Project Update

P6a: Resilient cattle (heat tolerance)

December 2024

P6a Resilient Cattle (heat tolerance)

Managing dairy cattle in hot, humid conditions is an increasing issue for the Australian dairy industry, with climate change and the trend towards intensification.

Under the supervision of Dr Anna Chlingaryan, Dairy UP PhD student, Alice Shirley, is exploring the diversity in dairy cattle responses to heat events. By collaborating with DairyBio and DataGene, the outcomes of this work will contribute to developing an improved tool for breeding dairy cattle with improved heat tolerance.

Heat Tolerance ABV

Published by DataGene, the Heat Tolerance Australian Breeding Value allows farmers to identify and breed animals with greater ability to tolerate hot, humid conditions with less impact on milk production.

The current Heat Tolerance ABV is derived from genomics only – the DNA testing of animals. It has a relatively low reliability which has contributed to slow uptake by farmers.

The Dairy UP project aims to develop phenotypes for heat tolerance to add to the model for the Heat Tolerance ABV. Phenotypes are indicators of animal performance that can be measured in commercial animals. Combining genomics with traditional and new measures of heat tolerance should improve the reliability (accuracy) of the Heat Tolerance ABV.

Data, Advanced Technology and Automation (DATA)

Dairy UP's P6 project is exploring ways to use existing farm, climate and industry data to develop ways to monitor cows and systems. Reports and tools based on this data could be used by farmers to make better decisions, for example about heat management, health and feeding.

Copious volumes of data are collected across the Australian dairy industry. Until now this has been stored in numerous, separate data bases.

This project aims to utilise data, advanced technologies and automation to integrate information from multiple sources to enable the creation of tools that support on-farm decisions.

P6 is a suite of three projects that combine animal science and data science. Each project is being undertaken by a PhD student.

- P6a: Resilient Cattle (heat tolerance).
- P6b: Resilient Cattle (health): early intervention for improved animal health, enabled by advanced sensing.
- P6c: Digital Feeding – data-driven feeding to optimise grain allocation in pasture-based herds.

This document provides an overview of Project P6a Resilient Cattle (heat tolerance).

Enhancing phenotype calculation (Dairy UP)

Dairy UP is developing a hybrid artificial intelligence (AI)-based model (HAIM) to improve the assessment of heat tolerance in dairy cattle.

The aim is to enhance the heat tolerance phenotype calculation using machine learning techniques and 20 years of historical climate and dairy cattle production data.

Traditional methods for determining heat tolerance in dairy cattle involve statistical models that use the rate of decline in milk yield as Temperature-Humidity Index rises above 60. The developed HAIM combines the predictive capabilities of machine learning algorithms with these established statistical models, allowing for the detection of intricate relationships within the extensive data. The HAIM has the potential to reveal patterns that might remain hidden when using traditional models alone, enhancing the understanding of heat tolerance in dairy cattle and the identification of more heat-tolerant animals.

Collecting phenotypes with sensor technology (Dairy UP)

Dairy UP is using innovative sensor technologies to extract value from data sources data (core body temperature) through advanced methods (machine learning).

Artificial intelligence is being used to build animal datasets to improve the understanding about which animals are more susceptible to heat.

Cows on three Australian pasture-based dairy farms have been fitted with rumen sensors (reticuloruminal boluses) to monitor core body temperature, every 10 minutes, 24 hours a day.

A water threshold model has been developed to account for water intake, isolating the impact of drinking events on core body temperature.

A total of 1429 animals were involved in this research, plus 28 heifers from the University of Sydney farm in NSW.

In addition, climate data from the past 20 years was obtained from the Bureau of Meteorology to match the observations from the cows.

Progress: October 2024

Two experiments are completed, and further research has been flagged.

Results confirmed significant variation between animals' reticulorumen temperature (core body temperature) and their drinking behaviour over time. This work also demonstrated the core body temperature of cattle increased at lower Temperature and Humidity Index (THI) levels than previously thought.

For example, the rumen sensors were indicating a rise in core body temperature at 67 THI. Until now, it has been recommended that herd managers prepare for a heat stress event at 70 THI, with negative effects on production expected at 75THI.

The research also confirmed that cows drink more often during summer and less in winter. As expected, cows in herds in warmer regions also returned to the trough to drink more times, on average, in a day compared to those in cooler climates.

A limitation to this study was that drinking events were included and as such affected by the temperature of water as the cow drinks.

Next steps

In further analysis, drinking events will be removed from this data to determine the effect of heat on the core temperature of pasture-based dairy cattle.

This information will be analysed with climate data from Bureau of Meteorology (BOM) stations to fill knowledge gaps and develop a better understanding of the link between cow behaviour and the weather.

The team will also collaborate with smaXtec – an animal health software company – to include data from more animals.

Combining phenotypes and genotypes (DairyBio)

This collaborative project is being undertaken by DairyBio and La Trobe University PhD student, Laura Jensen under the supervision of Professor Jennie Pryce.

DairyUP
Unlocking potential

This project is combining the genetic and performance data from animals with a variety of approaches including the sensor technologies from the Dairy UP project.

This information may allow the model for the Heat Tolerance ABV to be extended to incorporate sensor phenotypes which could help to identify animals that better tolerate hot and humid conditions with less impact on their milk production.

Sensors are one example of new research methods that could improve how we select for heat tolerance, capturing its full complexity. Success in this area will come from collaboration among animal scientists, combining genomics with traditional and new measures of heat tolerance.

Collaboration

Dairy UP
DairyBio (Victorian Government)
DataGene
Charles Sturt University,
SmaXtec
University of Sydney

Published articles

Shirley A. K. et al (2024) Review: Ruminant heat-stress terminology. Animal Volume 18, Issue 9.

Pryce Jennie E., et al (2022) Impact of hot weather on animal performance and genetic strategies to minimise the effect. Animal Production Science 62, 726-735

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Delivery organisations

The University of Sydney Dairy Research Foundation
NSW Department of Primary Industries
Saibus
Dairy Australia

Partner organisations

NSW Farmers Growing the best
eastAUSmilk
Dairy NSW
Dairy Australia
AFMH
Leppington Pastoral Company Pty Ltd
NSW Local Land Services
Norco

Additional program supporters, collaborations or partnerships

Charles Sturt University | DairyBio | DataGene | Eagle Direct | Entegra
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