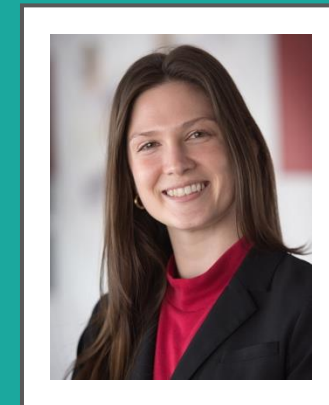


Heat Stress Is Here: Can Genetics Help?

Le stress thermique est là: la génétique peut-elle aider?



Gabriella R. Dodd¹, Christine F. Baes¹, Flavio S. Schenkel¹, Coralie Machefert¹,
Fatimatzahra Muhammad¹, Baran Amini¹, Victoria Storing¹, Allison Fleming²,
Kristin Lee², Francesca Malchiodi^{1,3}, Caeli Richardson⁴, and Filippo Miglior^{1,2}

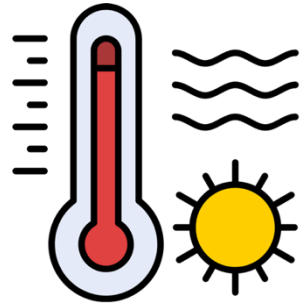
¹Centre for Genetic Improvement of Livestock, University of Guelph

²Lactanet, Guelph, Canada

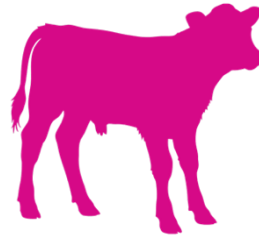
³Semex, Guelph, Canada

⁴AbacusBio International Ltd, Roslin Innovation Centre, Edinburgh, United Kingdom





Milk, fat, & protein
Lait, gras et protéines



Reproductive performance
Performance reproductive

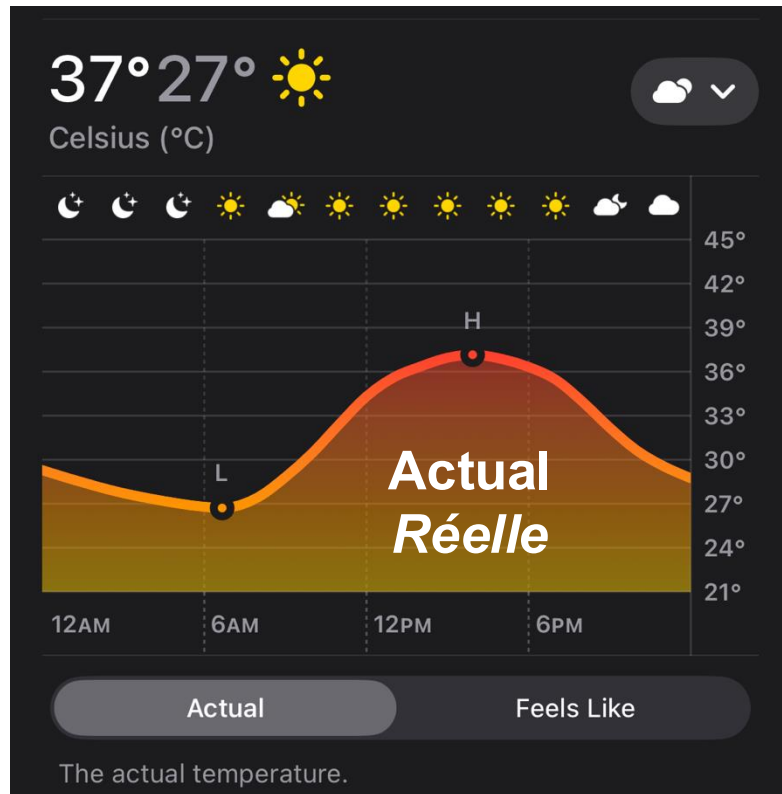


Metabolic & immune challenges
Défis métaboliques et immunitaires



Feed intake
Consommation alimentaire

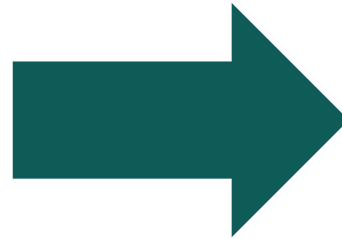
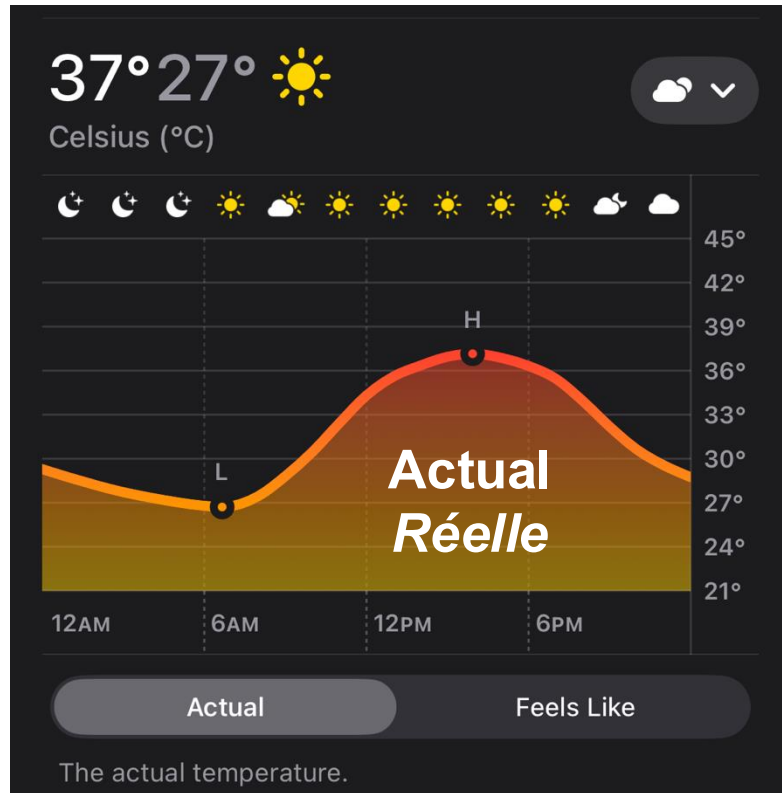
Temperature *Température*



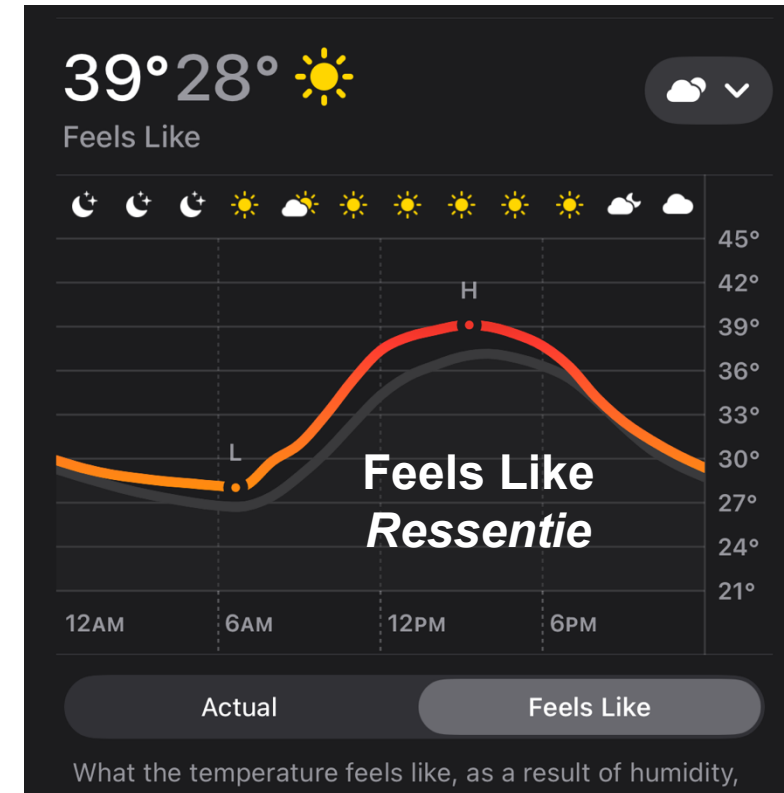
Charge Thermique

Heat Load

Temperature
Température

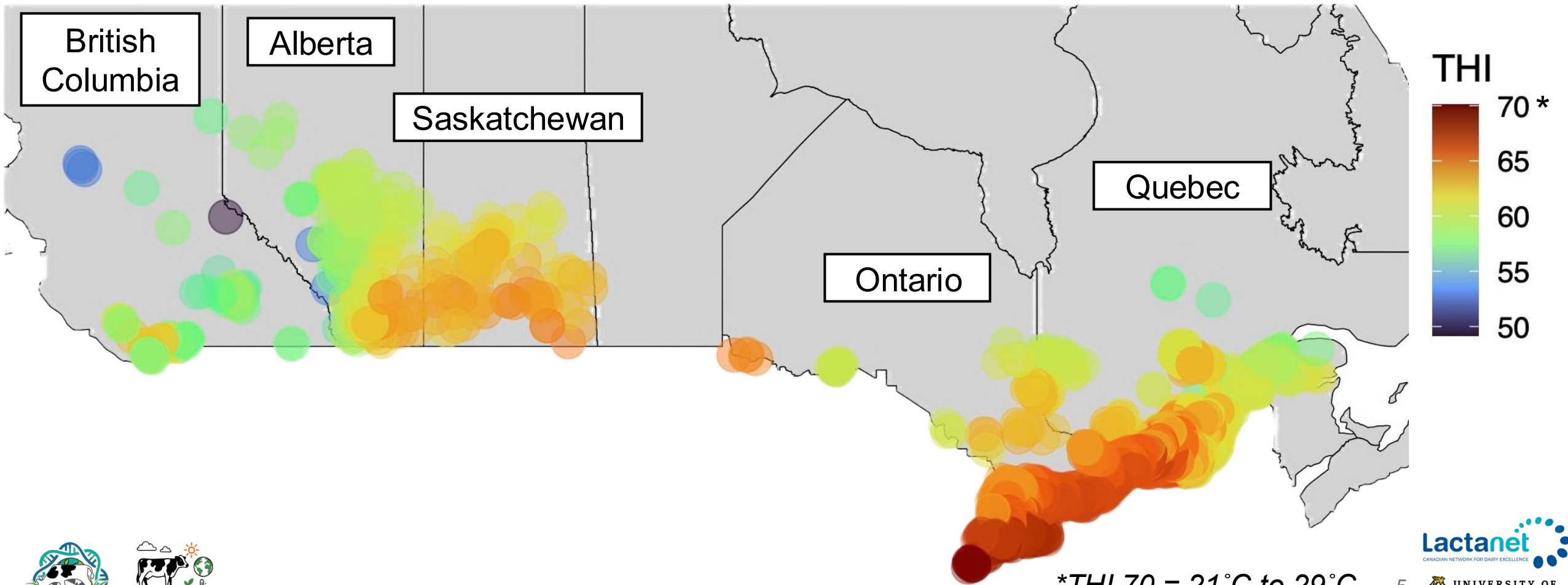


Temperature + Humidity = Heat Load
Température + Humidité = Charge Thermique



Temperature-Humidity Index (THI)

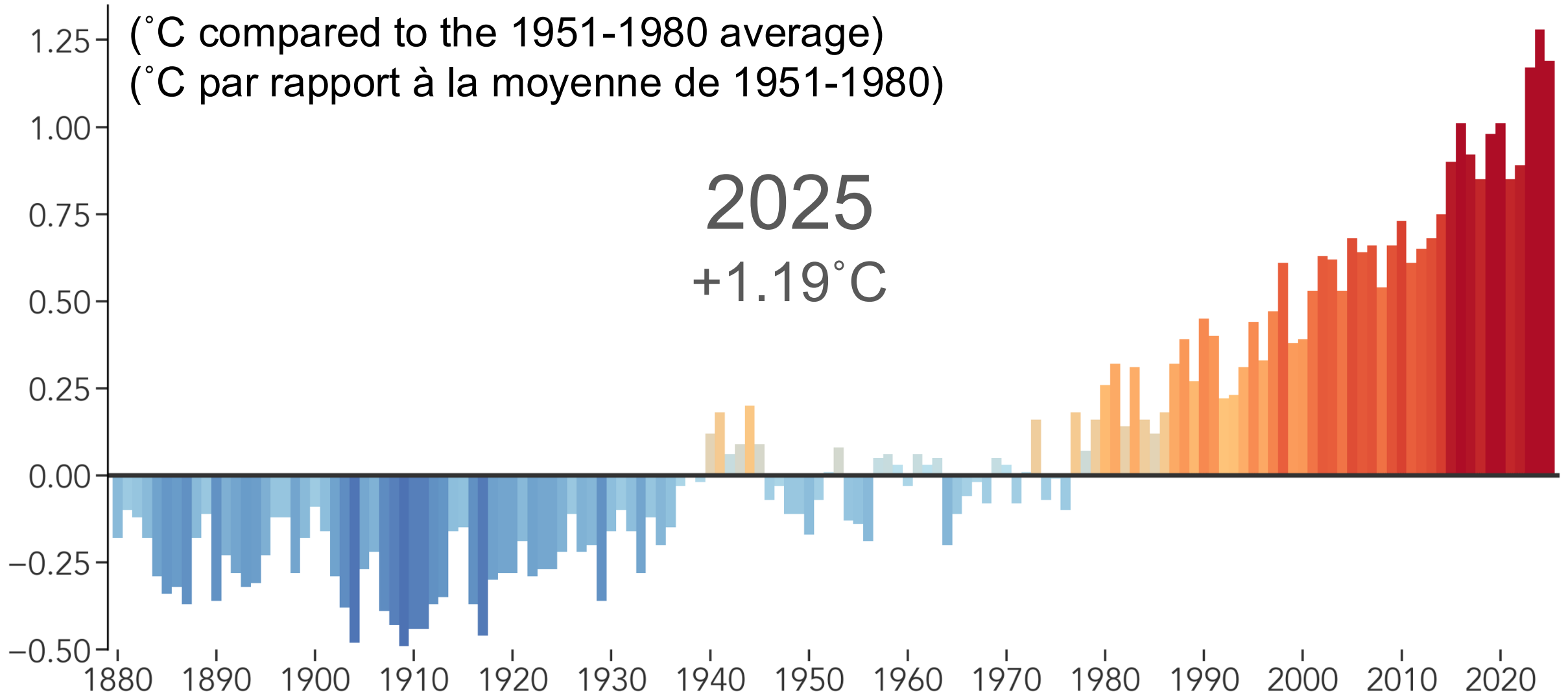
Summer Average: 2009 to 2018
Moyenne Été: 2009 à 2018



*THI 70 = 21°C to 29°C

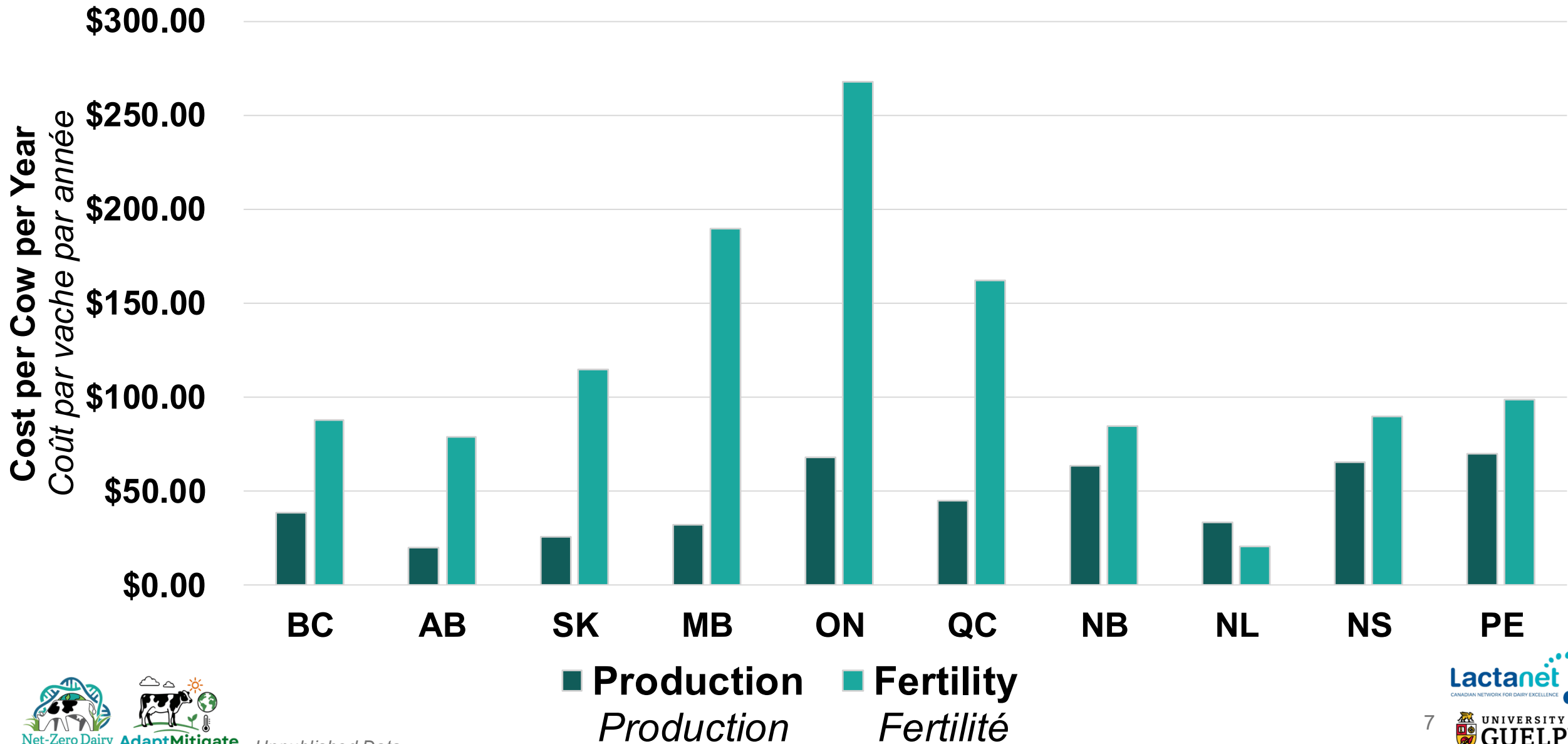
Anomalie de température

Global Temperature Anomaly



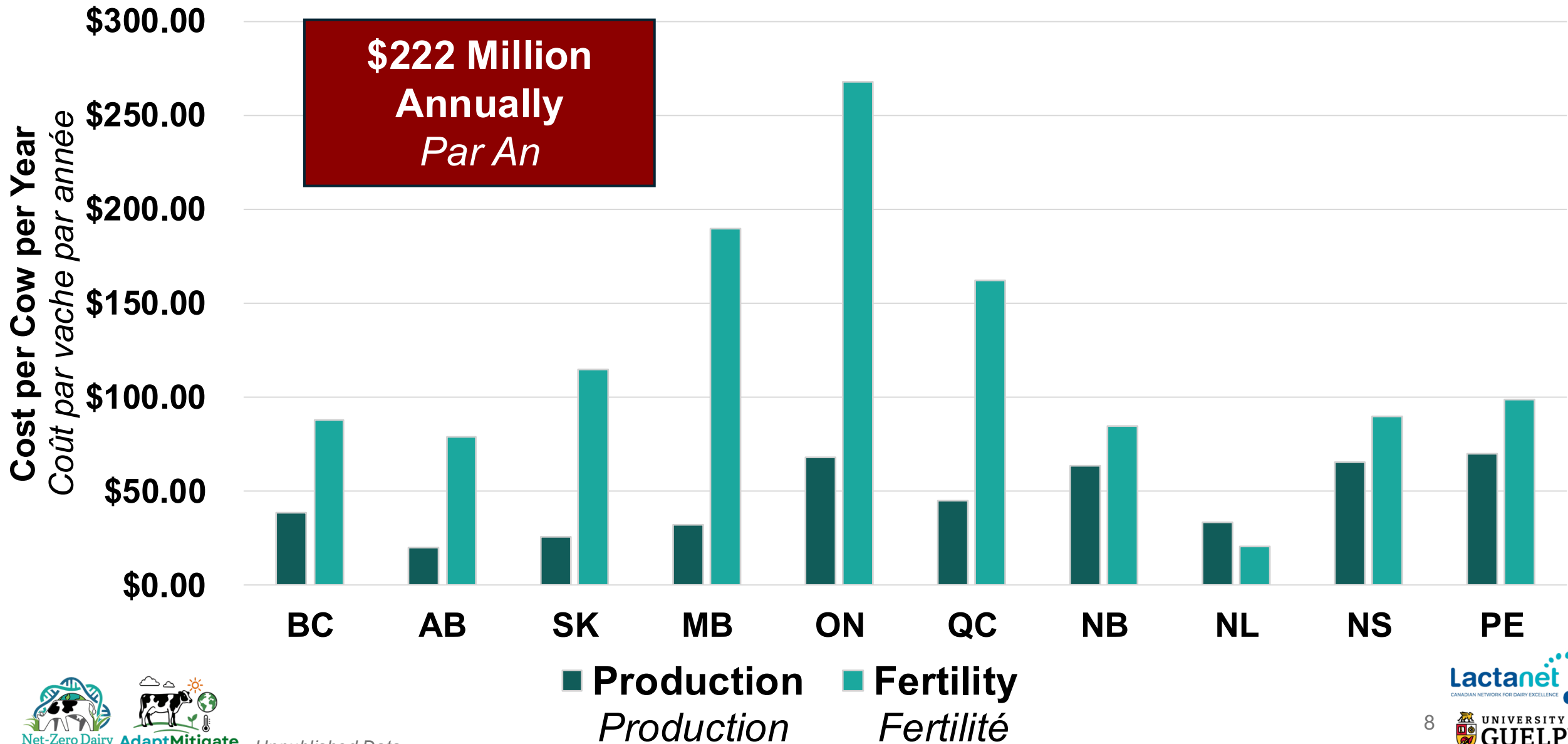
Coût du stress thermique

Cost of Heat Stress



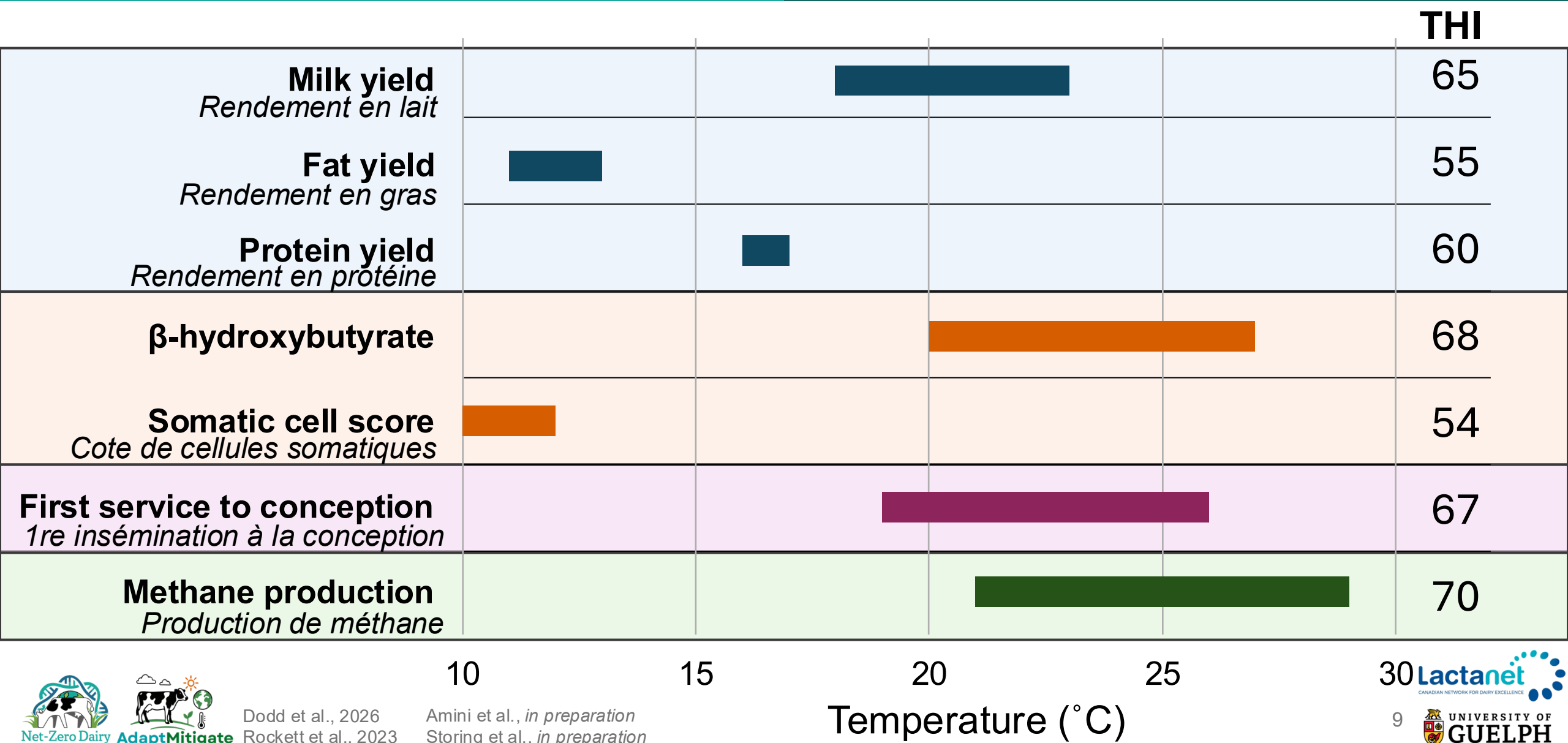
Coût du stress thermique

Cost of Heat Stress



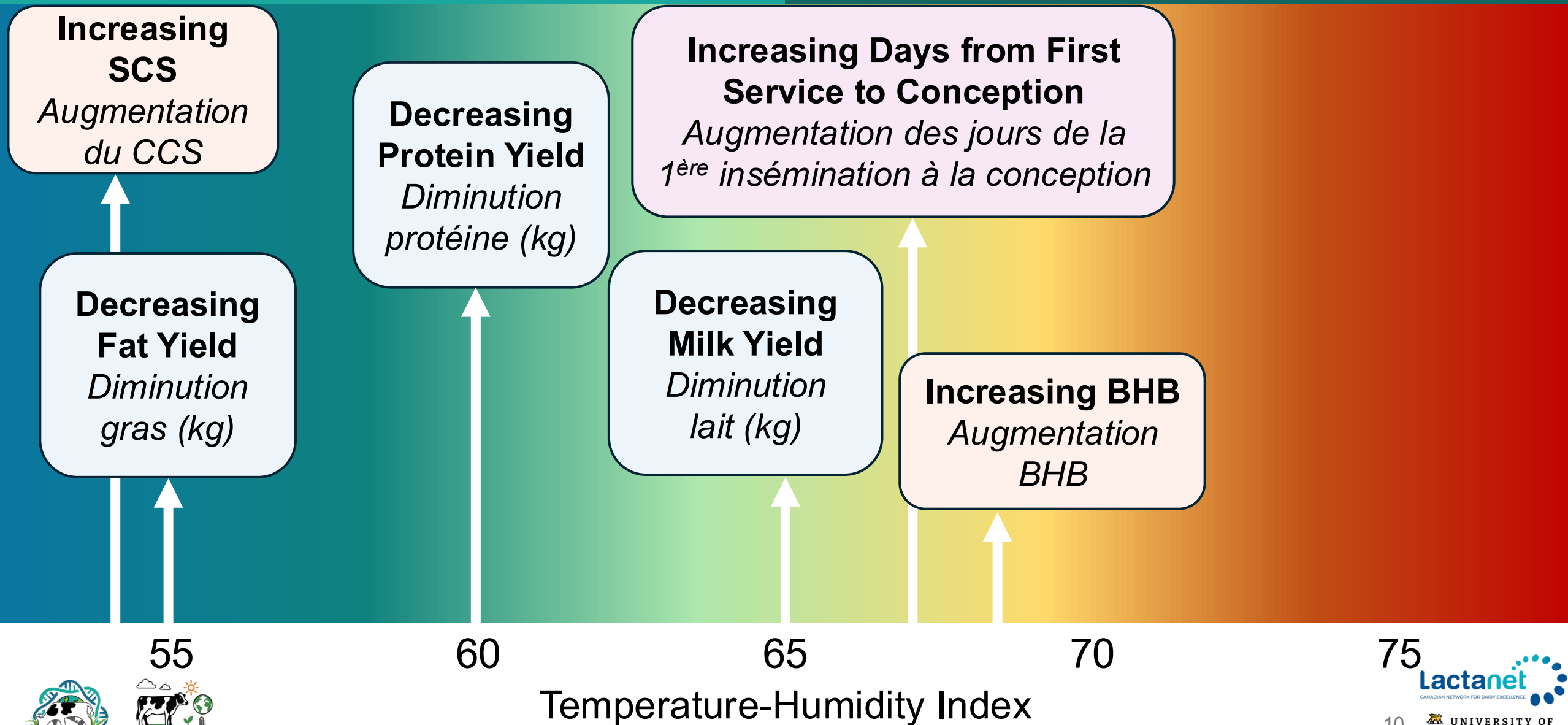
L'apparition varie selon le trait

Onset Varies By Trait



Conséquences du stress thermique

Consequences of Heat Stress



THI 70

– 150 g/d Milk Yield (*Lait*)
– 33 g/d Fat Yield (*Gras*)
– 14 g/d Protein Yield (*Protéine*)

+ 16% Risk of Ketosis
(*Acétonémie*)

+ 9% Risk of Mastitis (*Mammite*)

+ 3 Days Open (*Jours ouverts*)

THI 75

– 300 g/d Milk Yield (*Lait*)
– 44 g/d Fat Yield (*Gras*)
– 20 g/d Protein Yield (*Protéine*)

+ 30% Risk of Ketosis
(*Acétonémie*)

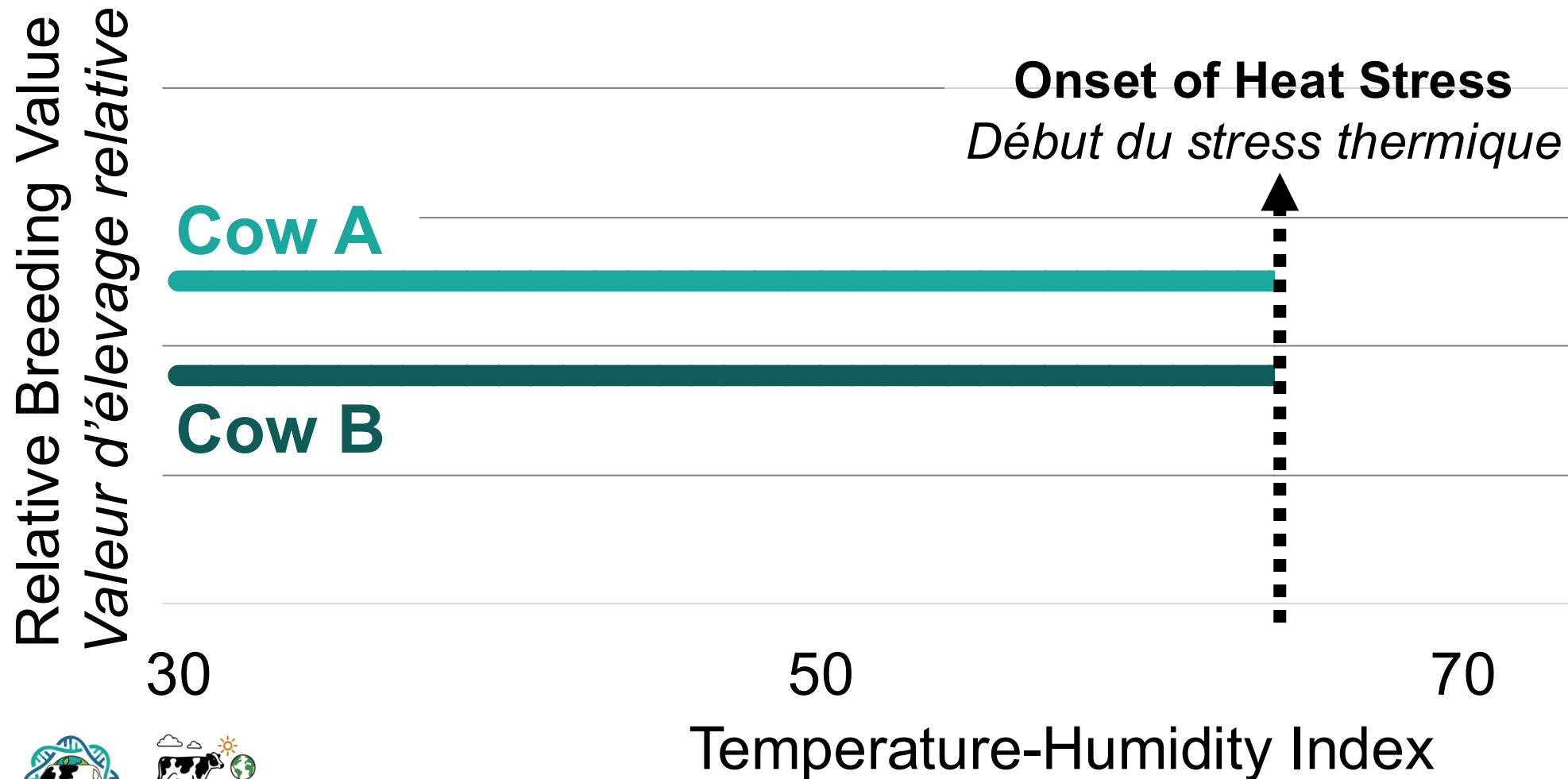
+ 9% Risk of Mastitis (*Mammite*)

+ 8 Days Open (*Jours ouverts*)

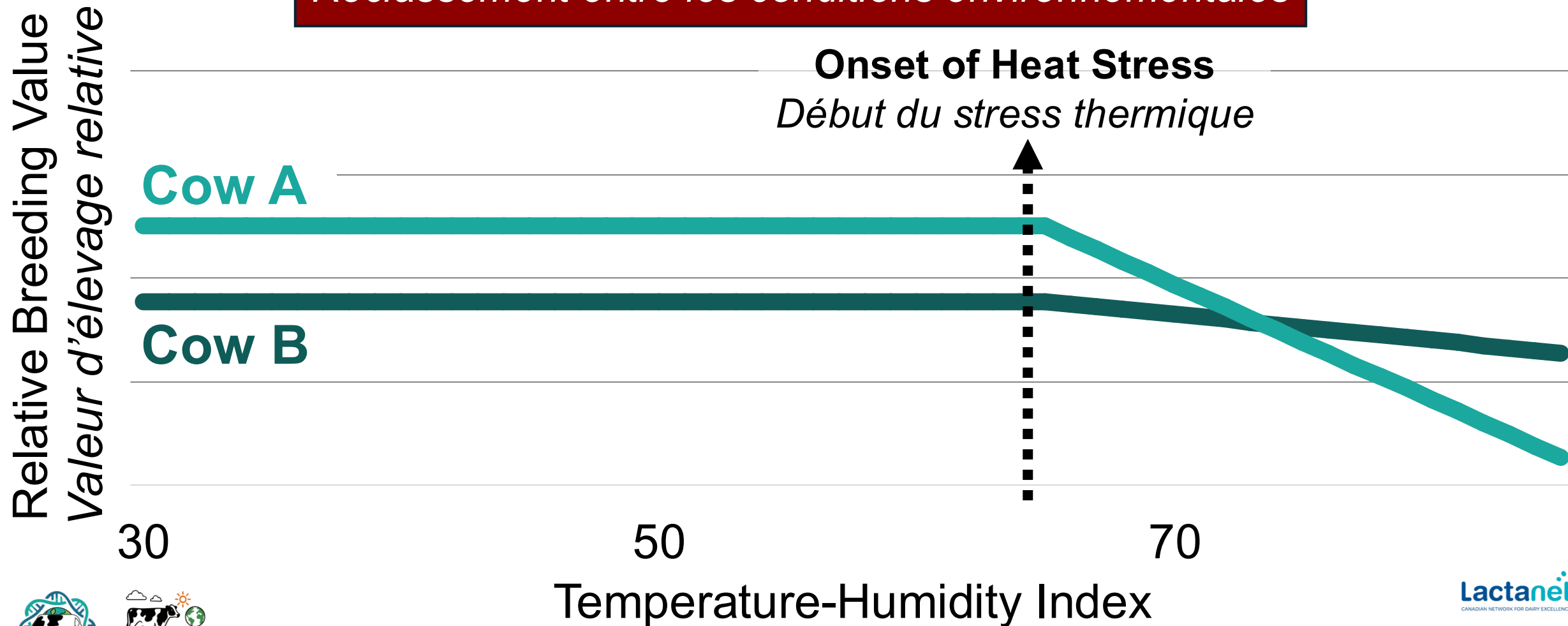
Production

Health
Santé

Fertility
Fertilité

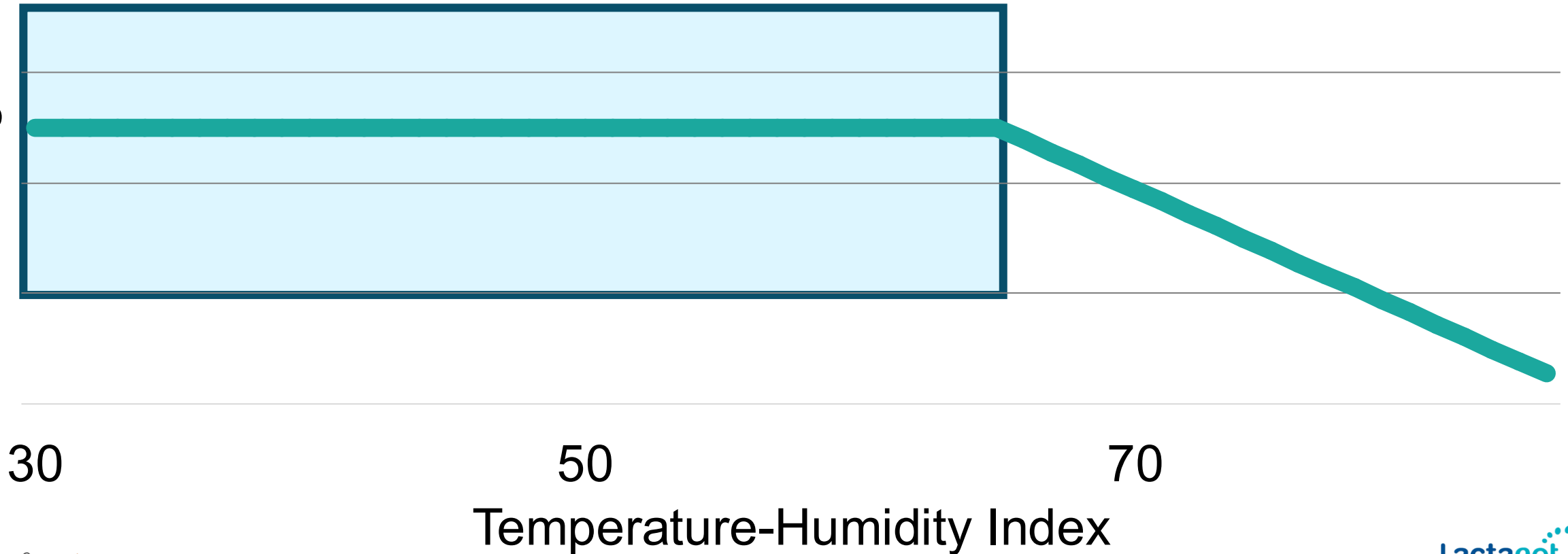


Reranking between environmental conditions
Reclassement entre les conditions environnementales



“Thermoneutral” Performance = Baseline genetic potential
Performance “Thermoneutre” = Potentiel génétique de base

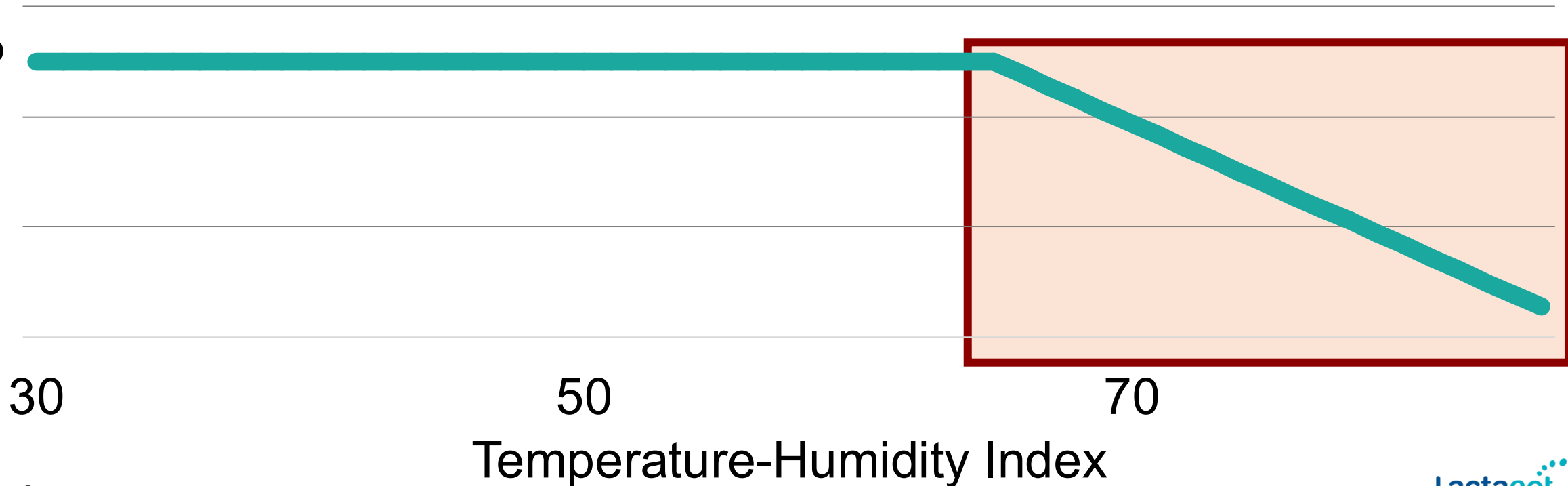
Relative Breeding Value
Valeur d'élevage relative



Heat Tolerance = Ability to maintain performance under heat stress

Tolérance à la chaleur = Capacité à maintenir la performance sous contrainte thermique

Relative Breeding Value
Valeur d'élevage relative



*Caractères de
rendement en lait*

Expected milk production compared with the herd
average under comfortable conditions
*Production laitière prévue par rapport à la moyenne
du troupeau dans des conditions confortables*

Milk Yield Traits	Sire A	Sire B
Thermoneutral	0.50	2.50
Heat Tolerance	-0.02	-0.09



Expected rate of change in milk production as
heat stress increases

*Taux de variation prévu de la production laitière
à mesure que le stress thermique s'intensifie*

VÉE Tolérance à la chaleur

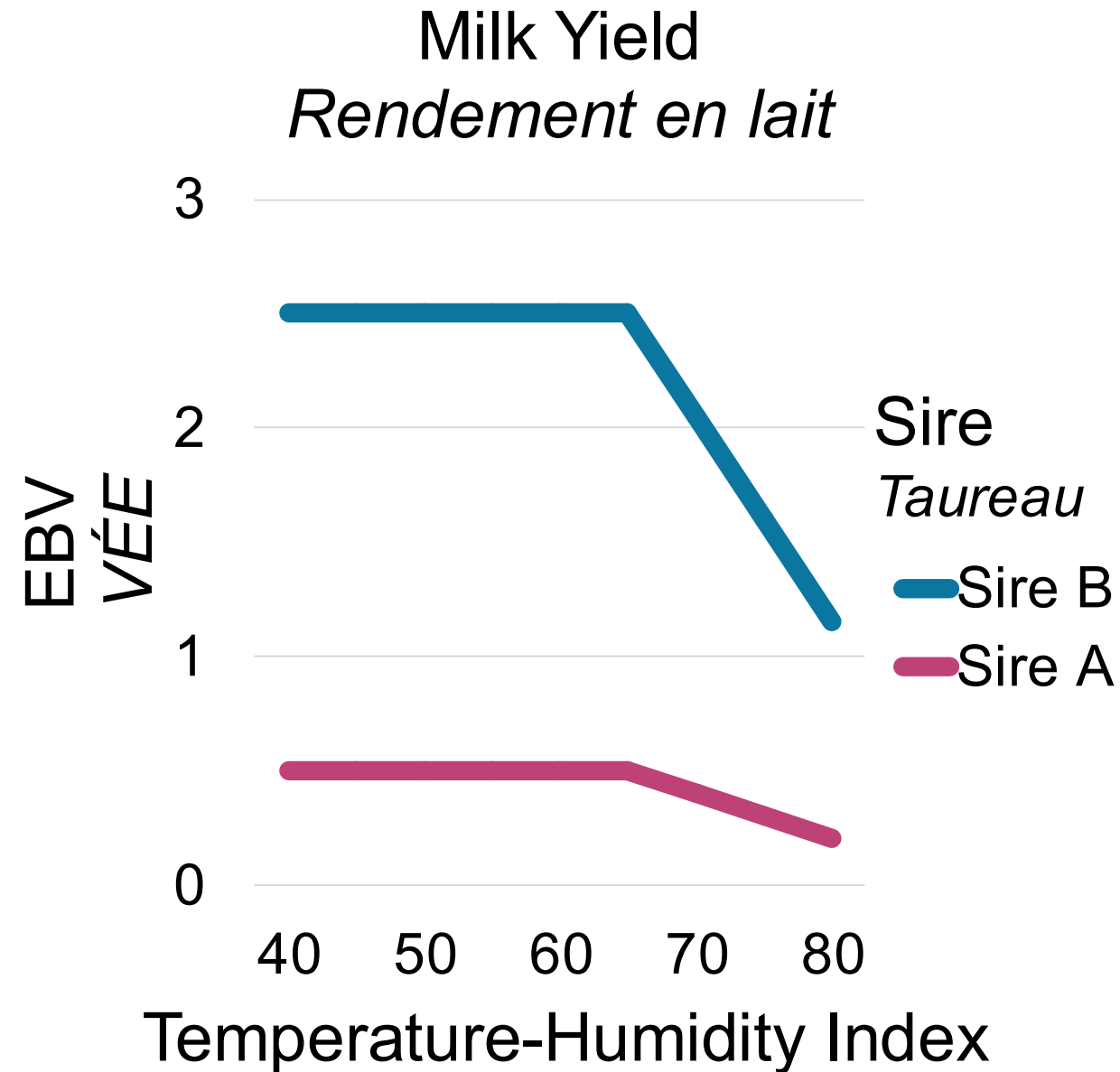
Heat Tolerance EBV

Caractères de
rendement en lait

Milk Yield Traits	Sire A	Sire B	Rank
Thermoneutral	0.50	2.50	Sire B
Heat Tolerance	-0.02	-0.09	Sire A

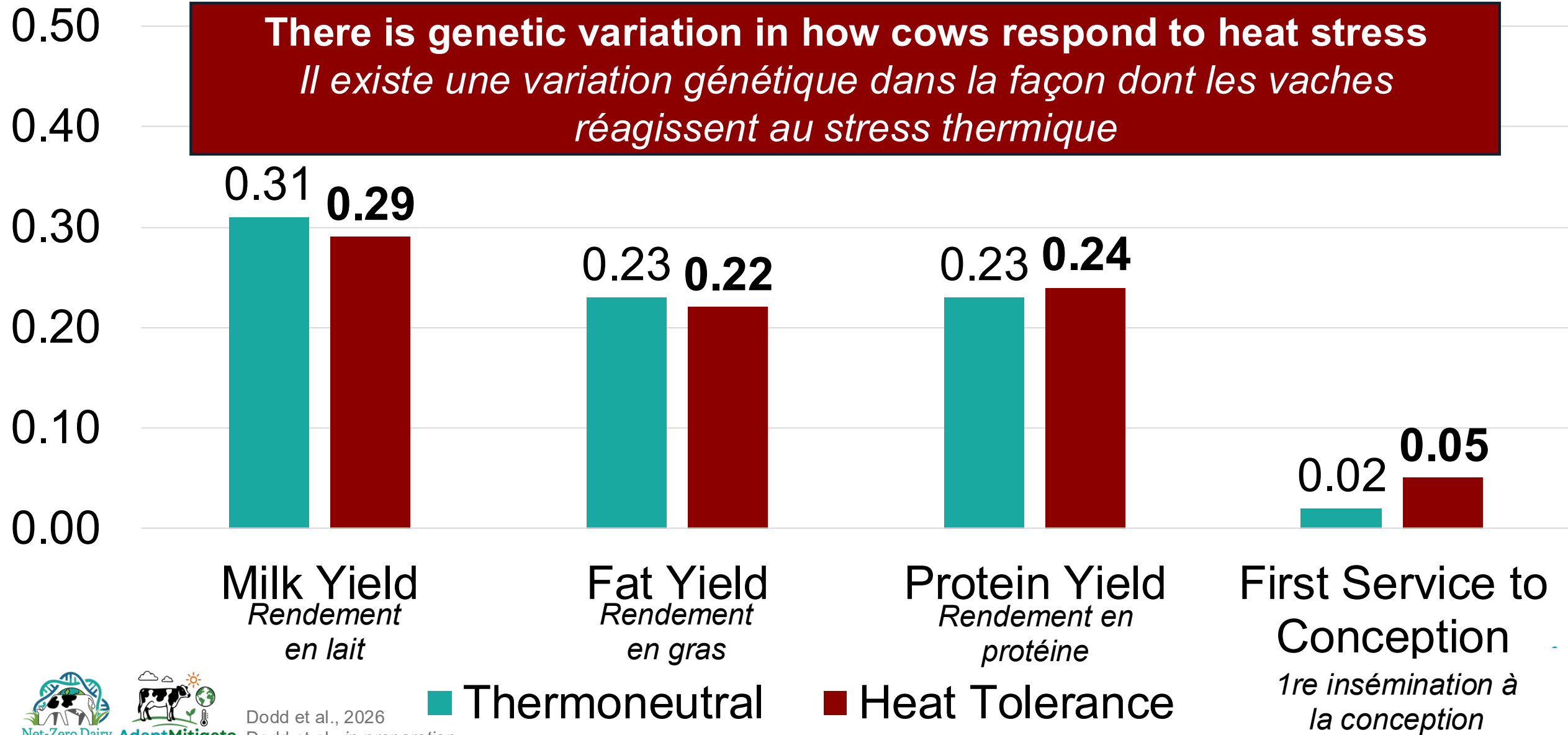
Sire B is always better, even though Sire A ranks higher for heat tolerance

Le taureau B est toujours meilleur, même si le taureau A est mieux classé en matière de tolérance à la chaleur



Héritabilité de la Tolérance à la chaleur

Heritability of Heat Tolerance



Évaluations actuelles au niveau mondial

Current Evaluations Worldwide

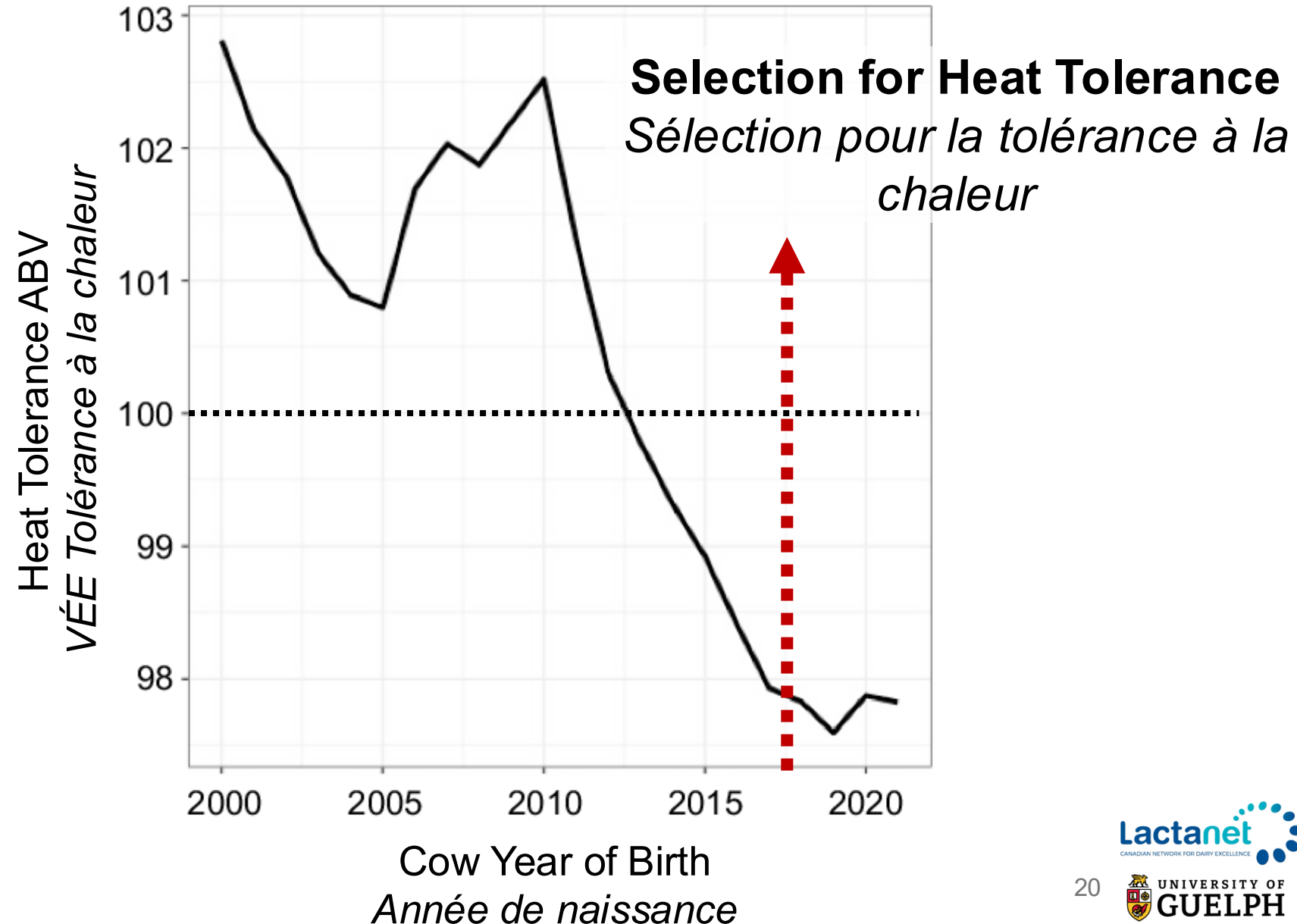
Organization	Country	Heat Tolerance	Year
<i>Organisation</i>	<i>Pays</i>	<i>Tolérance à la chaleur</i>	<i>Année</i>
DataGene	Australia	Heat Tolerance ABV	2017
ANAFIBJ	Italy	Italian Heat Tolerance (IHT)	2022
Zoetis	NA	Fertility Heat Resilience Milk Heat Resilience	2026
Breedi & Eurofins	NA	Heat Stress Tolerance	2026

Évaluations actuelles au niveau mondial

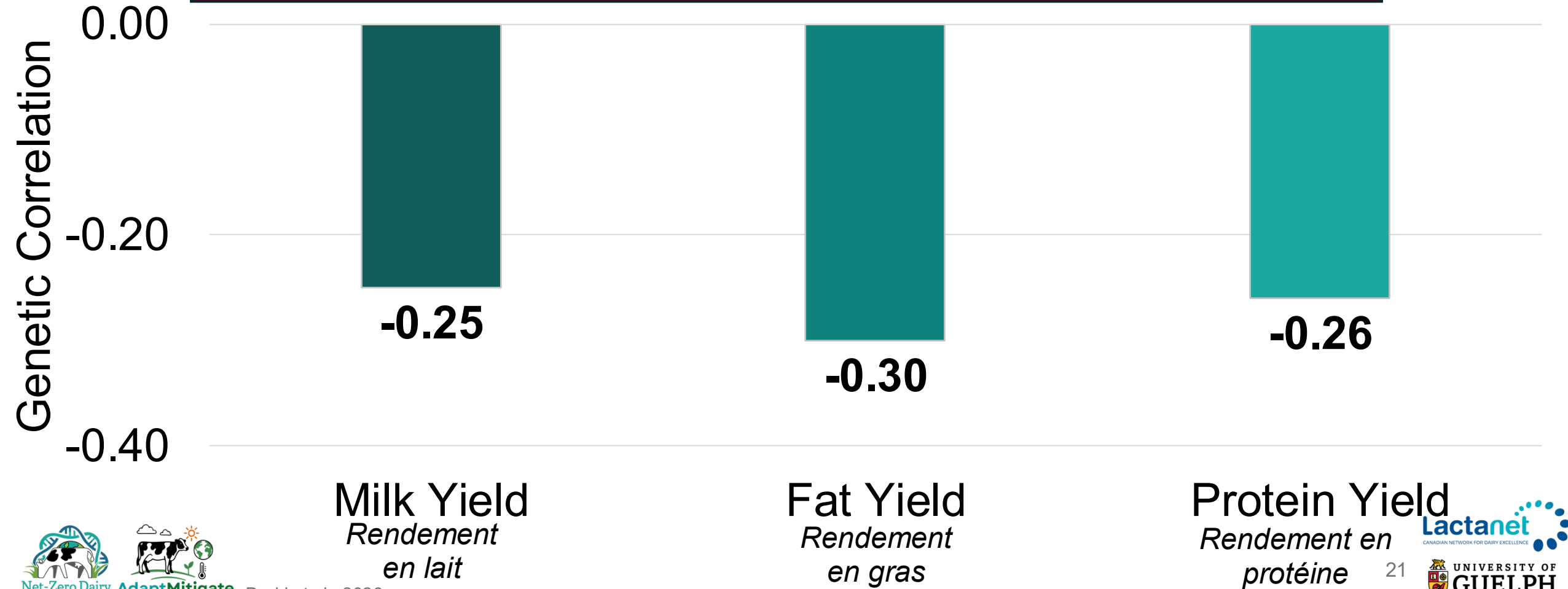
Current Evaluations Worldwide



**Demonstrated improvement
after selection**
*Amélioration démontrée
après la sélection*



High milk production associated with lower heat tolerance
Une production laitière élevée est associée à une réduction de la tolérance à la chaleur

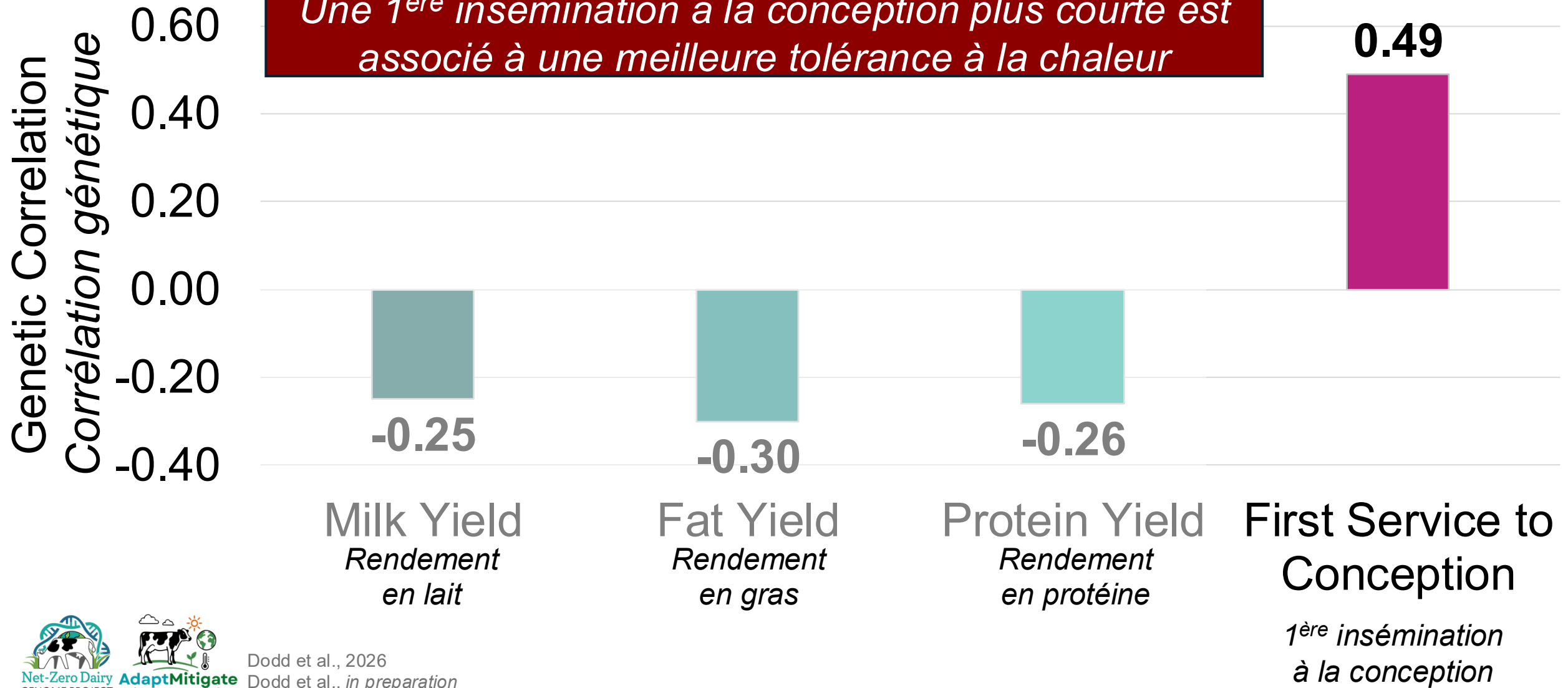


Fertilité vs. Tolérance

Fertility vs. Tolerance

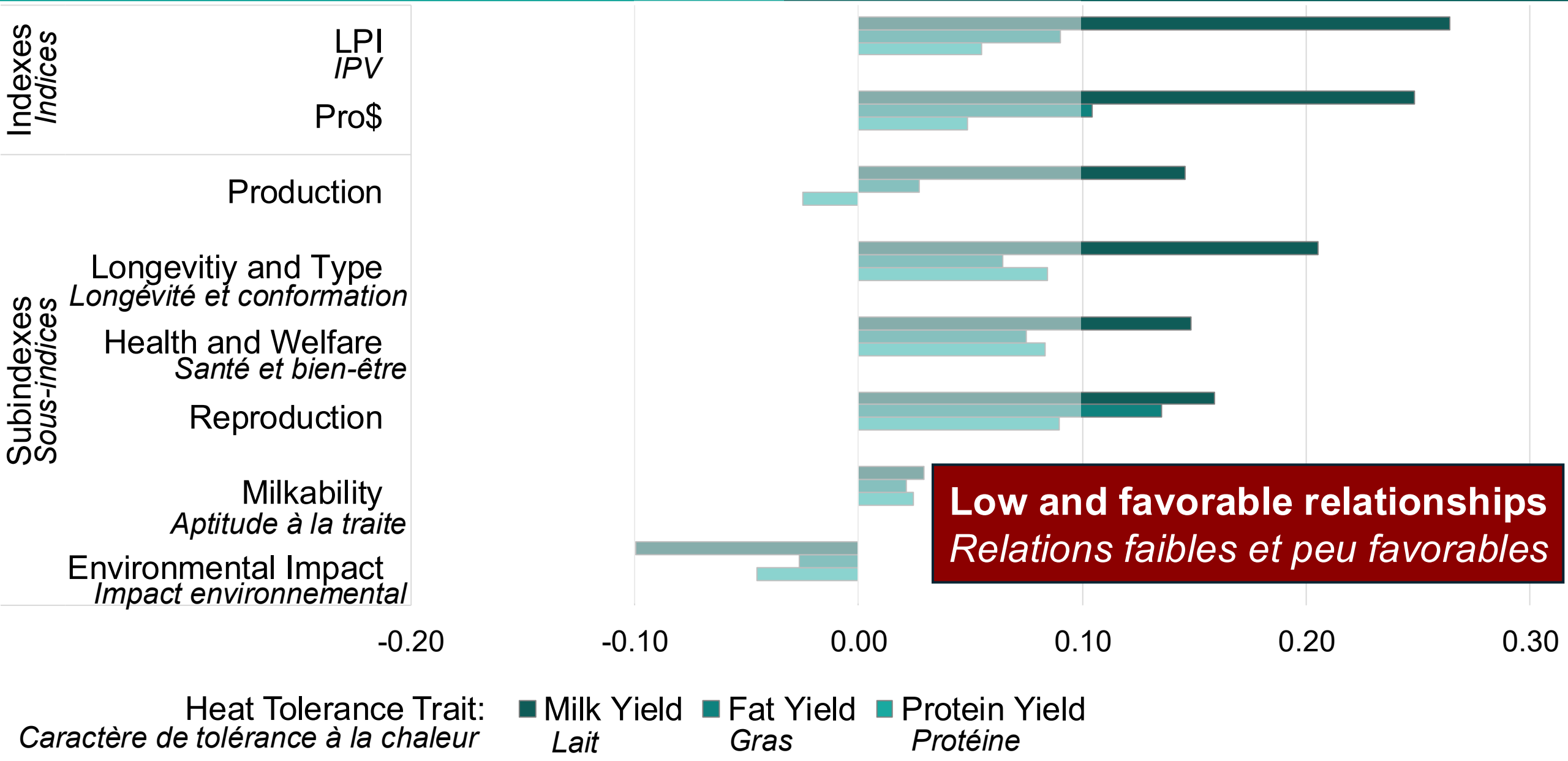
Shorter FSTC associated with better heat tolerance

Une 1^{ère} insémination à la conception plus courte est associée à une meilleure tolérance à la chaleur



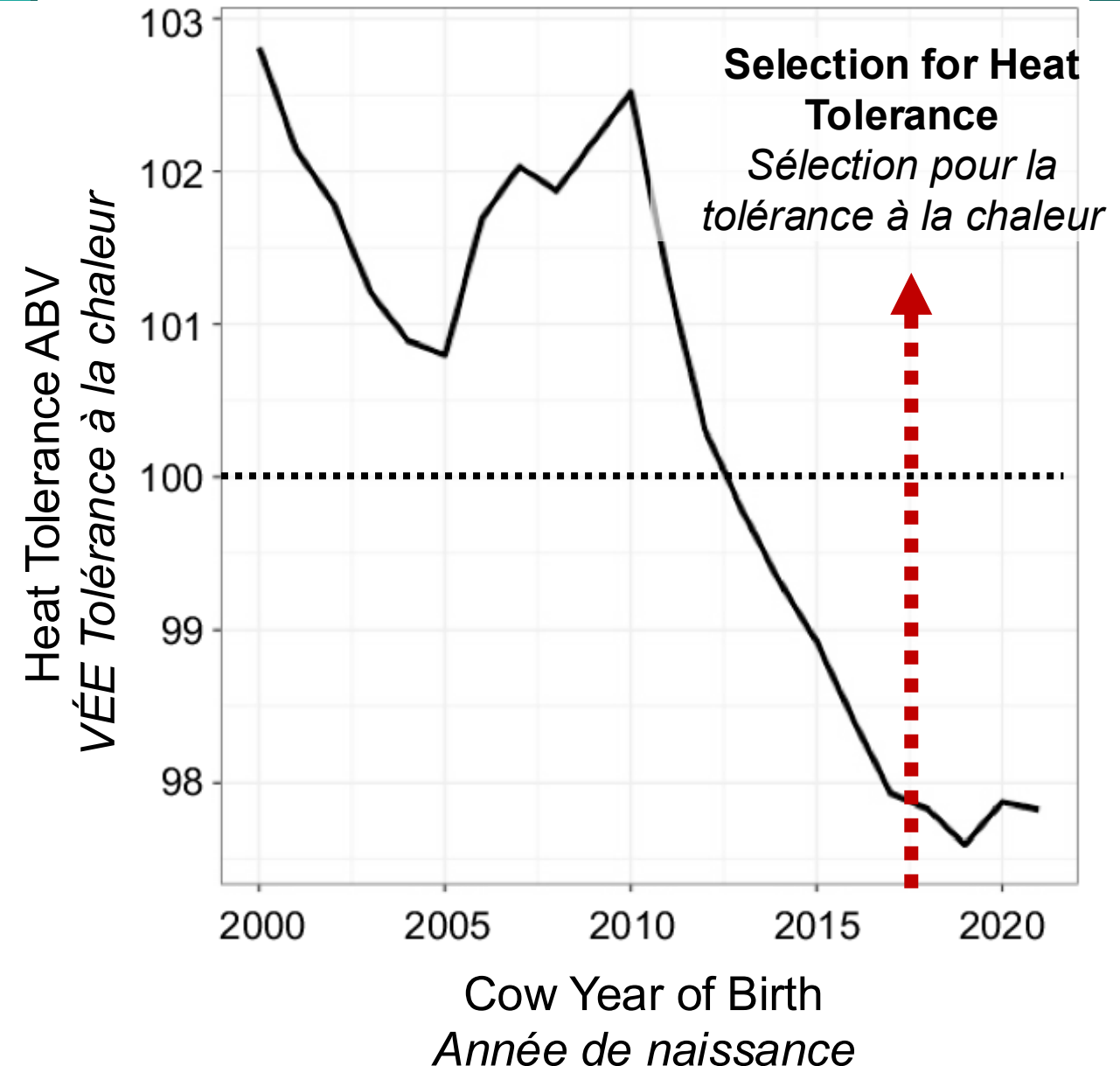
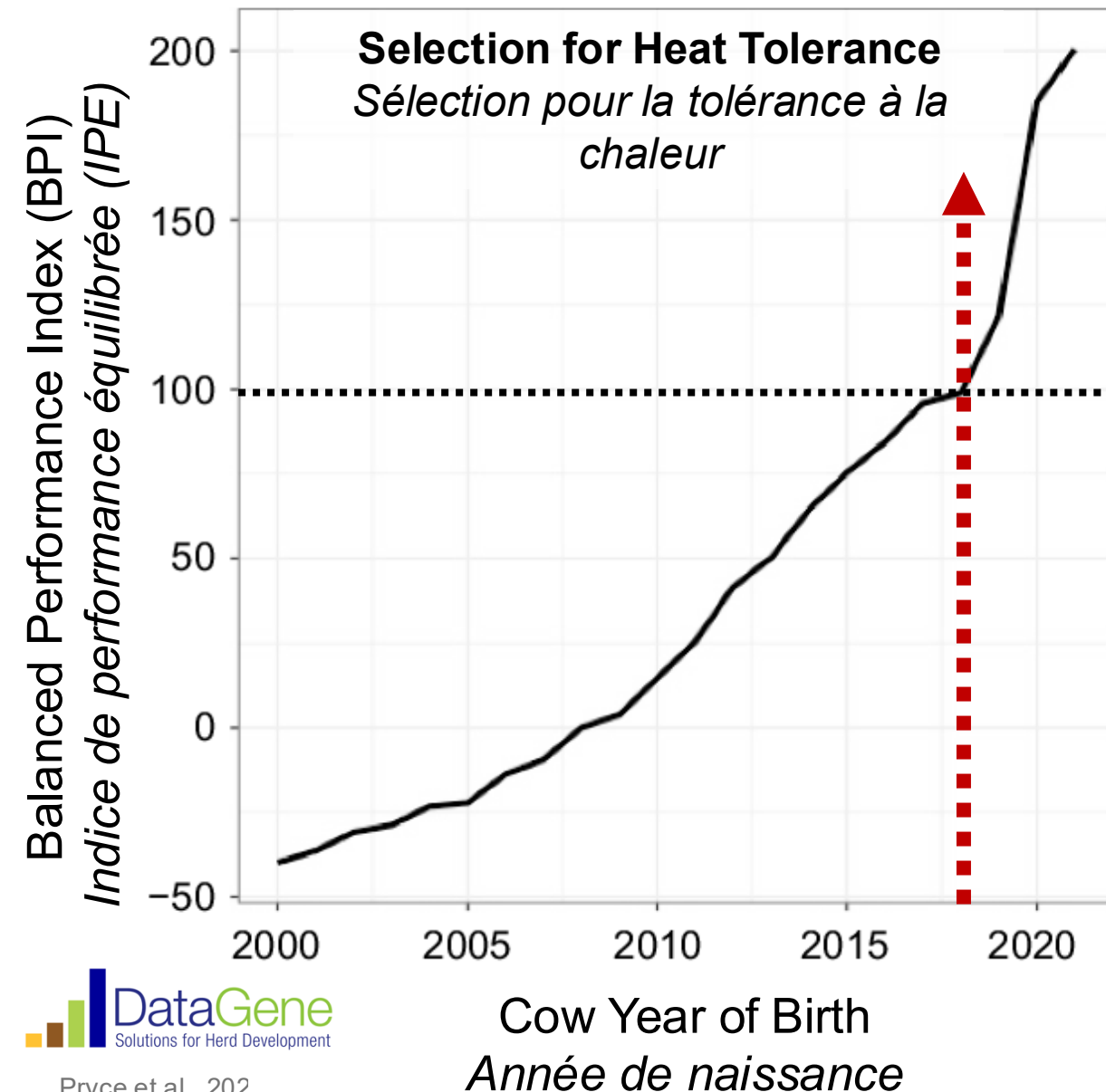
Corrélations avec les caractères existants

Correlations to Existing Traits



Progrès sans compromis

Progress without Compromise





Dr. Filippo Miglior



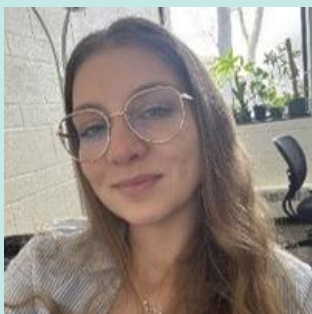
Dr. Christine Baes



Dr. Flavio Schenkel



Dr. Ella Dodd



Dr. Coralie Machefert



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Dr. Francesca Malchiodi



Dr. Ivan Campos



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Dr. Kristin Lee

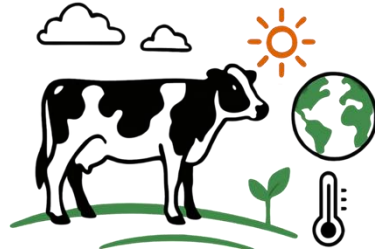


Dr. Caeli Richardson

Acknowledgements



Net-Zero Dairy
GENOME PROJECT



AdaptMitigate
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Agriculture and
Agri-Food Canada



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Climate Change Canada



THE UNIVERSITY
OF BRITISH COLUMBIA



Questions? Comments?

Des questions? Des commentaires?

