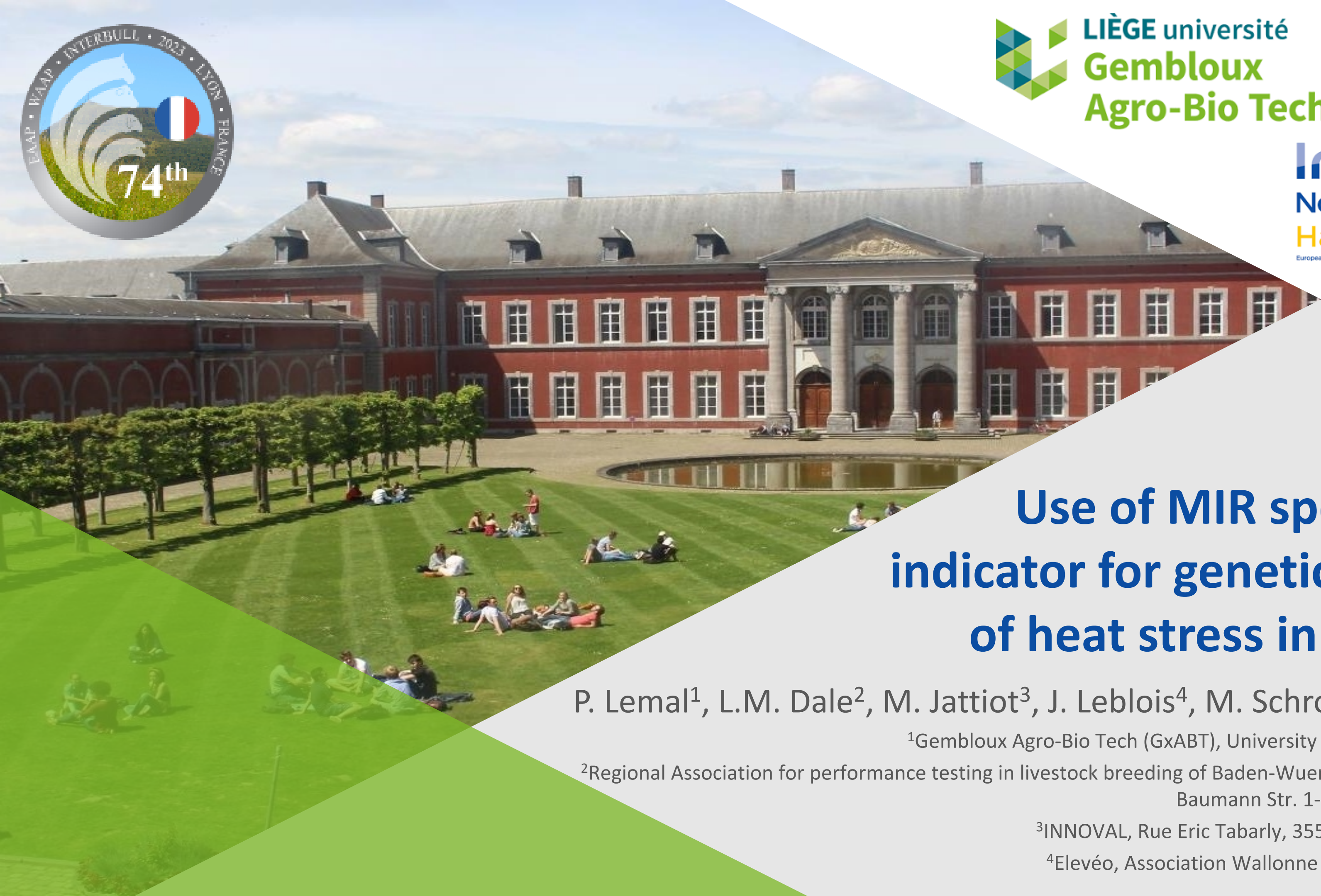

LIÈGE université Gembloux Agro-Bio Tech

Interreg North-West Europe HappyMoo
European Regional Development Fund

Use of MIR spectra-based indicator for genetic evaluation of heat stress in dairy cattle

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MIR spectral prediction based on heat stress in dairy cattle

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→ MIR spectra-based THI prediction

Objective

- Determine how the MIR spectra-based indicator could be used in the context of genetic evaluation for heat tolerance

MIR spectra-based indicator

- Represents the THI expected for a given milk composition

Hypothesis:

- A higher value of the indicator → thermosensitivity
  A lower value of the indicator → thermotolerance

- A high increase of the indicator during hot days → thermosensitivity
  A low increase of the indicator during hot days → thermotolerance

→ To test these hypothesis: comparaison to performance traits

Data

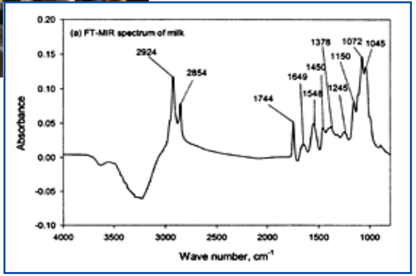
- Milk recording
  - **FPCM** (fat- and protein-corrected milk)

milk yield * (0.337 + 0.116 * fat % + 0.06 x protein %)

  - **MIR spectra-based indicator**

→ 53 328 Walloon Holstein cows

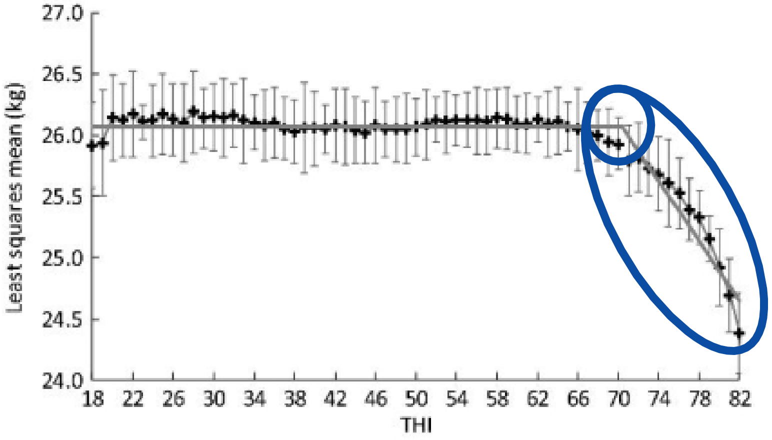
→ 754 337 records



- Meteorological data
  - THI: ((1.8 × T) + 32) – [(0.55 – 0.0055 × RH) × ((1.8 x T) – 26)]
  - Mean of the day and the 3 previous days

Method

- Reaction norm model on the THI



Hagiya et al., (2019), *Animal Science Journal*, *90*(5), 613-618.

- Define the threshold

y = THI + HY + (DIM-s) + lact + age + a + pe + e

- Evaluate the animals

y = HTD + (DIM-s) + lact + age + a + α [f(THI)] + pe + π [f(THI)] + e

Method

Model adapted from McWhorter et al., 2022

y = THI + HY + (DIM-s) + lact + age + a + pe + e

Fixed effects
- **THI**: Temperature-humidity index
- **HY**: Herd year
- **DIM-s**: Combination of day in milk and season of calving
- **lact**: Lactation number
- **age**: Age at calving

Random effects
- **a**: additive genetic
- **pe**: permanent environment

Method

Model adapted from McWhorter et al., 2022

If $THI < THI_{threshold}$: $f(THI) = 0$
If $THI \geq THI_{threshold}$: $f(THI) = THI - THI_{threshold}$

$$y = HTD + (DIM\text{-}s) + lact + age + a + \alpha\,[f(THI)] + pe + \pi\,[f(THI)] + e$$

Fixed effects

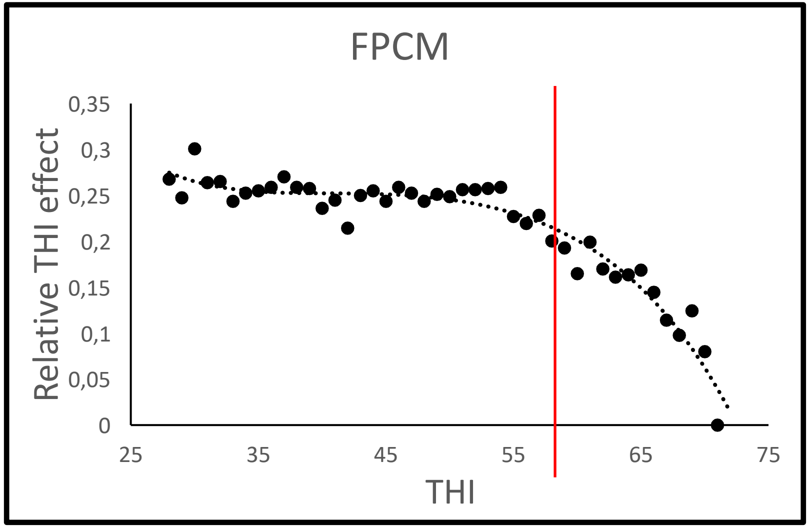
- **HTD**: Herd test-day
- **DIM-s**: Combination of day in milk and season of calving
- **lact**: Lactation number
- **age**: Age at calving

Random effects

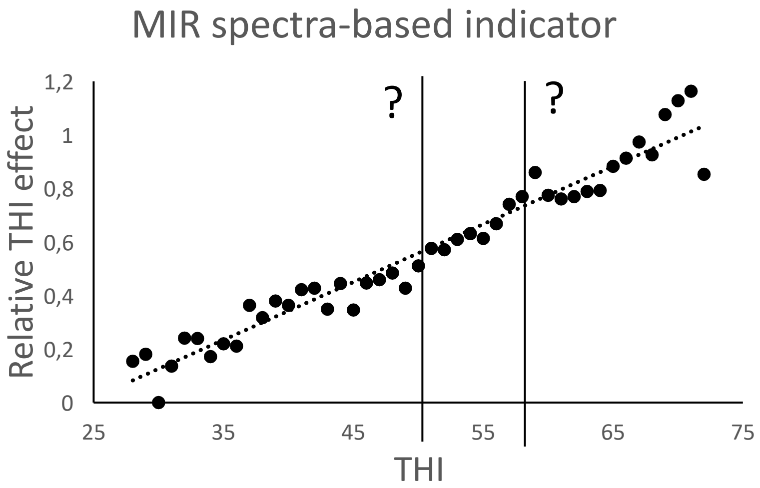
- **a**: additive genetic
- **pe**: permanent environment
- **α**: slope of the regression on THI for additive genetic
- **π**: slope of the regression on THI for permanent environment

THI thresholds

y = THI + HY + (DIM-s) + lact + age + a + pe + e



Considered as reference



Hypothesis 1: Use the indicator without regression

Correlations between the general indicator and the drop of FPCM :

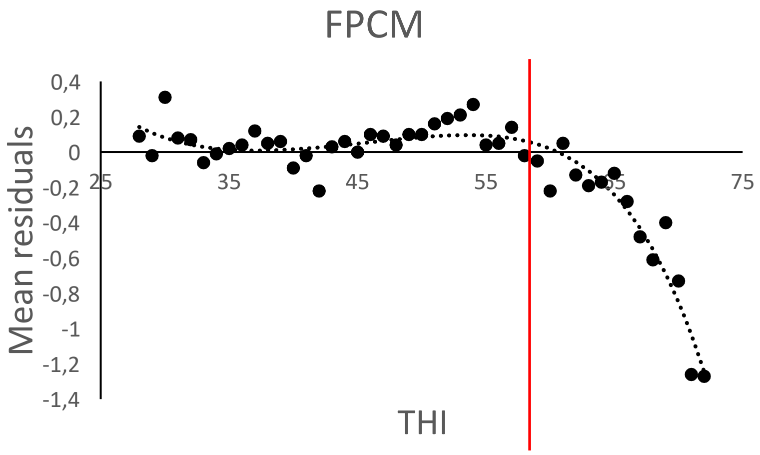
→ Close to 0

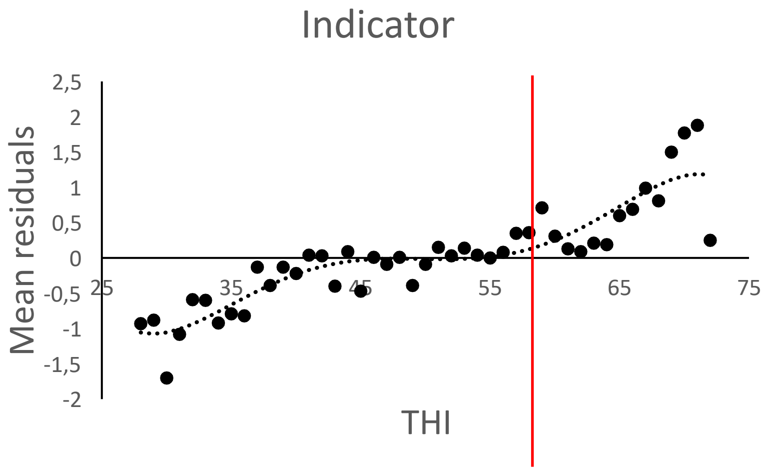
A higher value of the indicato… …ermosensitivity

A lower value of the indicator… …ermotolerance

Residuals

y = HY + (DIM-s) + lact + age + a + pe + e





Hypothesis 2 : Use the indicator with a regression

y = HY + (DIM-s) + lact + age + e

$e = a + \alpha\,[f(THI)] + pe + \pi\,[f(THI)] + e_2$

→ Classic method for FPCM (fat- and protein- corrected milk)

Genetic correlations

FPCM general / FPCM thermotolerance : -0.31

FPCM thermotolerance / Indicator thermotolerance : -0.69

Indicator thermotolerance / FPCM general : 0.02

Conclusion

A high increase of the indicator during hot days → thermosensitivity

A low increase of the indicator during hot days → thermotolerance

→ MIR spectra-based indicator could help to select thermotolerant animals at least for FPCM without selecting for reduced FPCM

Thank you for your attention

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