0.14

¹ Trait not included in the Norwegian total merit index

² Calf size: High score is small calf

³ Bone quality: High score is very fine and thin bones; low score for coarse bones (broad and thick)

- Correlations between EBV for CH₄ and indexes from routine genetic evaluations for all other traits
- 2,387 cows with CH₄ phenotype
- Favorable genetic associations to direct calving traits, cow fertility, and several health traits



Traits with no genetic associations to CH₄

- Laminitis-Related Claw Diseases
- Protein % milk, 305d
- Rear Teat Position
- Gestation Length, Direct
- CorkScrew Claw
- Front Teat Position
- Supernumerary Teat
- Retained Placenta (5 traits)
- Rear Udder Width
- Stillbirth, Maternal
- Milking Speed
- Hoof Quality ¹
- Fore Udder Attachement

Traits with index correlation to CH₄ ≈ 0

- Claw health
- Udder conformation
- Milking speed

Conclusion

- Index correlations provide insight into the strength and direction of the underlying genetic correlations between traits
- Understanding genetic relationships between key traits is essential when developing strategies aimed at breeding a feed-efficient, climate-friendly cow for the future





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