

Detecting heat stress in dairy cattle using milk composition data

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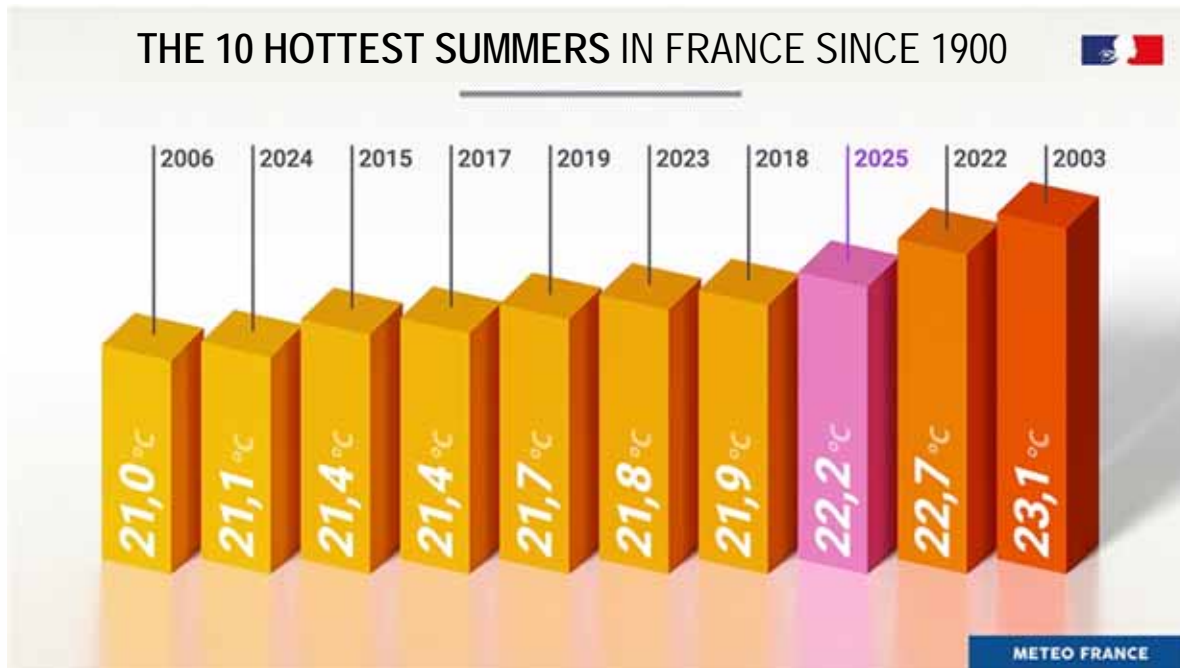
Avec la contribution financière du compte d'affectation spéciale développement agricole et rural CASDAR





GLOBAL WARMING IS HAVING A CLEAR IMPACT ON TEMPERATURES

- Increasingly high temperatures
- Heatwaves that are becoming more frequent, intense, prolonged, and occurring earlier and/or later in the year



Total number of heatwave days per year



Number of days



Source: Météo France - Données jusqu'à 2023 (Le Monde), Météo France - Données 2024 •
Périmètre : France métropolitaine
Pour les années avec plusieurs vagues de chaleur, le nombre de jours de vagues de chaleur a été cumulé



CONSEQUENCE: INCREASED HEAT STRESS FOR DAIRY CATTLE



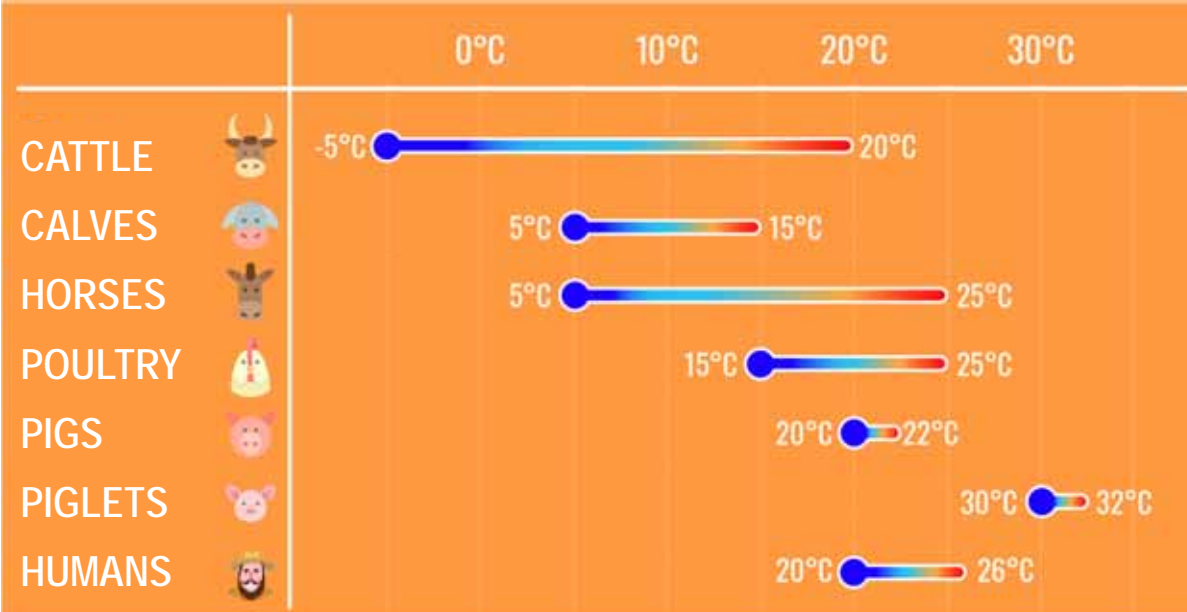
At temperatures above 20–25°C, adult cattle employ mechanisms to regulate their body temperature



Changes in behaviour, milk production and fertility, with sensitivity depending on:

- **Their individual characteristics:** stage of development, production level, breed, health status, etc.
- **External conditions:** temperature (but not only that!), humidity, wind speed, solar radiation, heat accumulation, access to shelter, etc.

THERMONEUTRAL ZONE OF SEVERAL SPECIES





SCREENING OF HISTORICAL DATA



Average daily temperature and humidity (data from Météo France / SAFRAN)

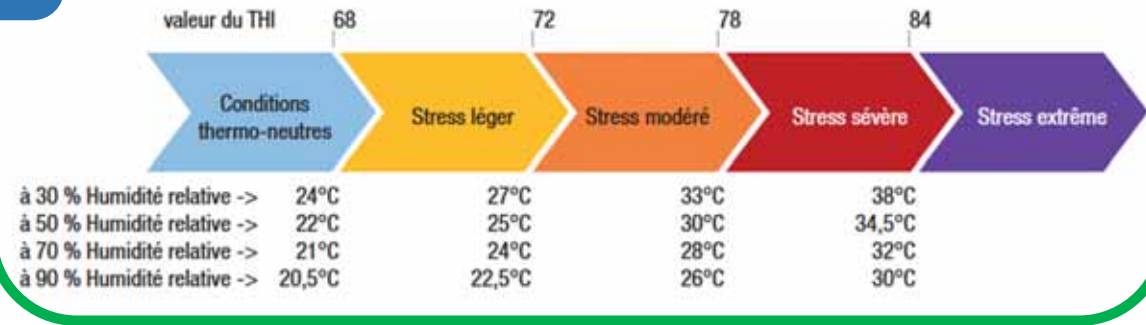


> 4,000 herds located between 200 metres and 5 kilometres from a weather grid cell



Milk data (TB, TP, urea, SCC) and detailed milk composition, including fatty acids

1. Calculation of the daily THI (temperature-humidity index)
2. 3-day average THI = the previous 2 days + day X
3. Classification according to these thresholds:



Variations in milk composition by THI class during the period June–July–August 2021 and 2022





SCREENING OF HISTORICAL DATA

2021 (n=8022)



2022 (n=8216)



- Thermoneutral conditions
- Low heat stress
- Moderate heat stress

- There is no difference in milk composition across different THI classes
- At equivalent THI levels, two distinct milk profiles emerge, regardless of the THI class



- Are we primarily detecting variations linked to diet?
- Does the THI truly capture the cows' discomfort?
- Were the chosen thresholds appropriate?



DATA COLLECTION ON FARMS



Assessing the actual heat stress experienced by dairy cows through observations taken at the hottest time of the day



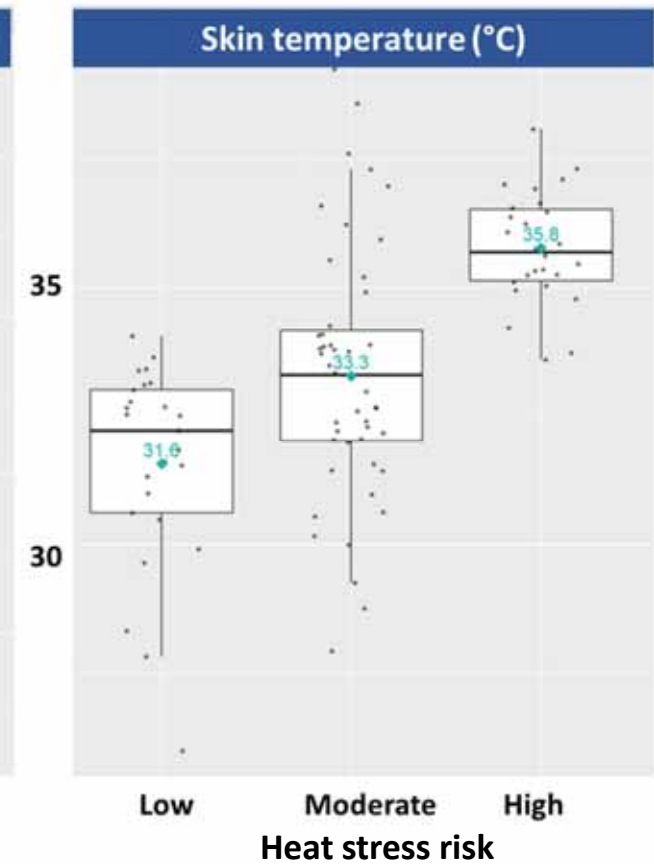
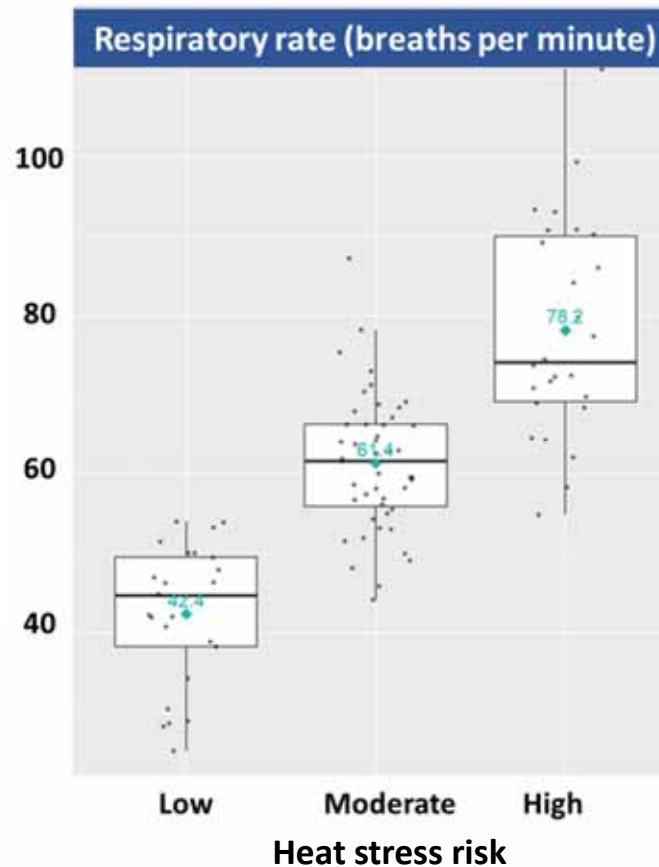
>100 visits carried out in 2024 and 2025 across ~50 farms

- Weather-triggered visits
- Visits carried out in the afternoon
Measurement of the THI in the dairy cows' living area
- Skin temperature measurement (on the shoulder, in the shade)
- Measurement of panting
- Recording of bulk tank milk composition



DEFINITION OF THREE LEVELS OF HEAT STRESS RISK AT HERD LEVEL

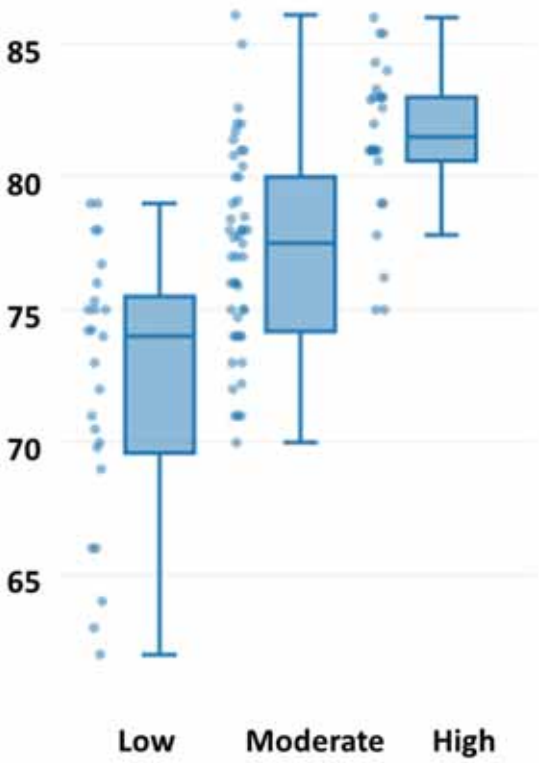
Risk of heat stress	Skin temperature (°C)		Respiratory rate (breaths per minute)
Low risk (n=25)	Fewer than 25% of cows > 35°C	AND	Less than 25% of cows > 60
Moderate risk (n=47)	More than 25% of cows > 35°C	OR	More than 25% of cows > 60
High risk (n=26)	More than 25% of cows > 35°C	AND	More than 25% of cows > 60





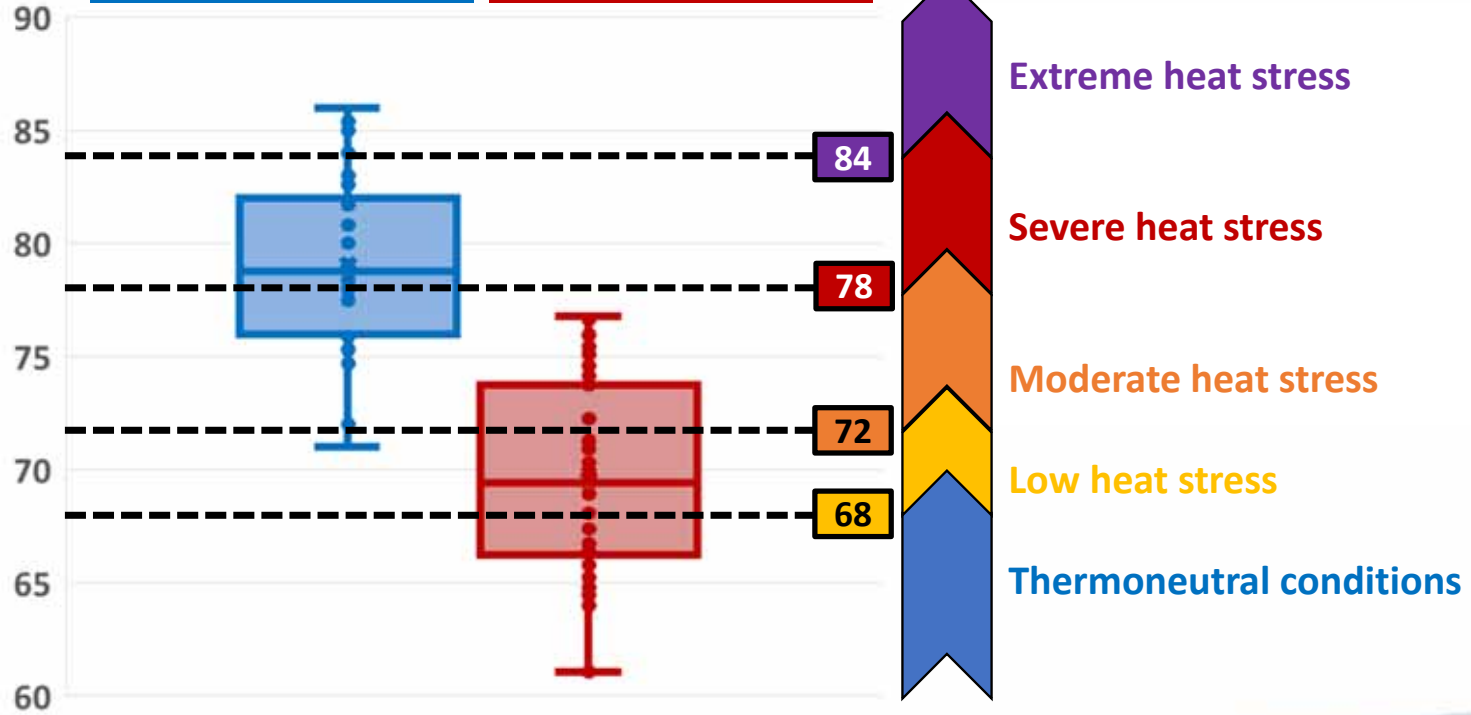
THE HEAT STRESS EXPERIENCED BY COWS IS GREATER THAN THE AVERAGE DAILY THI SUGGESTS

THI in cows' living area



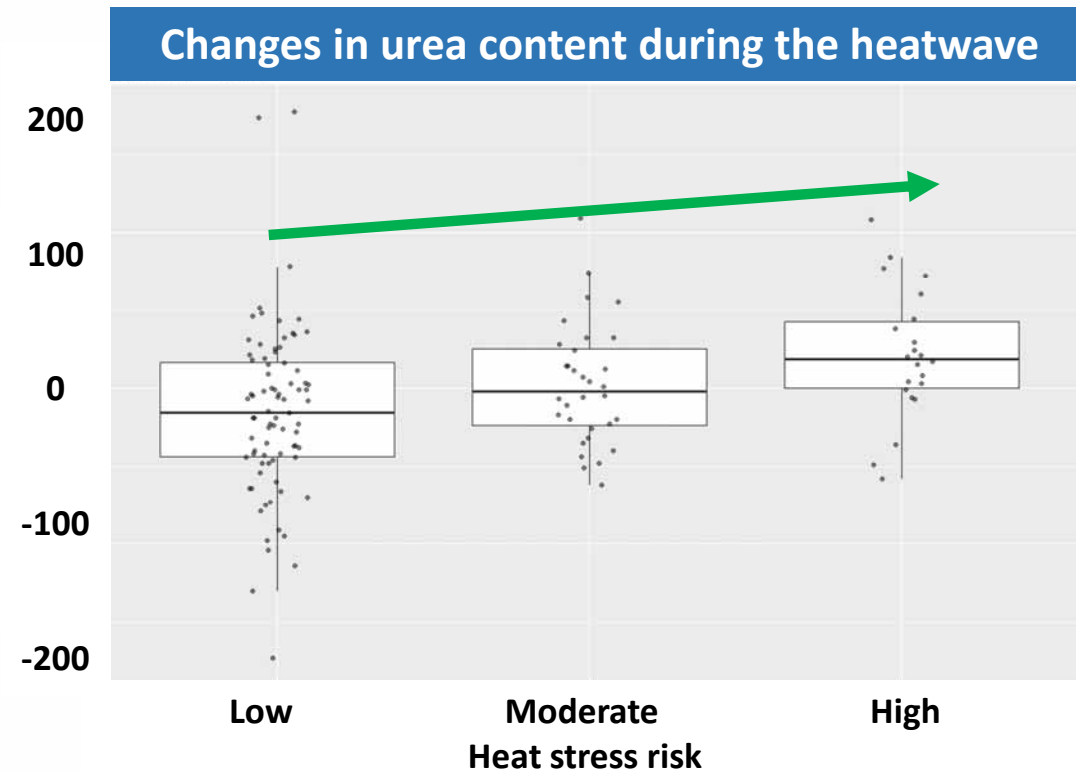
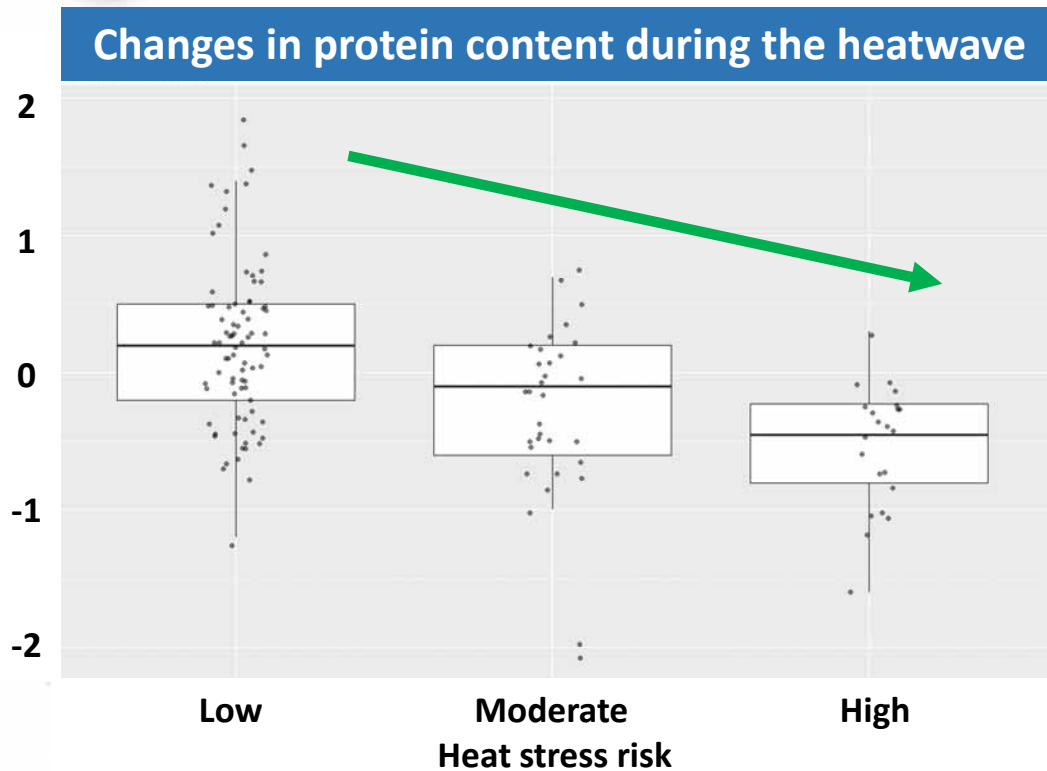
THI in the cows' living area at the time of the visit (2 pm–6 pm)

Average THI for the day of the visit, calculated using SAFRAN data





IMPACT OF HEAT STRESS ON MILK COMPOSITION



Heat stress causes **statistically significant changes in the protein fractions** of milk (between D-3 and D0) **without any major effect on the milk fat content and composition**

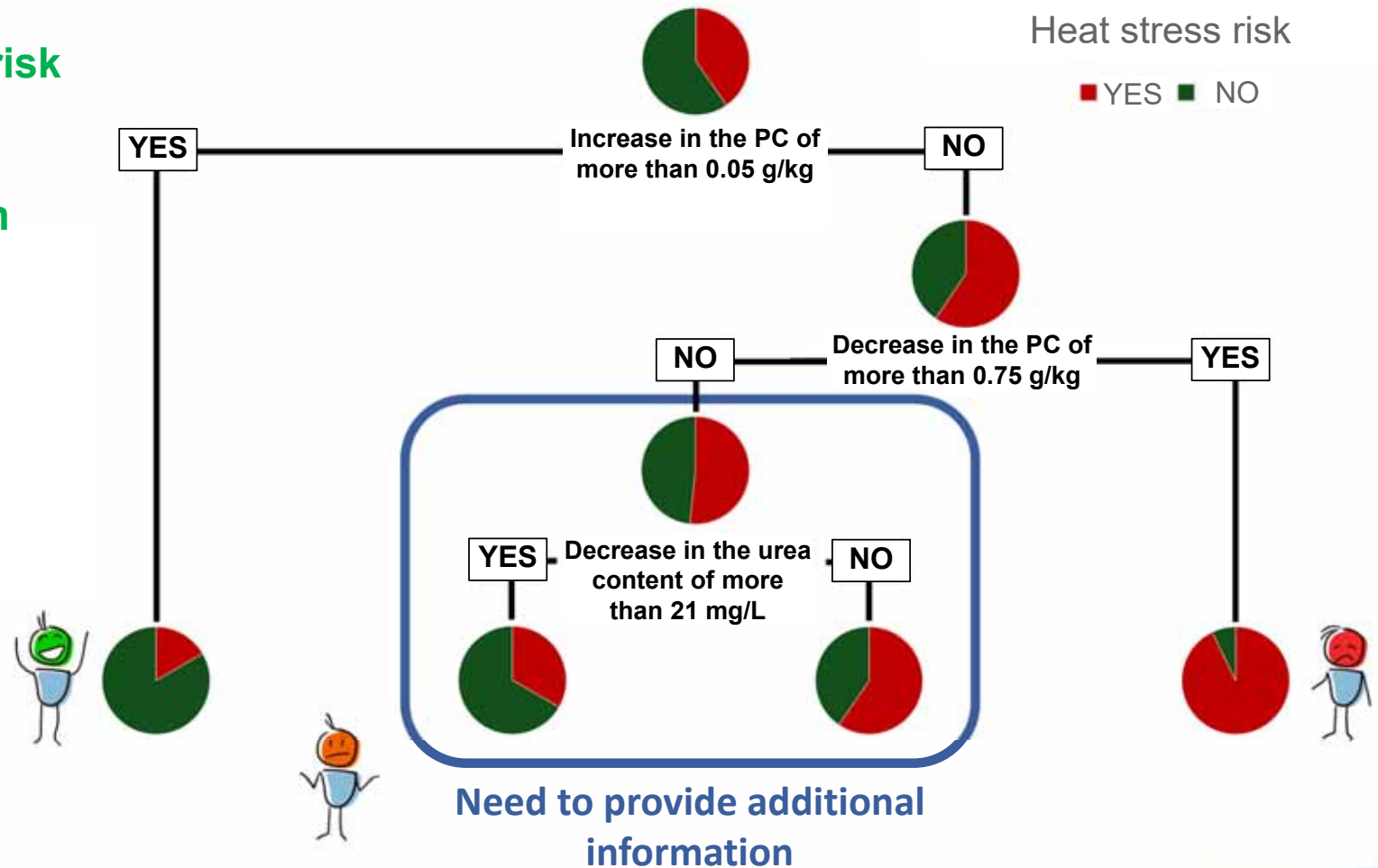


CAN THERMAL STRESS BE PREDICTED OR ESTIMATED BY ANALYSING CHANGES IN MILK COMPOSITION?



Classify heat stress risk of herds based on variations in milk composition between D-3 and D0

- The selected decision tree – results based on 2024 data
 - Sensitivity = 70 %
 - Specificity = 77 %
- Testing on 7 new surveys (May–June 2025)
 - Sensitivity = 67 %
 - Specificity = 100 %





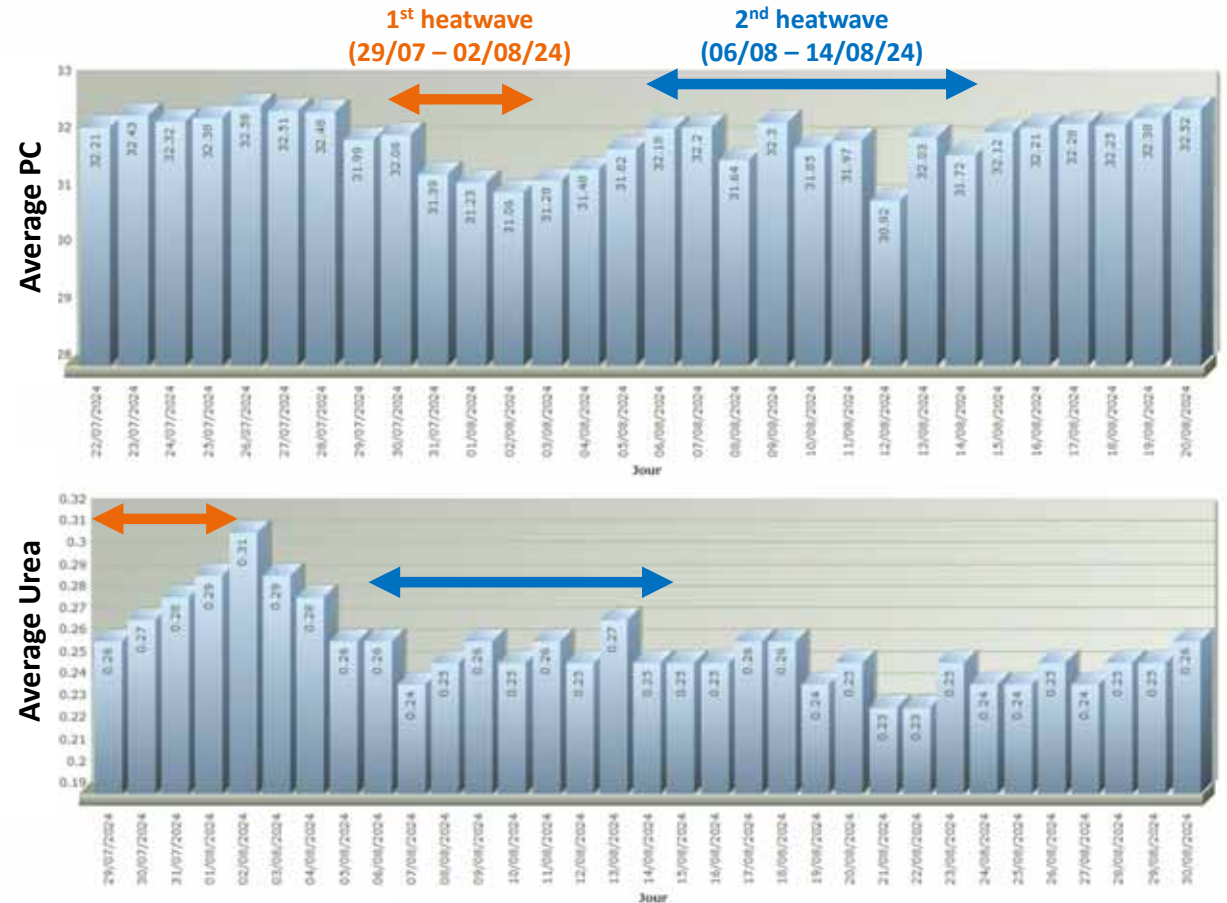
CONCLUSION

The RobuST project has shown that:

- ❑ The average daily THI alone is not sufficient to indicate heat stress in a herd of dairy cows
- ❑ A drop in total protein and a rise in milk urea levels during a hot period should serve as a warning sign of heat stress in the herd



Histogram of daily averages for days with more than 100 samples



(Agrolab's, summer 2024)



Thank you for your attention!

Questions ?

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