A YEARLONG STUDY: EFFECTS OF WEATHER AND ANIMAL CHARACTERISTICS ON RESPIRATION RATE IN DAIRY CATTLE

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Respiration rate (RR) in cattle

- **Early indicator of heat stress** (as pictured)

- Thresholds differ widely in what is considered "high" or "hot":
  - Veterinary textbooks: 30 – 50 breaths/min
  - Literature range: 15 – 150 breaths/min

- Metabolic rates and heat dissipation appear to affect RR:
  - Individual characteristics and behavior
  - Weather

Our goal was to determine which weather variable or thermal index best predicted RR and to evaluate how individual animal characteristics affected RR outcomes

California Dairy Sustainability Summit

The study

406 female cattle: 11,210 records

- Calves, heifers, lactating and dry cows (Holstein & Jersey)
  - Newborn to 6th lactation cattle
  - Weekly records for age, lactation number, production (volume and DIM), health and reproductive status

- Observed once a week from Oct 2016 to Aug 2017
  - 7:30 to 17:30h
  - Balanced by breed, age and production

- 13 observers involved recording:
  - RR
  - Posture (standing vs. lying)
  - Location within pen (e.g., lying vs. feeding areas)

Portable weather station in place

- Recorded every 5-min: air temperature (**AT**), humidity, wind speed, rainfall, solar radiation and black globe temperature

Preliminary data analyses were conducted using SAS

- All weather variables above (except for rainfall), 15 different thermal indexes, and other 5 daily averages were examined
- Mixed, linear and logistic regression were estimated

In conclusion,

- **AT** was the best predictor of RR
- **Animal characteristics** should be considered when making decisions about heat load management

These factors have important implications for the effectiveness of heat abatement and, ultimately, the sustainability of managing hot weather on CA dairies.

Air temperature alone best predicted RR in cattle

- Among 25 parameters tested: 35% of variation explained
- AT range during observations: 35 to 111°F
- RR range: 16 to 184 breaths/min

- Every **10°F** increase in AT resulted in **+8 breaths/min** (Fig. 1): **Calves** were the **most vulnerable** while **dry** cows were the **least sensitive** group (10 vs. 6 breaths/min; $P<0.001$; Fig. 2)
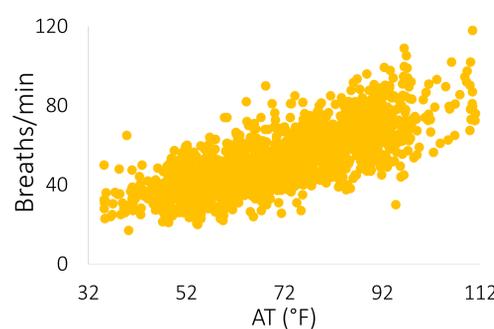

Fig 1. Relationship between AT and mean RR

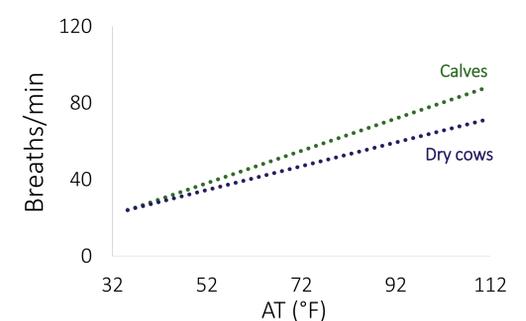
Fig 2. Relationship between AT and RR by category
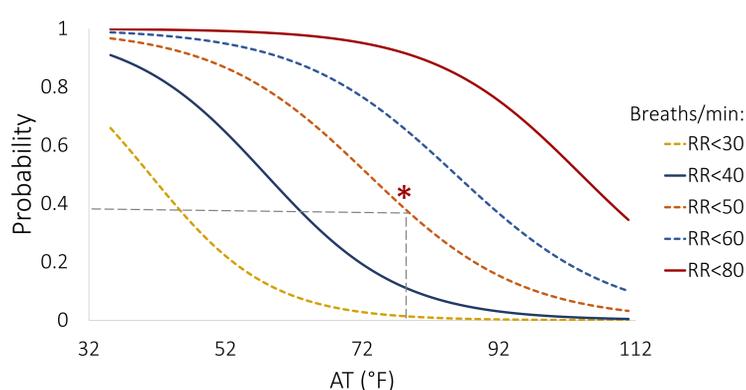
- RR less than 50 breaths/min were unusual

Fig 3. Probability of RR at different AT

*At 76°F, only 4 for every 10 cows were likely to have RR below this threshold, for example (Fig 3.)

Other individual characteristics were less pronounced

- Posture did not affect RR (50 vs. 51 breaths/min; $P=0.169$)

- **Jersey** animals were **more sensitive** than Holsteins ($P=0.021$), **but the difference was minimal** (+2 breaths/min every 10°F).

- RR were the **lowest** when lactating cows were **near the feed bunk** compared to lying stalls or open areas (46 vs. 53 breaths/min; $P<0.001$) **likely due to water-based cooling** provided there.