Heat stress

Is it an issue for UK Dairy Cows?

What can we do about it?

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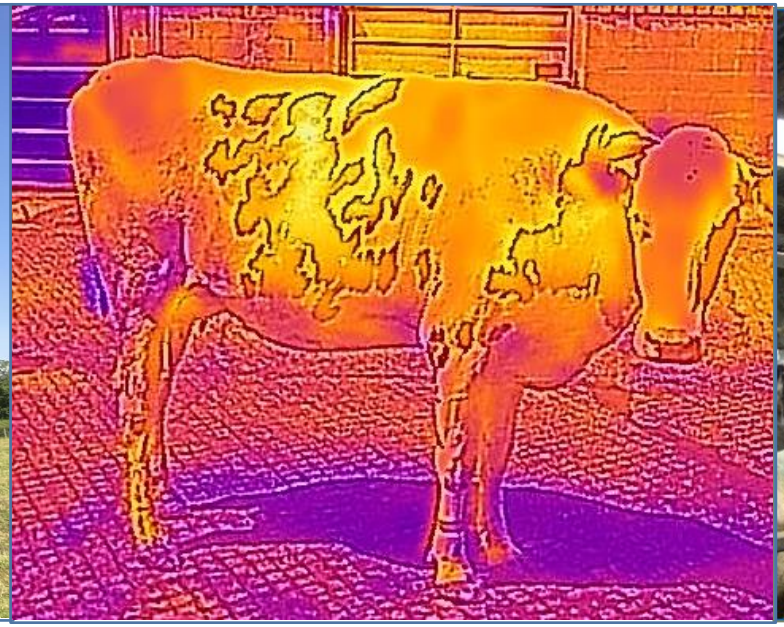
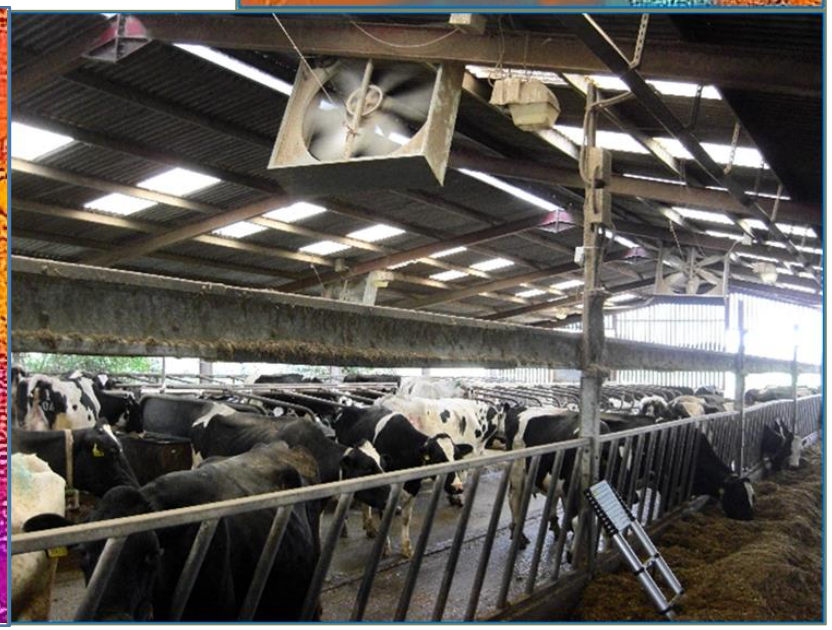
Chalcombe Ltd





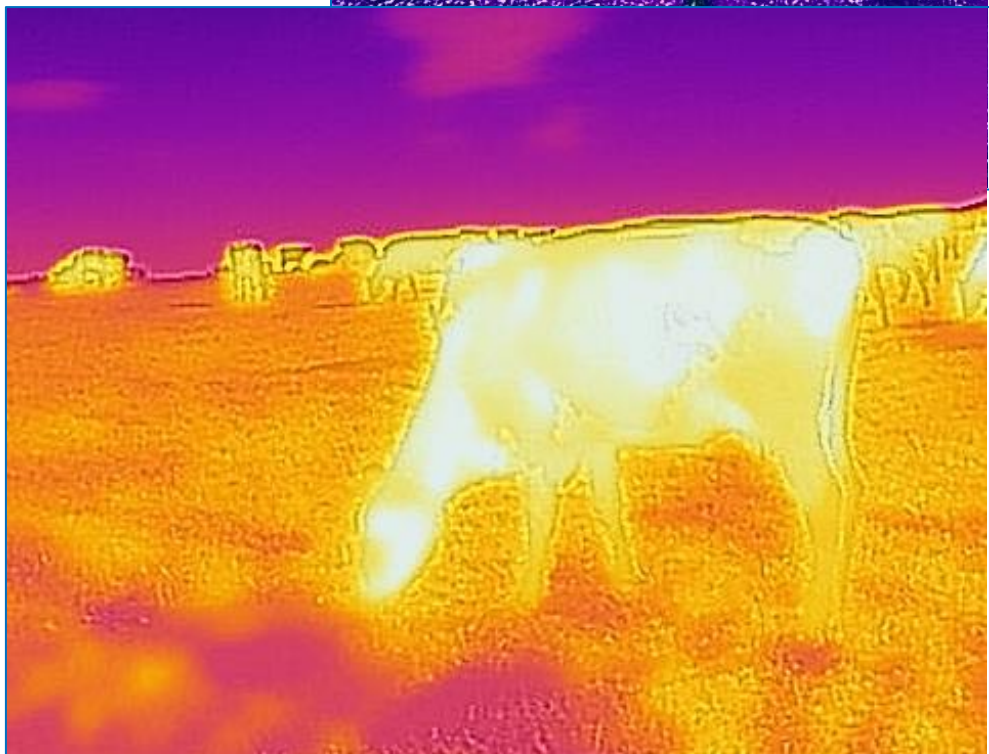
Talk structure

- What is heat stress?
- Measuring heat stress
- Is it a problem in the UK?
- Effects of heat stress
- Reducing heat stress
- How do we measure success?
- Acknowledgements
- Top priorities

What is heat stress?

Excessive heat accumulation

- Balance of
  - Heat production and heat inputs
  - Animal's ability to lose heat
- Problem for Housed and Grazing cows

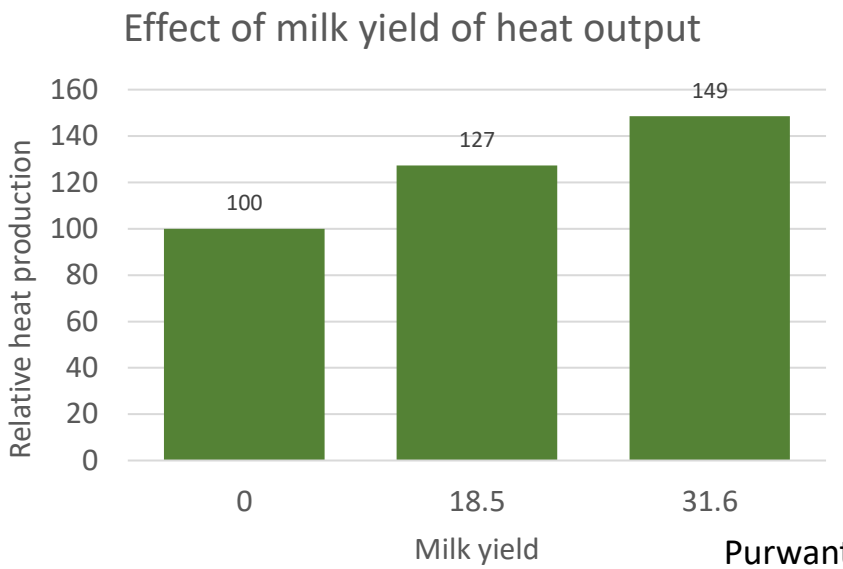


Heat stress – sources of heat

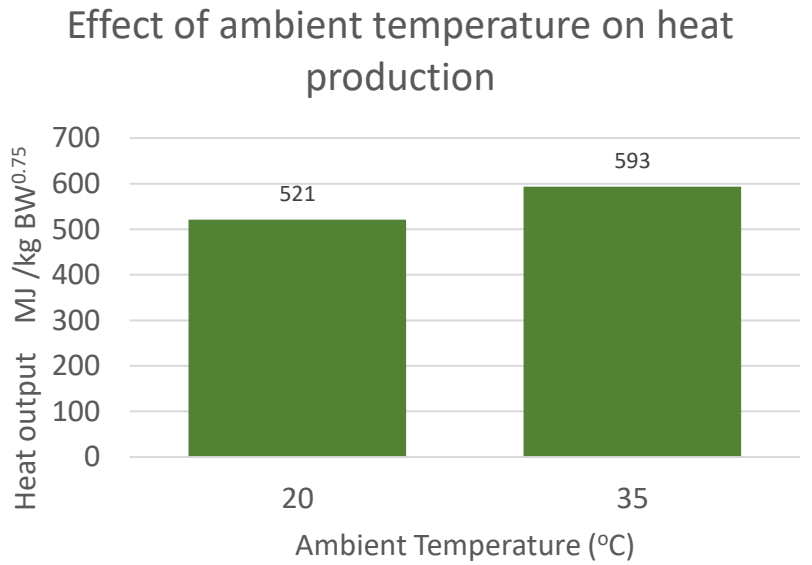
Metabolic activity (FiM, 2004)

Activity	KW heat output
20 l/day	1.22
40 l/day	1.61
60 l/day	2.00
40 weeks pregnant	1.27
Human	0.09

- Milk production is increasing
- Affects milking and dry cows
- Panting increases heat production



Purwanto, 2014

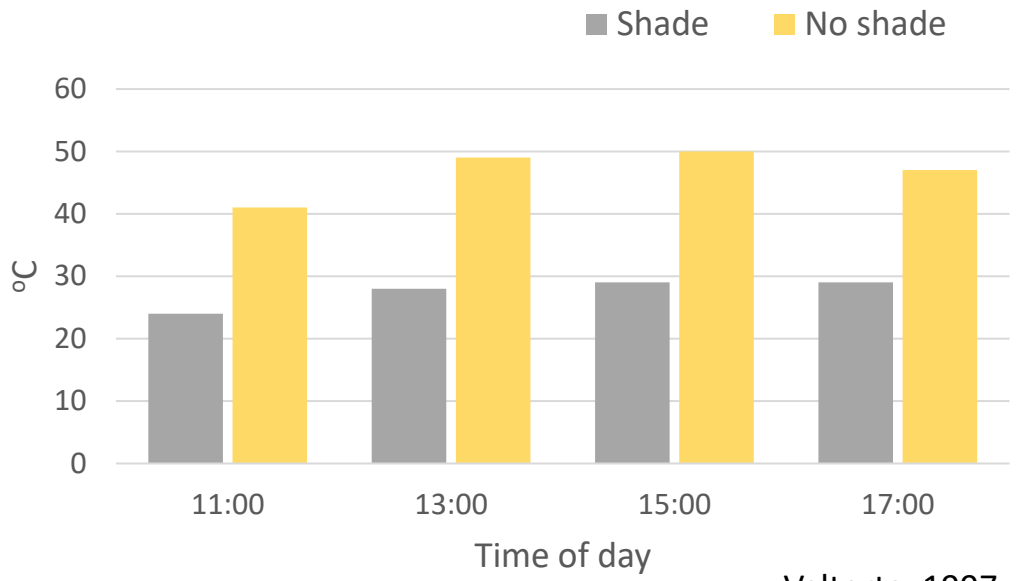


Robinson, 1986

Heat stress – sources of heat

- **Radiant heat** (sunshine)
- Major source of heat when grazing
- Measured using 'black globe'

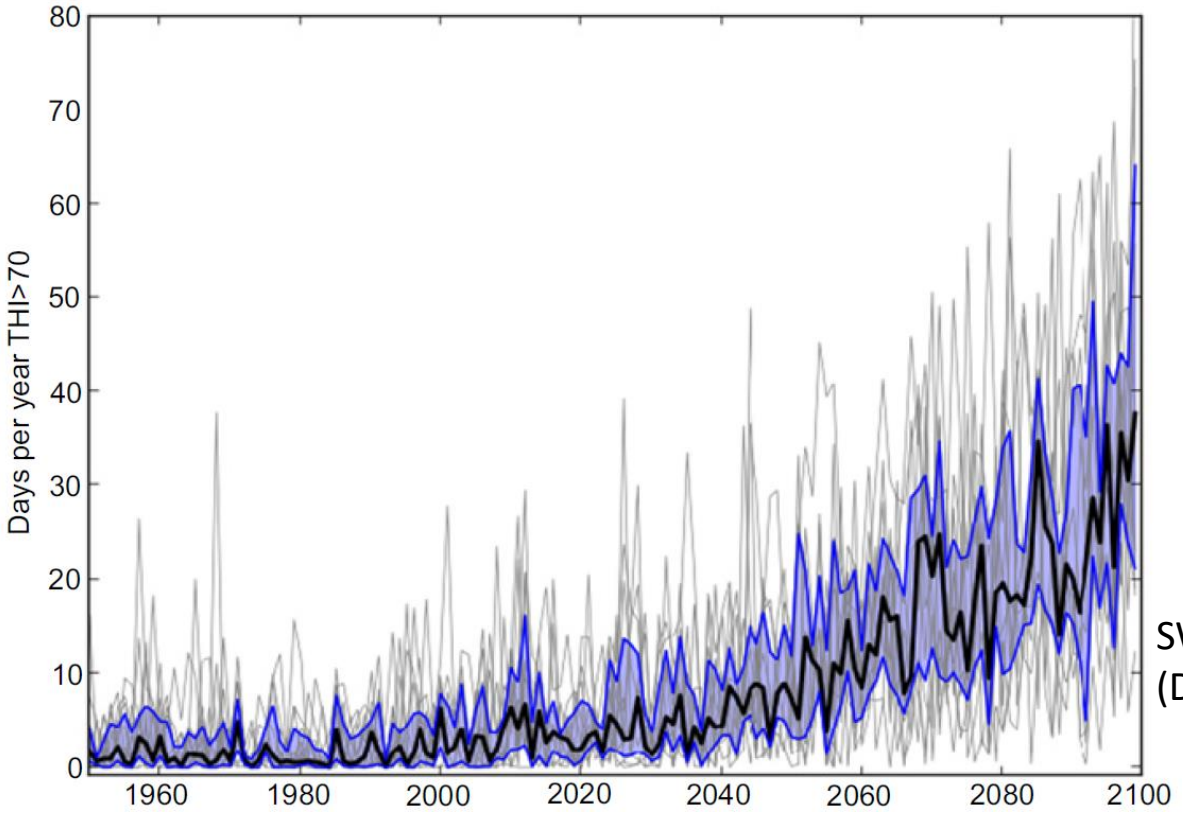
Temperatures in shaded and non-shaded concrete holding pens



Valtorta, 1997, Argentina

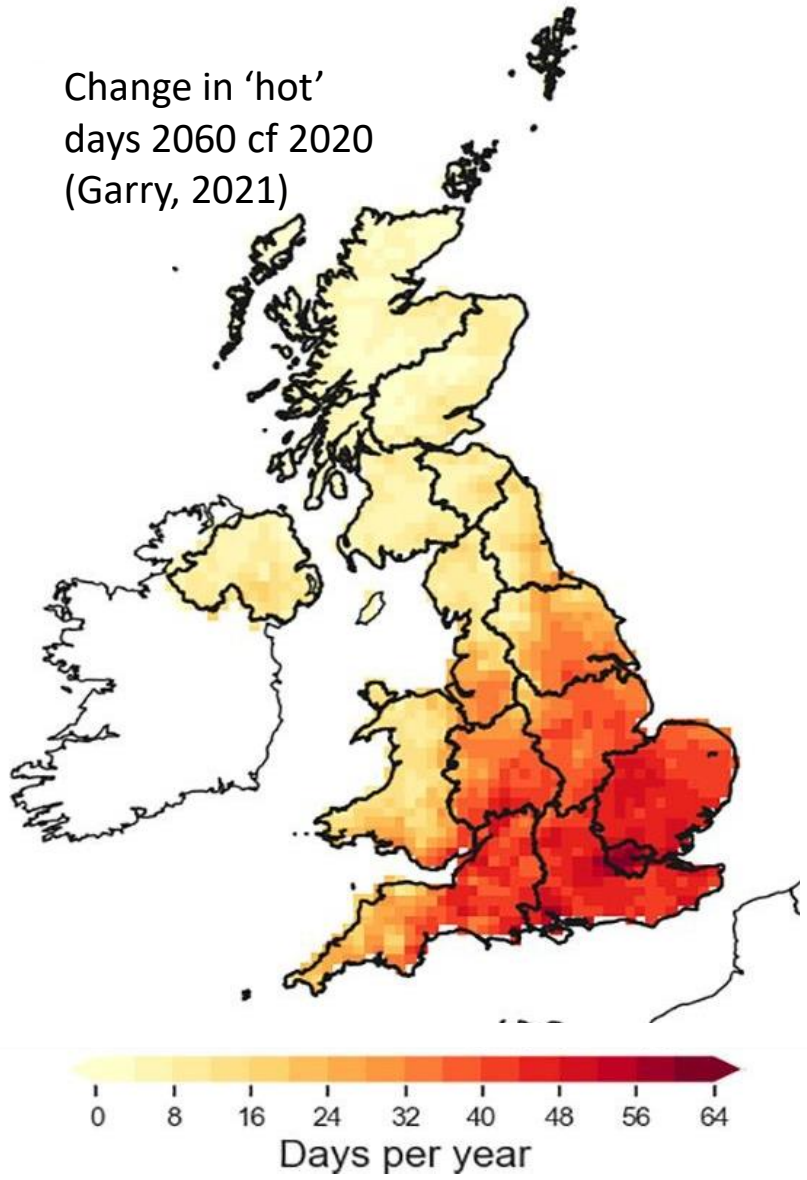
Global warming

- Rising average temperatures
- Rising numbers of ‘hot’ days
- More extreme events
- Heat Stress is a global, growing problem



SW England
(Dunn, 2014)

Change in ‘hot’
days 2060 cf 2020
(Garry, 2021)

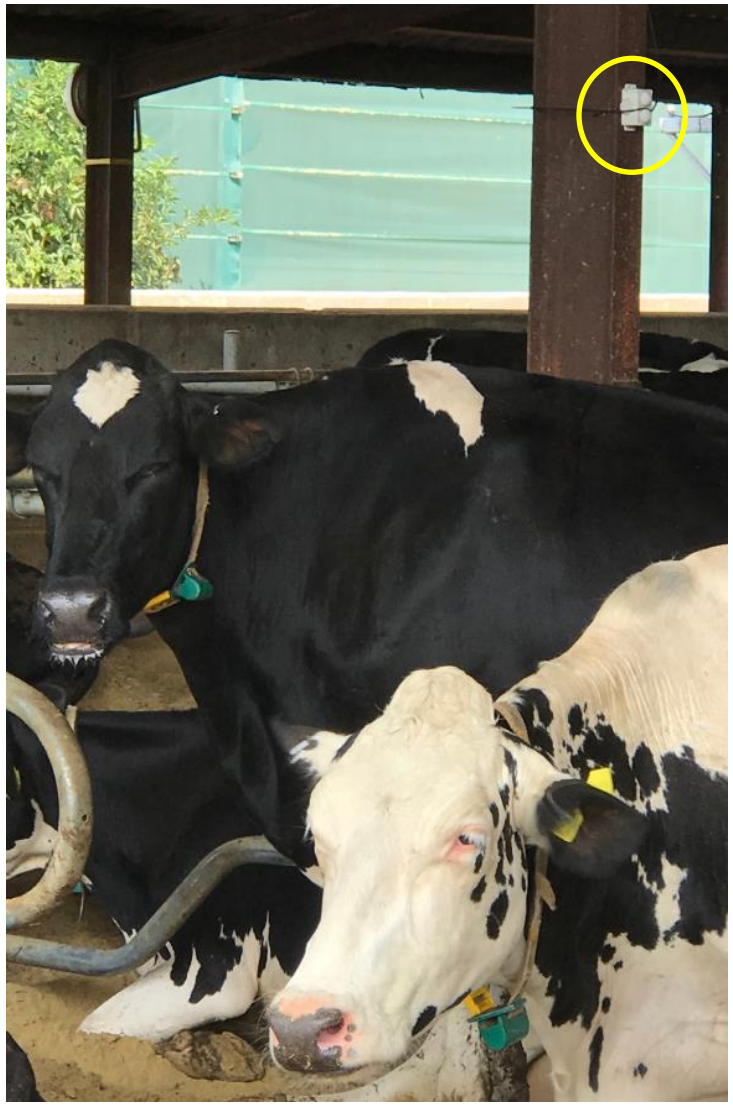


Heat stress - Ability to lose heat

- Ability to lose heat
  - Temperature and humidity of surrounding environment
  - Panting – respiratory rate
  - Area of cow exposed to air
  - Blood supply to skin
  - Sweating and evaporation
  - Cows will acclimatise (months-years)
  - ?Genetic component

How is heat stress measured?

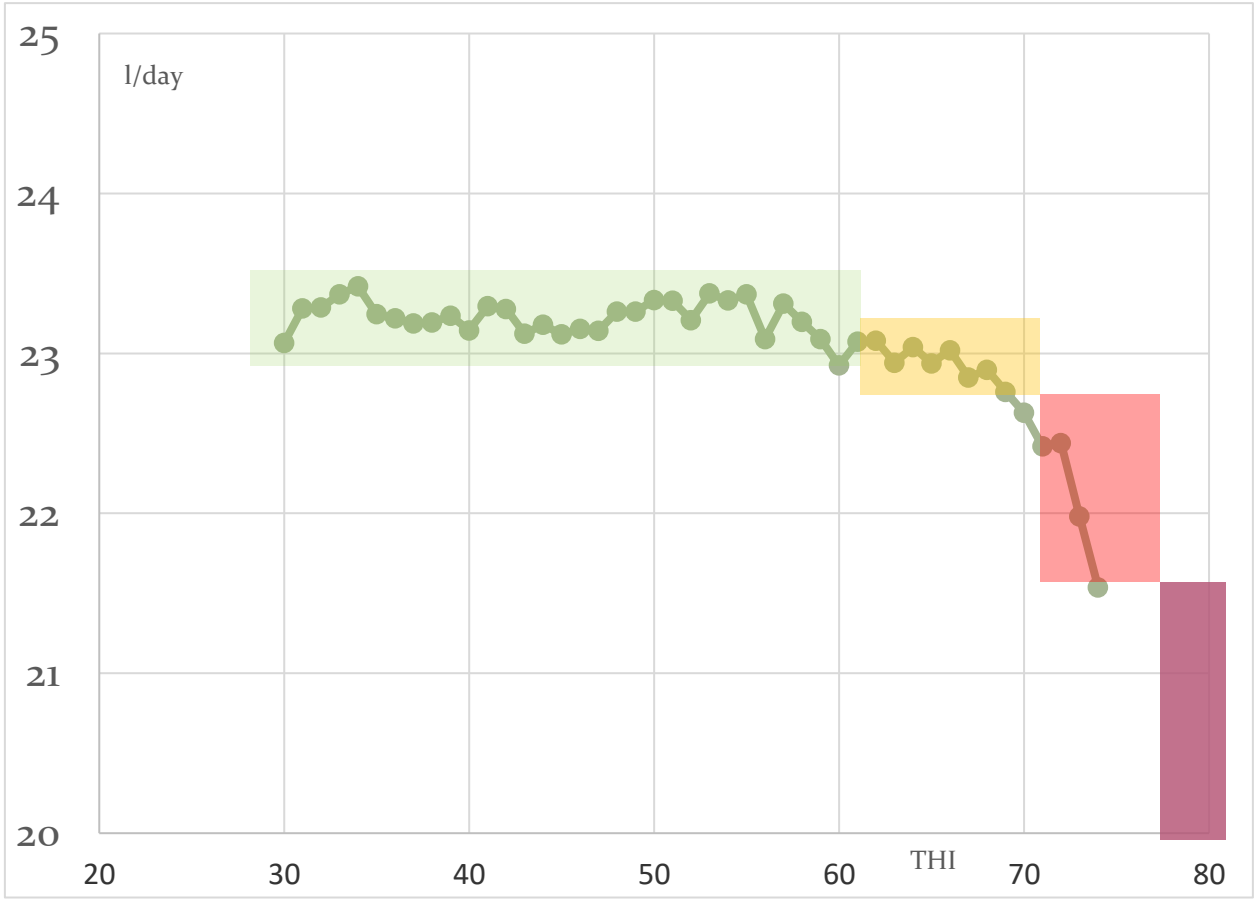
- THI Housed cattle (USA NRC 1971)
  - Based on shed temperature and humidity
  - Developed in hotter regions of USA
    - Florida, Arizona, Georgia
  - THI thresholds vary with underlying climate
    - Cows acclimatise over several months
- THI does not measure radiant heat so only useful for housed cattle
- Derive thresholds for moderate, high, severe



Effect of THI score on dairy cow production

- Yield data from heifers in Northern Europe

Assessment	Est. milk yield loss (l/day)	THI Scores
None	0	under 62
Moderate	0 to 2	62 to 72
High	2 to 4	73 to 79
Severe	over 4	over 79



- Losses start lower than USA thresholds would suggest

- Start at 18^0C – 20^0C
  (%RH dependent)

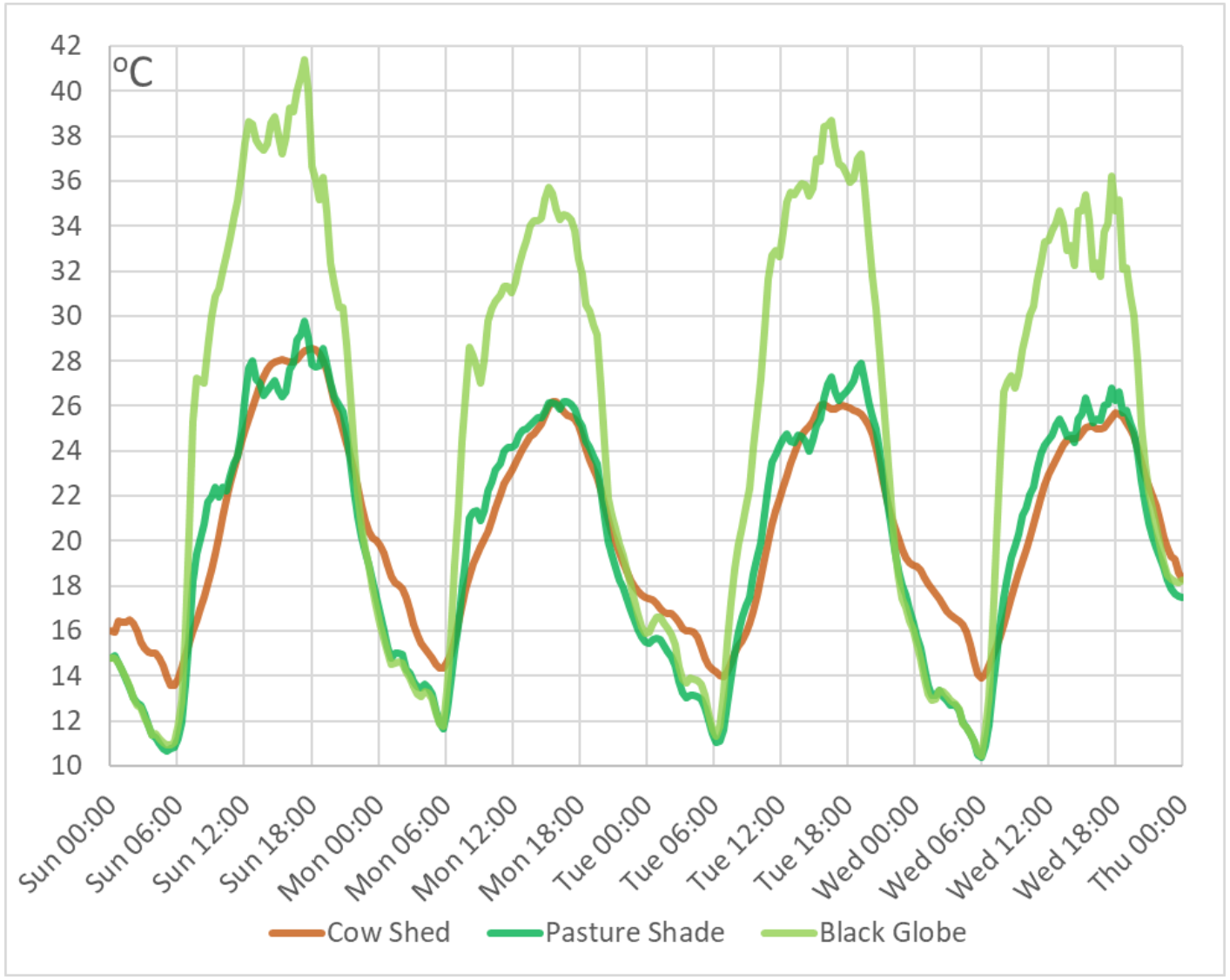
Hammemi, 2013

Heat Stress at Grass

- Shade is the dominant requirement (Mader, 2006)
- Not captured by THI
  - Need Black Globe temperature to represent cow
- Measured with DHLI index

10:00am
Sunday 13 August
96 cows

Temperatures in paddock and shed

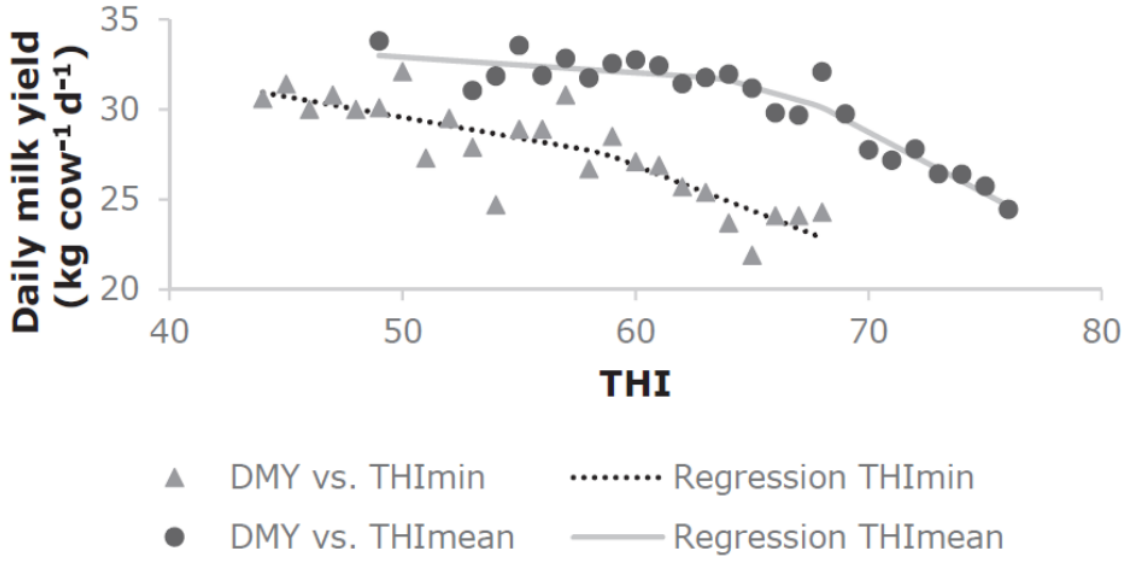


- June 21
- South England
- At night pasture cooler than shed
- By day BGlobe temperature up to 36°C – 38°C

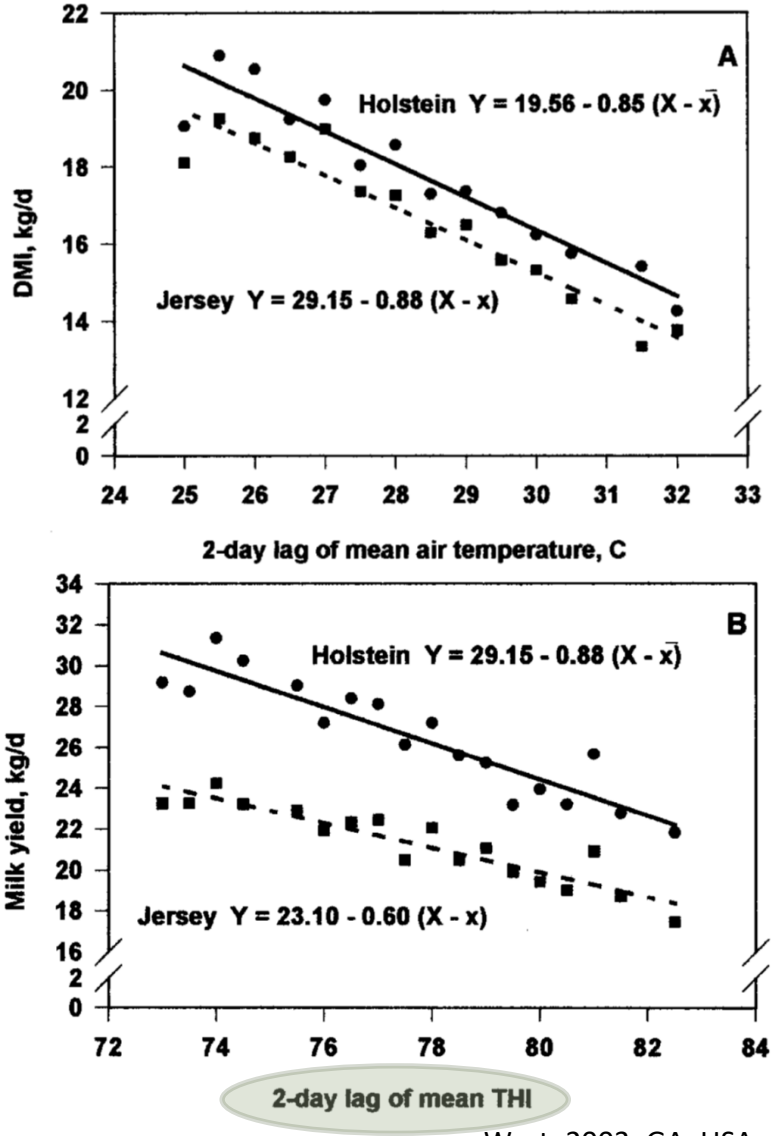
Effects of heat stress

Reduced feed intake – reduced milk output

- Fall in intake only accounts for 50% of milk yield drop
- ~1 kg glucose 'lost' in balance trials (Baumgard,2020)
  - ?intestinal inflammatory response



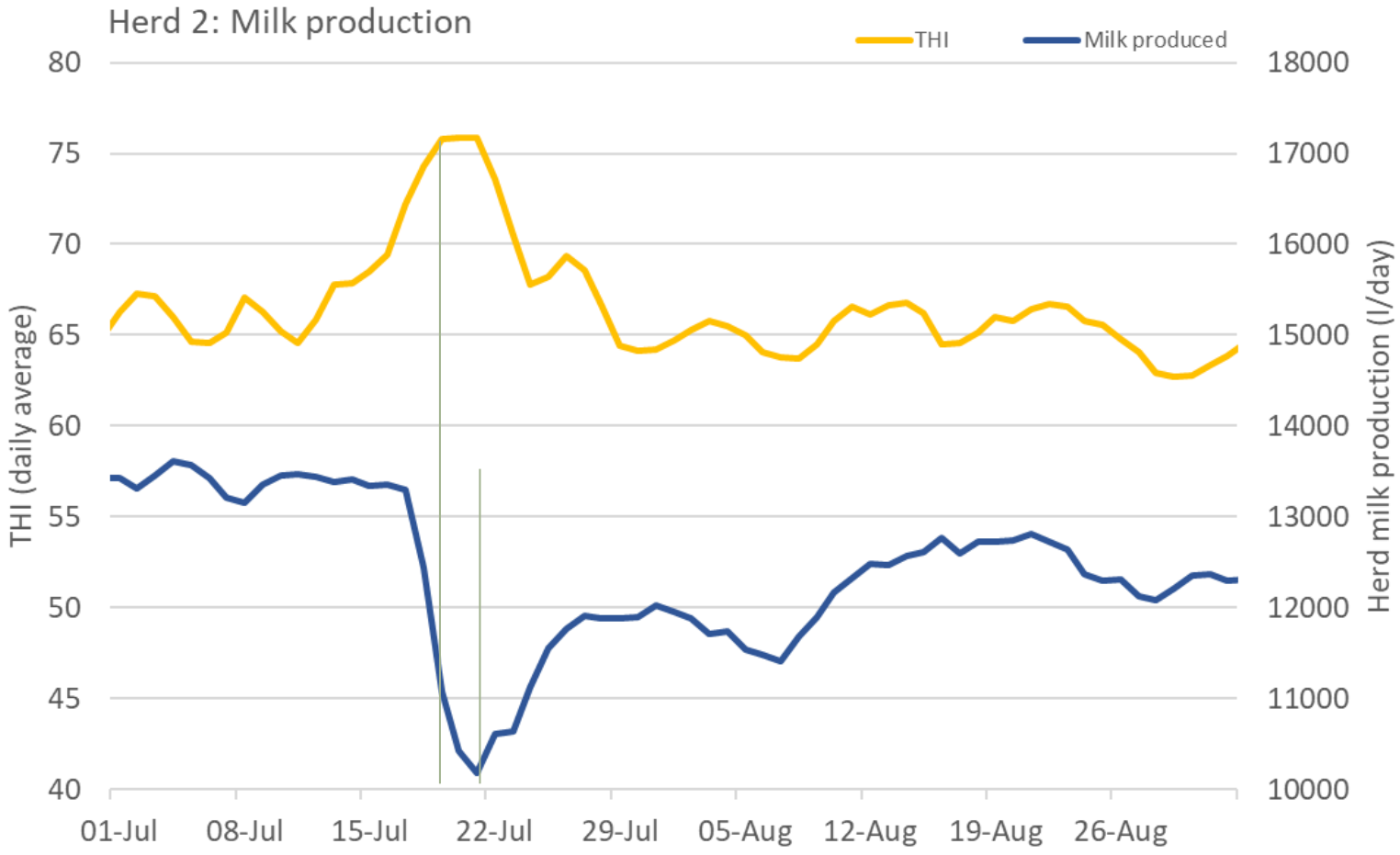
Boyu, 2003, QLD, AU



West, 2003, GA, USA

Effects of heat stress

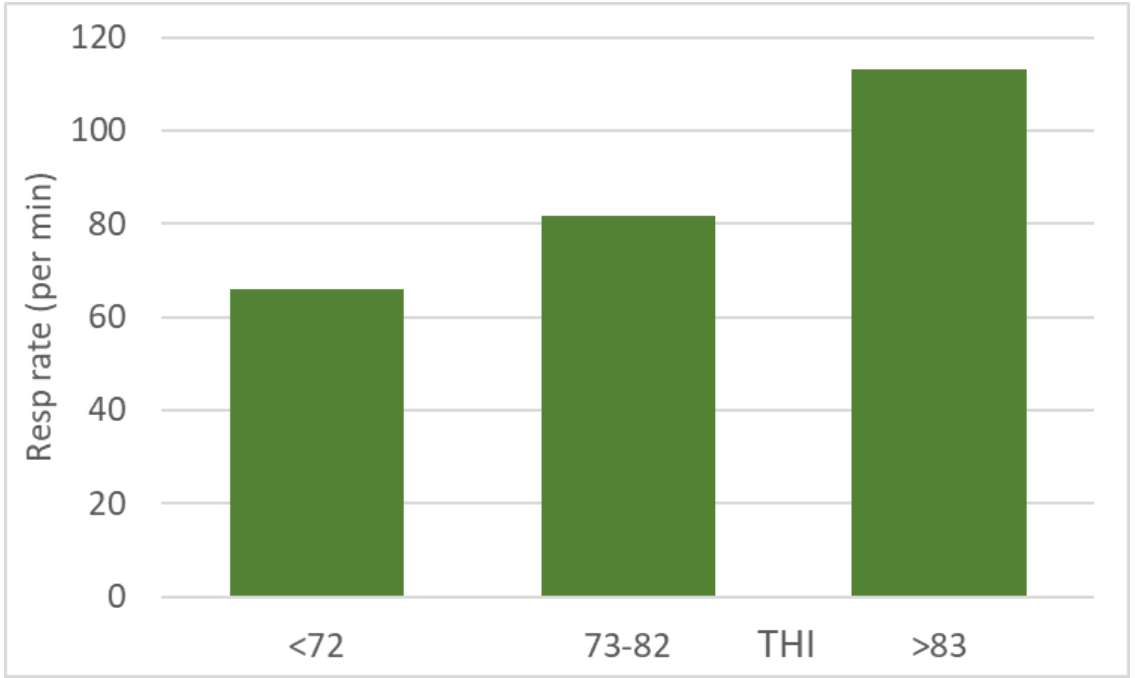
Reduced feed intake – reduced milk output



- UK data
- Summer, 2021
- 2 day lag in milk drop
- Lost 3,000 l/day
  - (400 cows)
- Forage supply issues after heat stress event

Effects of heat stress
Increased panting

- Cow pants to get rid of heat
- Blows off carbon dioxide
- Kidneys lose bicarbonate to compensate
  - Cow becomes acidotic
- Panting animal
  - Fewer, bigger eating bouts
  - Less rumination



Osie, 2019, VIC, AU

Increased respiration rate

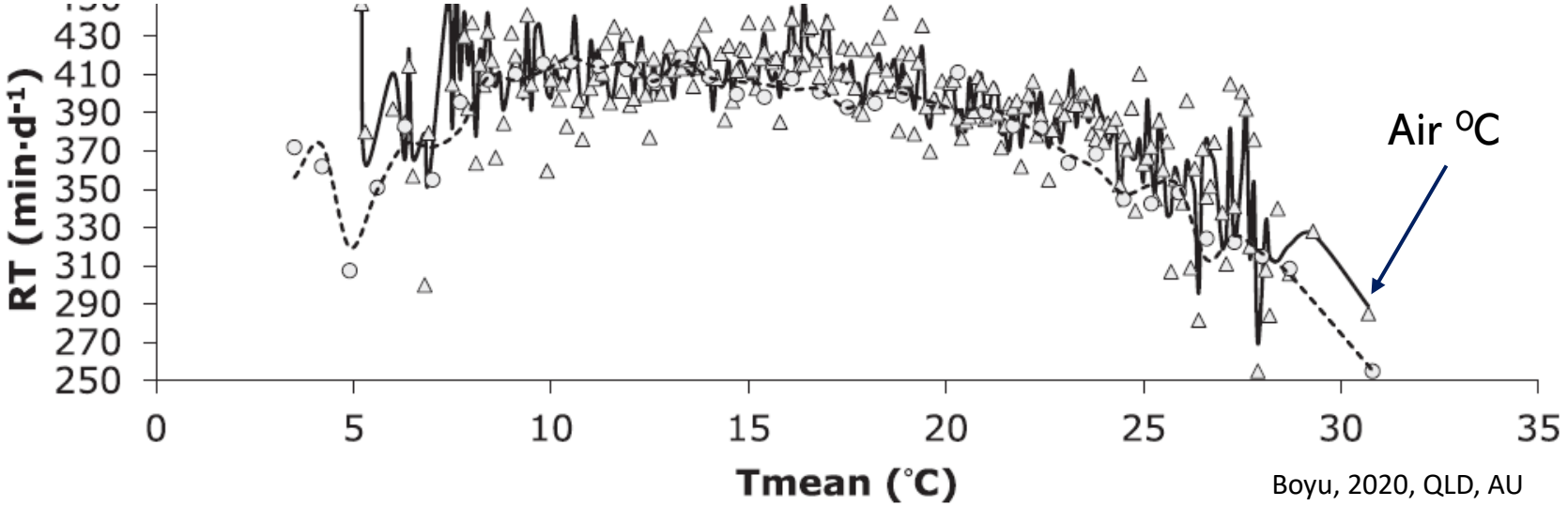
11:00 am 16 June

27°C, 48% RH
Short term THI : 73
24 hr average THI : 66

RR : 92/min
Not ruminating

Trigger threshold: Resp rate over 60 / minute)

Effects of heat stress - Digestive upsets



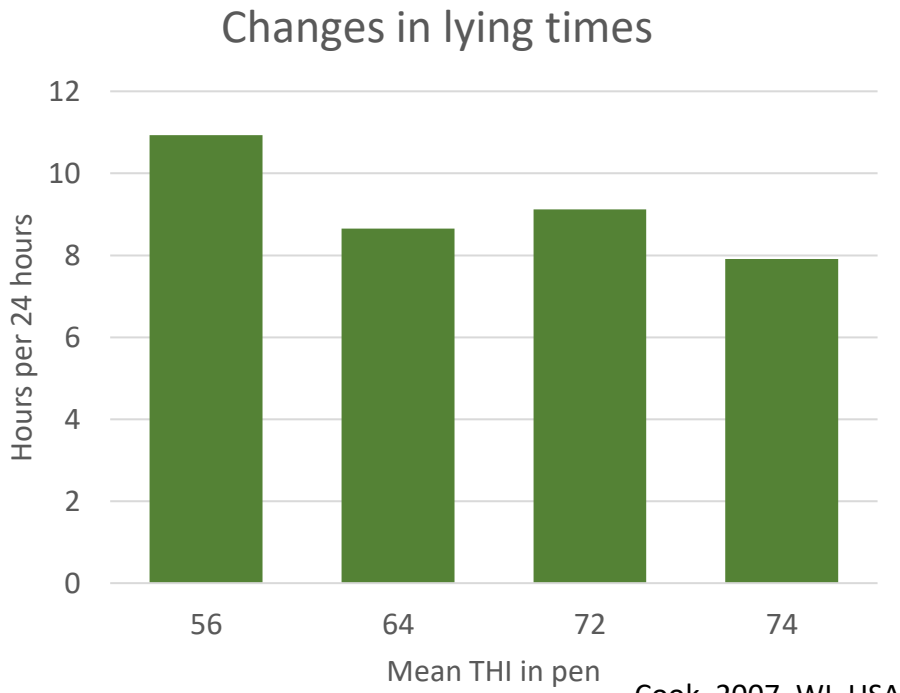
Boyu, 2020, QLD, AU

- Metabolic acidosis
  - Due to panting
- Increased salivation
  - Saliva loss – reduced buffering
- Reduced rumination
- Fewer, bigger eating bouts
- All cause ruminal acidosis

= **Sick rumen**

Effects of heat stress
Lameness problems

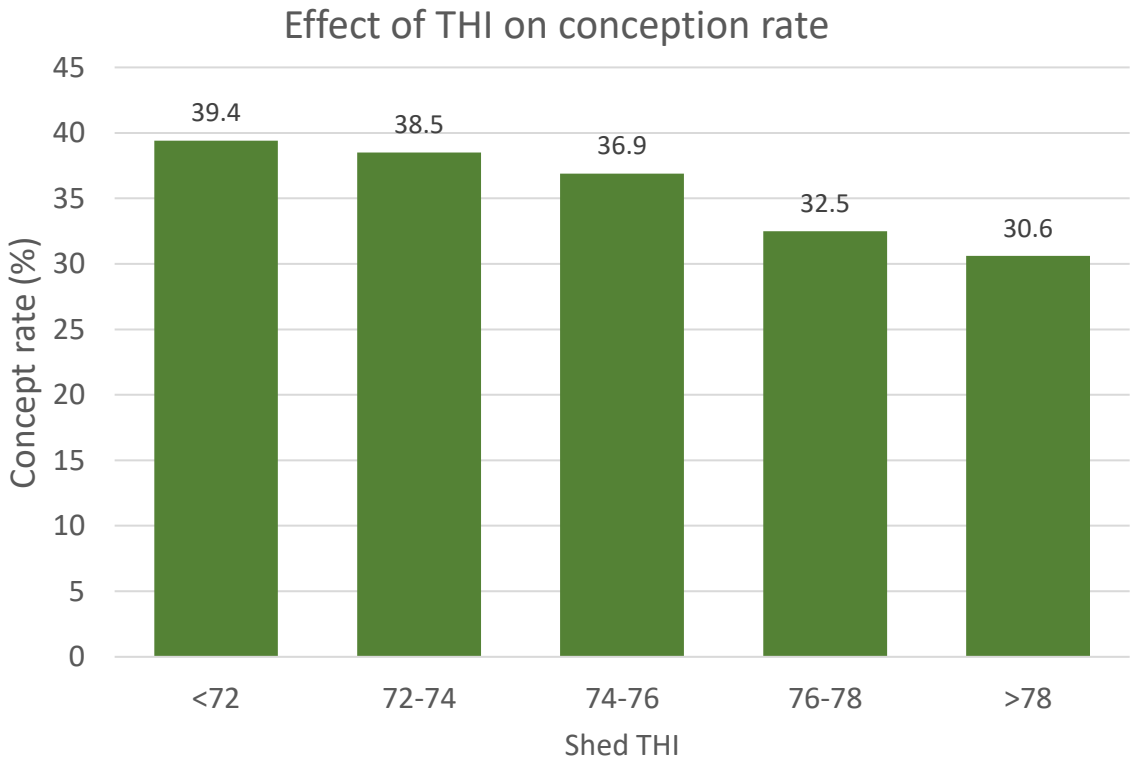
- Increased standing time
  - Increase skin area exposed
- Reduced lying times
- Reduced blood circulation in foot
- Pathology to solar area
- Increase in solar ulcer issues 2-3 months later



Cook, 2007, WI, USA

Effects of heat stress
Fertility problems

- Poorer energy status
- Reduced oestrus signs
- Poorer conception rates
- Increased EED



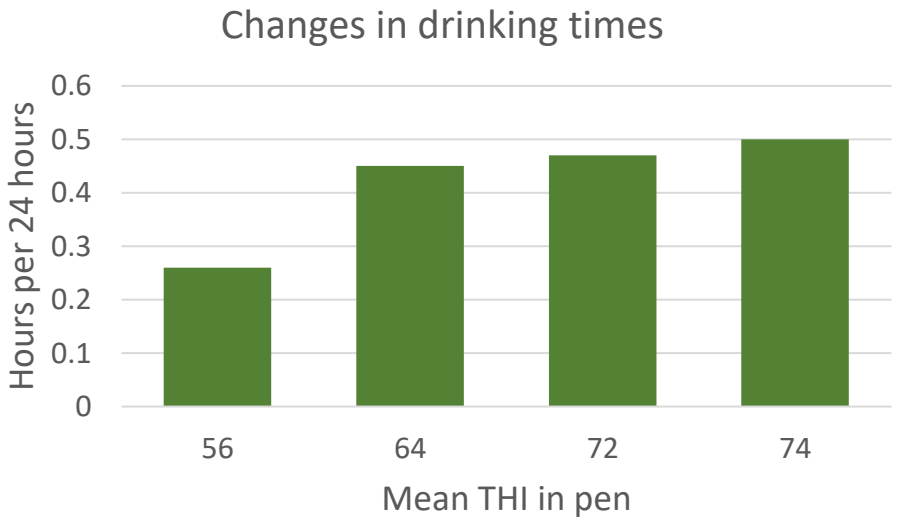
Xue, 2010, Mexico

Effects of heat stress
Water intake

- Increased panting
- Increased salivation
- Increased sweating

- Cows will drink more water

- Higher peak demands
  - When come out of shade



Cook, 2007, WI, USA

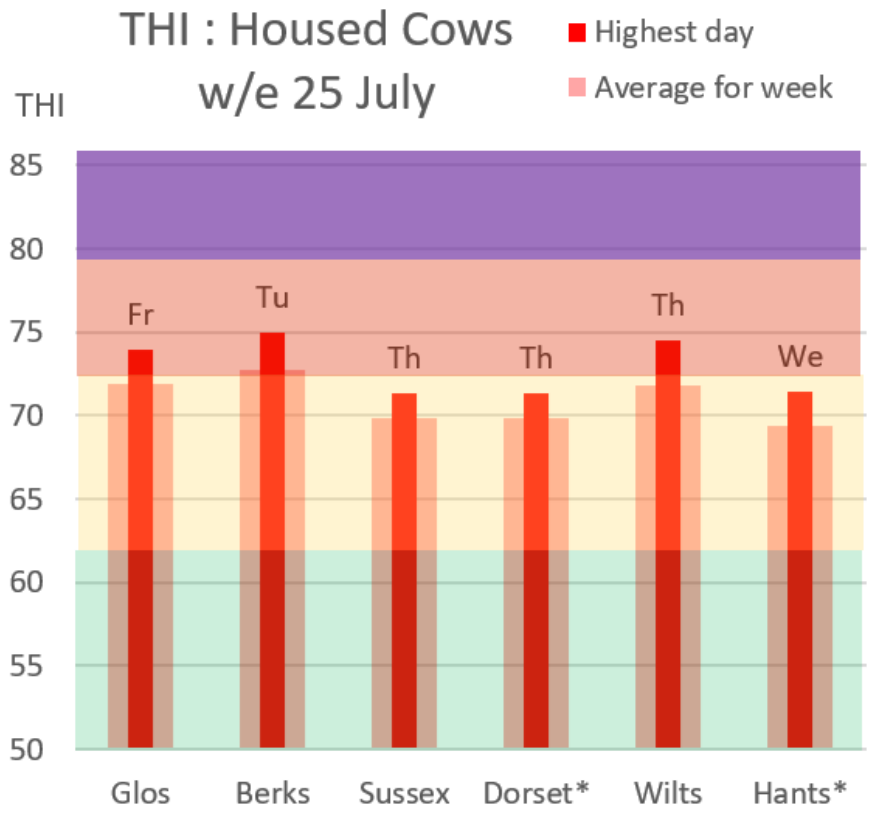
Effects of heat stress
Effects on dry Cows

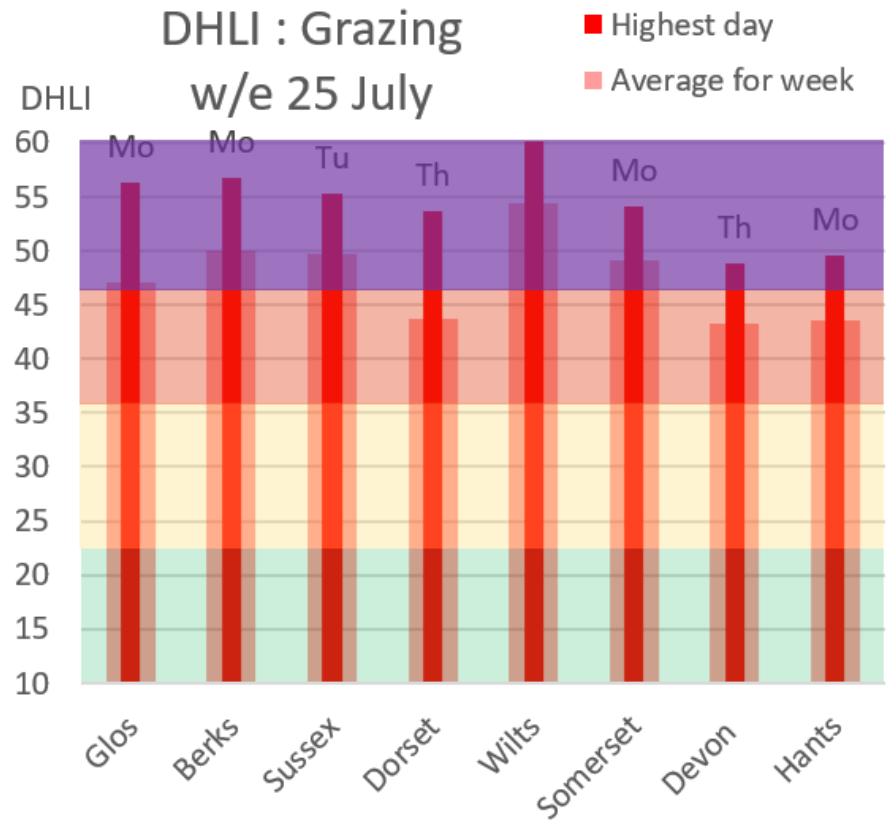
- Raises resp rate (74 vs 48/min, $p<0.01$)
- Reduces milk production in first 8 weeks (30.3 vs 33.1 kg/d, $p<0.01$)
- Reduces DMI post partum ($r=0.33$, $p=0.01$)
- Reduces gestation length ($r=0.24$, $p=0.08$)
- Reduces calf birth weight ($r=-0.20$, $p=0.09$)

NOTE – Florida – Extreme THI values

Toledo, 2020, Florida, USA

Did we get Heat Stress in England (2021) end July

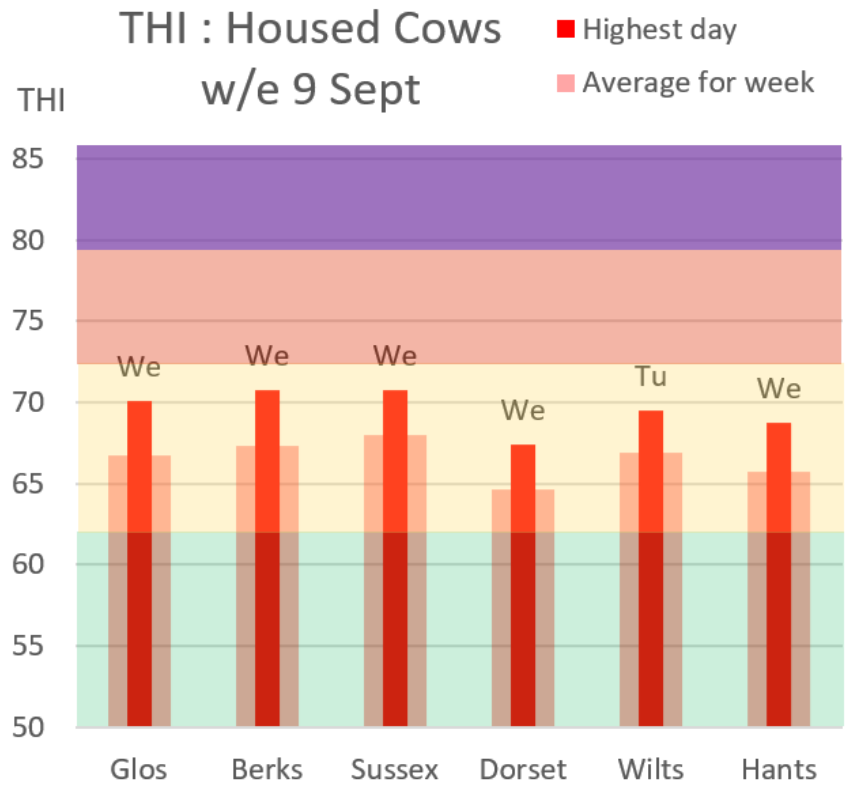


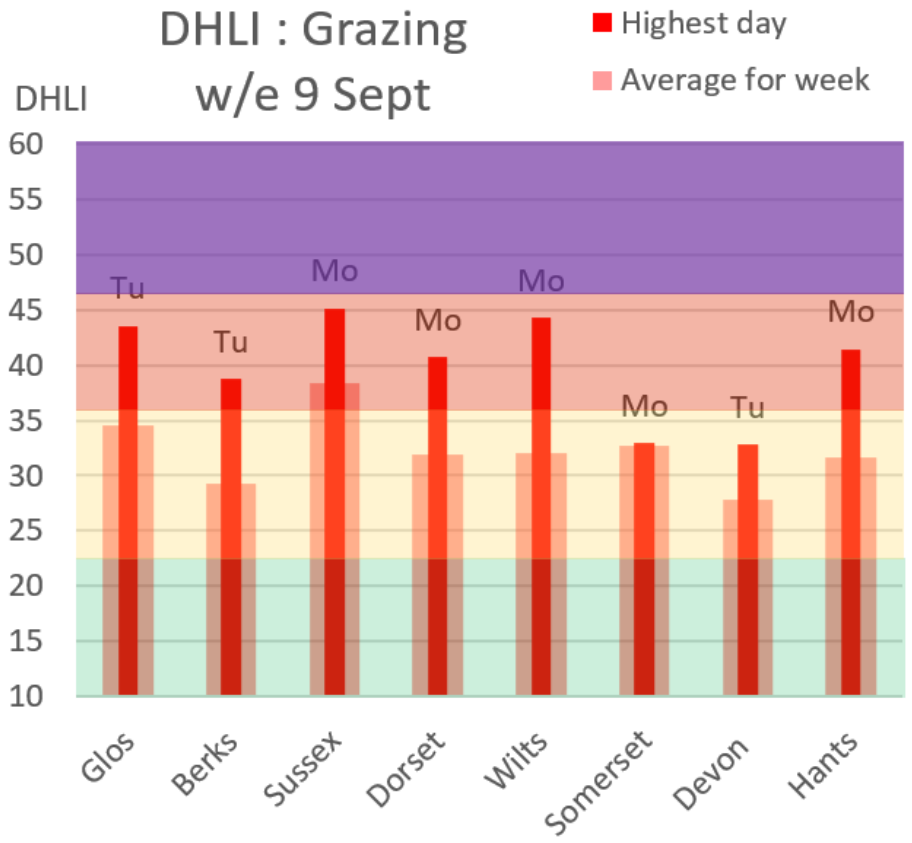


- Grazing has potential to be worse than housed
- Milk yield losses of 3-5 l/day reported by farmers

Chamberlain, 2021, LinkedIn posts

Did we get Heat Stress in England (2021) early September





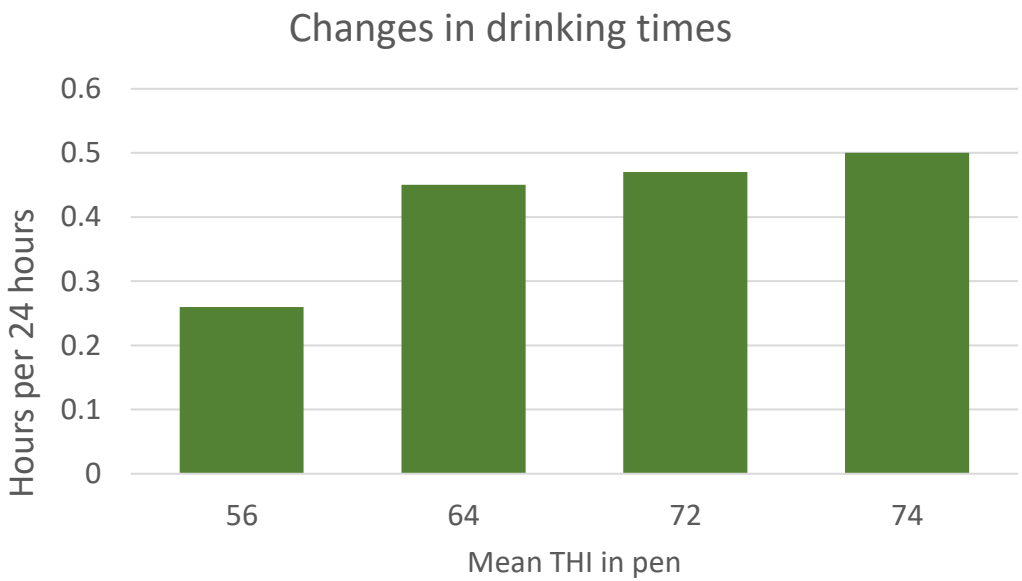
- Shorter day length reduced effect
- Cooler nights allowed heat dissipation

Chamberlain, 2021, LinkedIn posts

Ways to reduce heat stress

Water

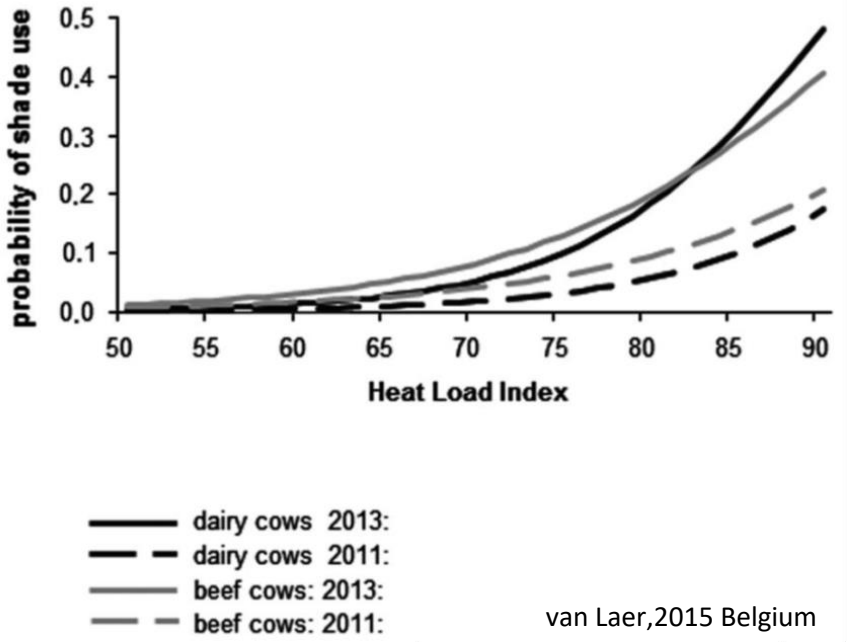
- Critical
- Clean and cool <20°C
- Ample linear space
- Near grazing area
  - Under 100m
- Avoid troughs emptying
  - Thirsty cows
  - Damaged troughs
- High flow or high volume



Cook, 2017, WI, USA

Shade

- Biggest risk factor = direct sunlight
- Provide shade – housing, awnings etc
- Aim 4 – 6 m^2 shade per cow
- Shade when grazing – not easy to achieve required areas
- Maximise eating time / opportunities in evening
- ?? 'Siesta' management
- Cows with shade (Palacio, 2015, Canada)
  - At water trough less (x6.4)
  - Lying down more (x 1.75)
  - Grazed more when THI was high (x 1.5)



van Laer,2015 Belgium

Lallemand, 2021

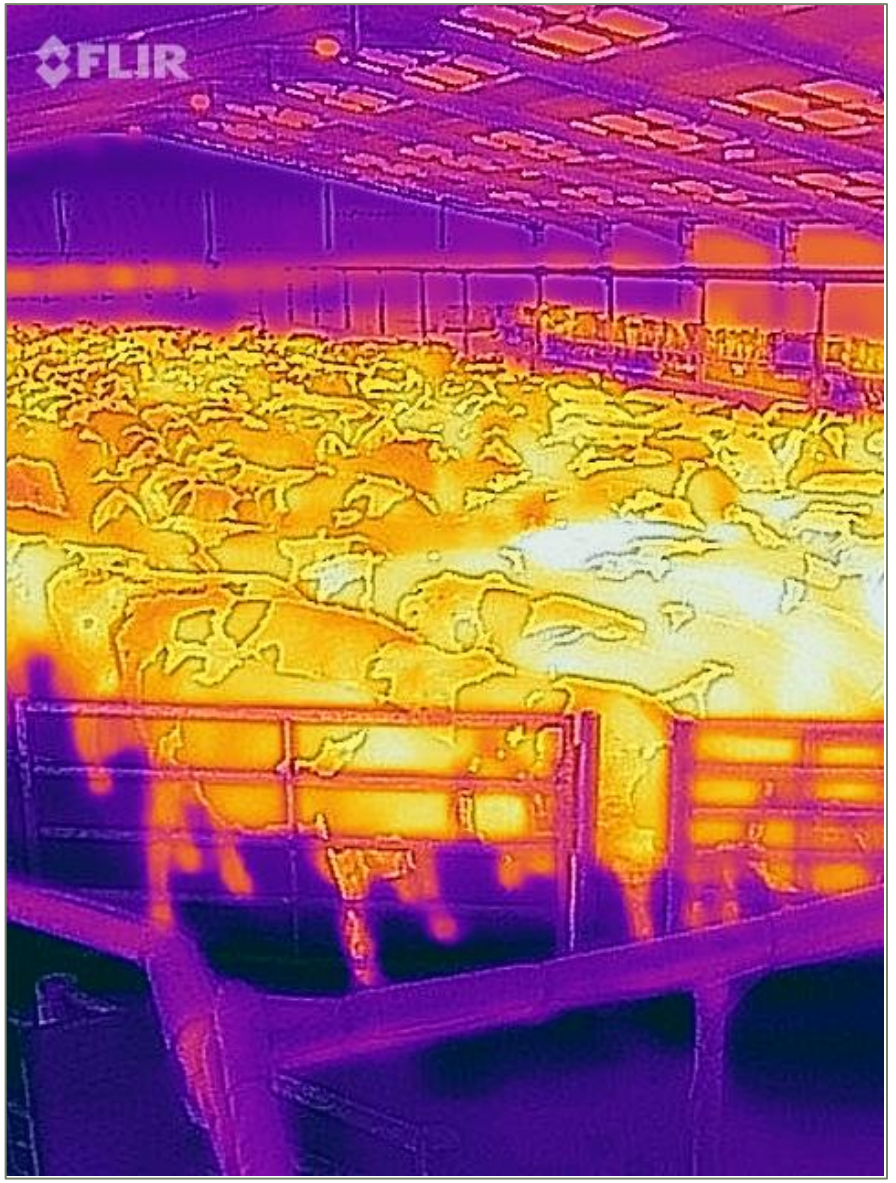
Feeding

- TMR
  - fresh as possible : maximise palatability
  - Can re-formulate to lower fibre / raise fats so that less metabolic heat produced
- Rumen health
  - Buffers – sodium bicarbonate
  - Probiotics to support stressed rumen
- Recognise cows eat better in cool times of day
  - give best grazing in evenings, etc.

Environment and housing

- Avoid over crowding
  - particularly in collecting yard
    - Biggest heat stress area
  - Can cause longer term effects
  - Gentle with backing gate

- Handle at cooler times



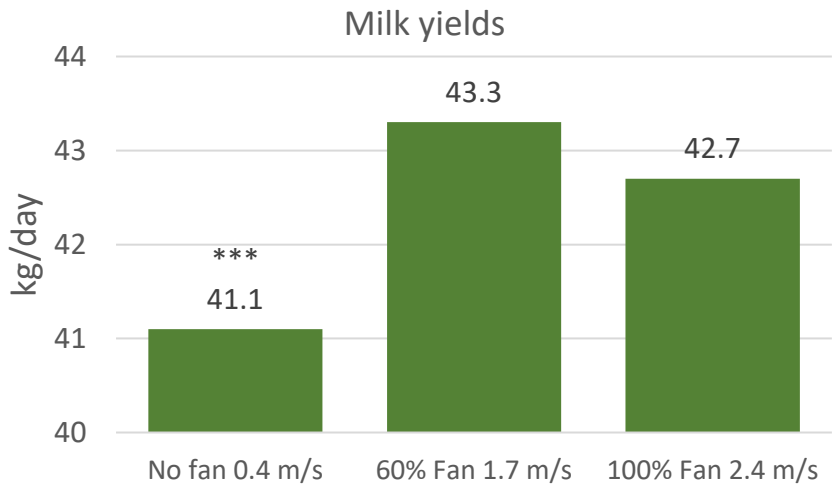
Environment and housing

- Increase natural air movement
  - Open ridges
  - Minimal side walls

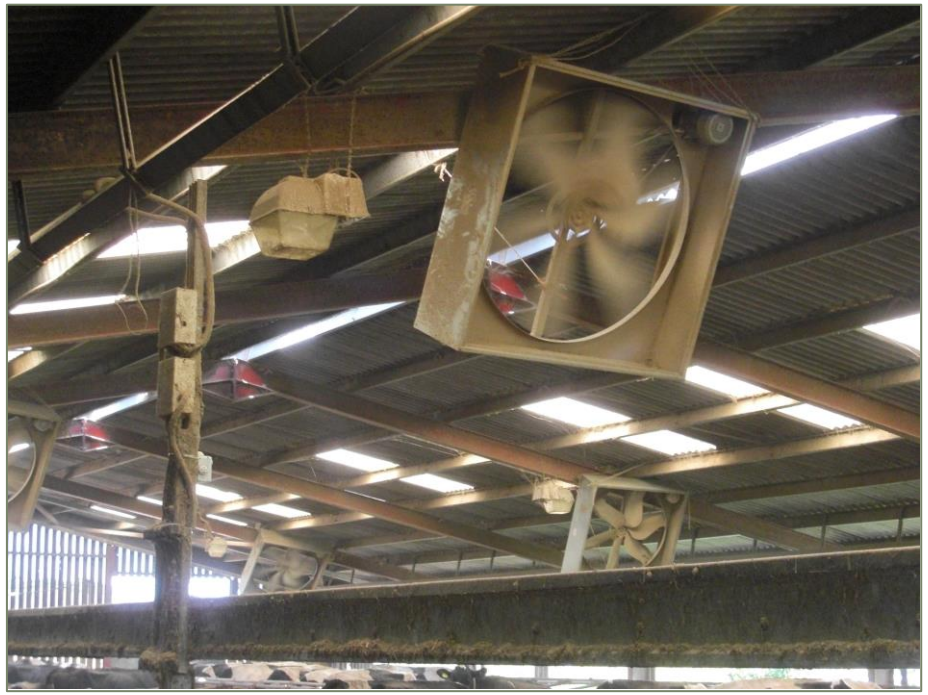
- Open sheds up as much as possible
  - Movable gale-breaker curtains
  - High, open ridge

Fans

- Start with the collecting yard
- 1m wide fan projects air 10m daisy chain as needed
- Target 3-4 m/sec air over areas you want cows to cool
  - Collecting yard
  - Over cubicles and feeding areas
  - 1 m/sec drops THI 2 points (Mader, 2006)



Reuscher,2021, WI, USA



Fans

- Fans need cleaning and maintaining
  - Question role of grill mesh
  - Big drop on efficiency

- Sprinklers
  - Low volume / fine mist
    - latent heat of evaporation cools air
  - Soaking
    - uses high water volumes
  - Both need low humidity and good air movement
    - Limits utilisation

Water – soaking or misting?

- Misting cools the air, soaking wets the cow
- Need low humidity to get required evaporation
- Need good control system and ample water supply

How do we measure success
Are we measuring the right indexes?

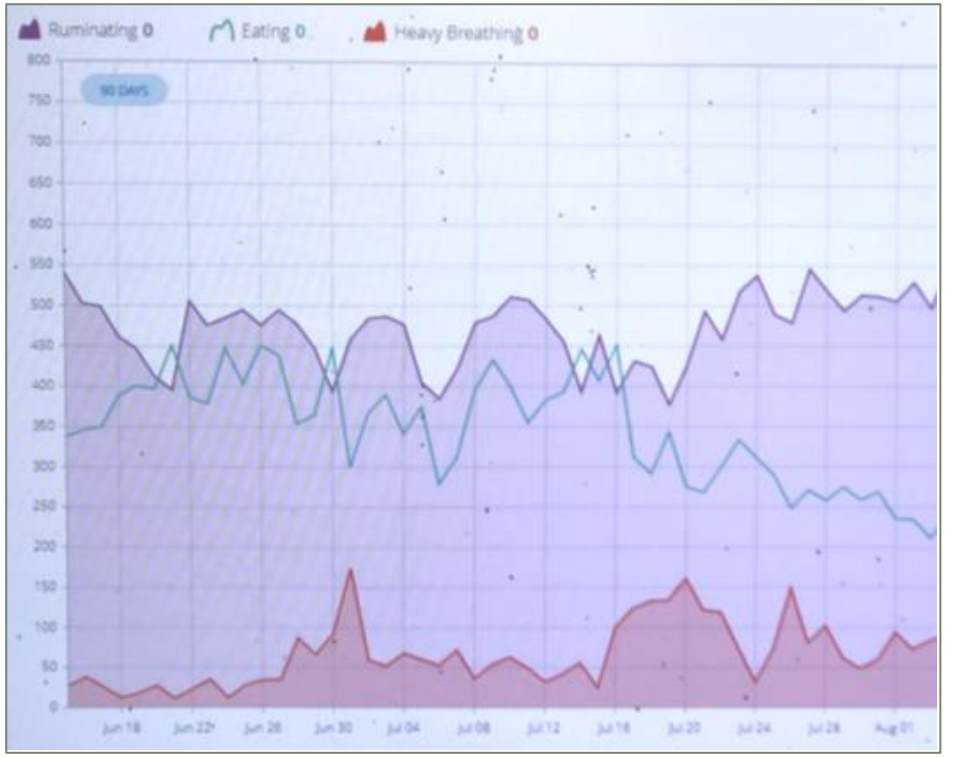
- Want an index that
  - Cope with different management systems
  - Cope with varying amount of shade
  - Take account of acclimatisation
  - Capture benefits of genetic differences
- Determine benefit and ROI of mitigation actions
- Quantify (and audit) risk of heat stress
- Can we predict heat stress 3 – 5 days ahead?

How do we measure heat stress?

- THI and DHLI assess the environment not the cow
  - Temperature, humidity, sunlight
  - Omit wind/fans, shade, feed supplements
  - Do not show effects of mitigation
  - Interpretation difficult and specific to climatic regions.
  - DHLI is the ‘maximal impact’ of continual full sun.

Towards a cow-focused index

- Measure the cow not the environment
- Can be done in research conditions
- Need to develop techniques for on farm use
  - ‘a temperature gauge for cows’
  - Applicable in different climates
  - Work with different management systems
  - Pick effects of fans/shade/supplements
  - SCR – ‘Panting score’ from neck collars



Acknowledgements

- Sponsors
  - Lallemand Animal Nutrition
  - Trouw Nutrition (UK)
- Farms involved
  - Hartpury College and University, Glos
  - Phil Nash, Horsham, Sussex
  - James Yeatman, Dorchester
  - Mapledurham Estates, Reading

TotalDairy 2021 #TopPriorities

- Recognise and look out for heat stress
- Measure and quantify heat stress
- Take mitigating actions
  1. Ample water
  2. Provide shade
  3. Dietary modifications
  4. Cooling fans
     - Misting systems

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