

Selection for heat tolerance

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Climate change and rising temperatures pose significant challenges to dairy production, particularly in warm and humid regions. Heat stress negatively affects milk yield, fertility, and overall animal welfare, leading to economic losses for farmers. Genetic selection for heat tolerance provides a sustainable, long-term solution to enhancing dairy cattle resilience under heat stress conditions.

To facilitate selection for improved heat tolerance, the team at DairyBio, Agriculture Victoria, has developed genomic estimated breeding values (GEBVs) for heat tolerance. This trait is defined as the rate of decline in milk, fat, and protein yield under heat stress conditions. The initial model, based on production and weather records from 2003 to 2013, used a temperature-humidity index (THI) threshold of 60 and a random regression approach to estimate production decline for individual cows. These slope estimates were used to define daughter trait deviations for their sires, with genomic best linear unbiased prediction (GBLUP) applied using a 50K SNP panel. The reference population initially included 2,300 Holstein sires and 2,189 cows, along with 575 Jersey sires and 1,188 cows, yielding an average prediction reliability of 0.38 for both breeds.

A recent update expanded the dataset to include production and weather records from 2000 to 2021, increasing the reference population to 4,947 sires and 42,419 cows for Holstein, and 1,031 sires and 10,314 cows for Jersey, with an improved SNP density of 74K. This led to an increase in the reliability of heat tolerance predictions for Holstein (0.48), though no improvement was observed for Jersey. The heat tolerance breeding values developed in Australia have been independently validated in both Australia and the United States.

By integrating genetic selection with improved management strategies, the dairy industry can enhance herd resilience, ensuring stable productivity in the face of increasing climate variability.

Keywords: Climate change, heat tolerance, THI.