Introducing Methane Efficiency!

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In April 2023, Lactanet Canada will make history by publishing the first official Methane Efficiency genetic evaluations for the Holstein breed. This collaborative initiative with Semex Alliance will make Canada the first country globally to deliver evaluations aimed at reducing methane emissions in dairy cattle.

Methane (CH_4) is a potent greenhouse gas (GHG) that warms the atmosphere at a rate 25 to 27 times more than that of carbon dioxide. The average Holstein cow produces nearly 500 g of CH_4 per day or 180 kg per year, mainly due to enteric fermentation (i.e.: burping). A 30% difference above or below average can also be seen between cows, meaning two cows in the same herd can differ in their CH_4 emissions by up to 110 kg per year. Methane emissions can also represent a loss of 4% to 7% gross energy intake for the animal[1]. The emission differences between animals and loss in energy intake highlights the opportunity to decrease methane emissions by using genetic selection.

The Data

As discussed in our previous CH_4 article, Genetic Selection for Reduced Methane Emissions, collected CH_4 data has been made possible via the Efficiency Dairy Genome Project (EDGP) and the Resilient Dairy Genome Project (RDGP, see http://www.resilientdairy.ca/). These research projects also included the collection of mid-infrared (MIR) spectral data from milk

samples for each cow with CH_4 data. Researchers from the University of Guelph used artificial intelligence and machine learning approaches to determine that a cow's milk MIR data can be used as a good predictor of its CH_4 emissions. Thanks to this pivotal result, Lactanet was able to replicate this research through several data processing steps and develop CH_4 predictions using milk spectral data and CH_4 data collected from research herds in Canada. The resulting data used for Methane Efficiency genetic evaluations is milk MIR predicted CH_4 on first lactation Holsteins between 120 and 185 days in milk. This includes records on over 700,000 cows in milk-recorded herds across Canada.

Genetic Evaluation for Methane Efficiency

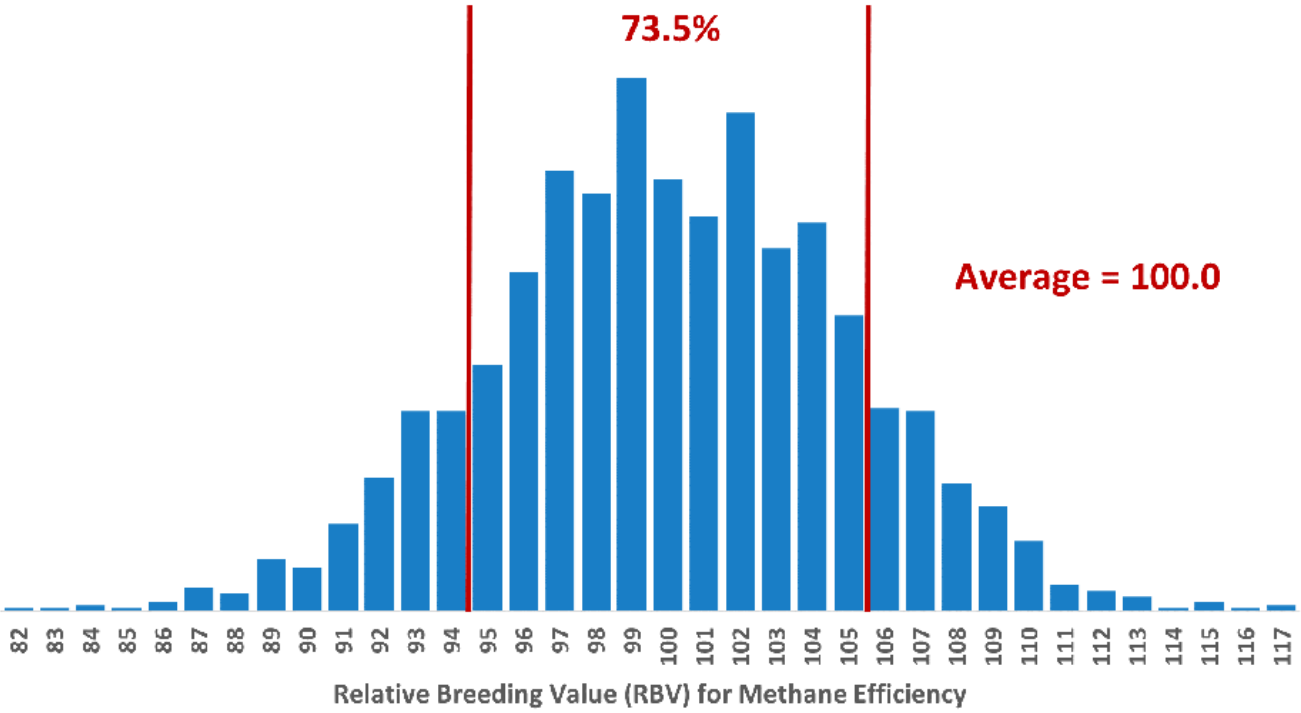
Like genetic evaluations for Feed Efficiency and Hoof Health, Methane Efficiency evaluations are calculated using Single-step methodology, which uses all pedigree, performance, and genotypic data to calculate genomic evaluations. The focus of Canada's Methane Efficiency evaluations is on selection for reduced CH_4 without affecting production levels. Therefore, Methane Efficiency can be defined as methane production genetically independent of milk, fat, and protein yields. Methane Efficiency has a an average reliability surpassing 70% for genotyped young bulls and heifers.

Interpretation and Delivery

Methane Efficiency is a functional trait expressed as a Relative Breeding Value (RBV) averaging 100 and generally ranging from 85 to 115. For the group of over 2,000 sires with an official evaluation for Methane Efficiency, approximately 74% of the RBVs will fall between 95 and 105 (Figure 1). The higher a sire's RBV the less CH_4 their daughters are expected to produce so for every 5-point increase in a sire's RBV for Methane Efficiency, daughters are expected to produce approximately 3 kilograms

less CH_4 per year. This equates to a 1.5% reduction in CH_4 emissions per cow per year and a 20% to 30% reduction by 2050 is possible.

Figure 1. Distribution of Methane Efficiency Relative Breeding Values (RBV) for Official Sires

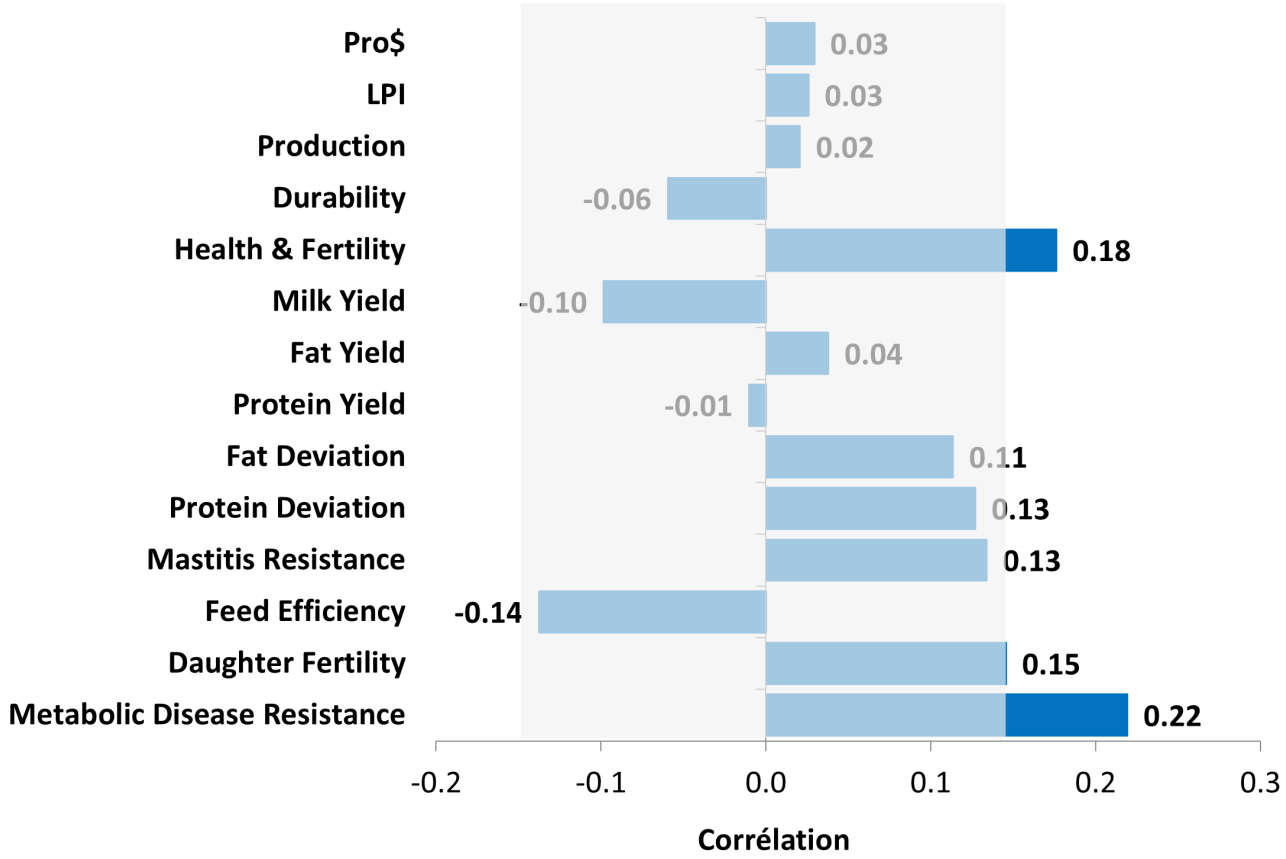


The delivery approach for Methane Efficiency evaluations for heifers and cows in Canadian herds will mimic the current strategy used for Feed Efficiency, however, Feed Efficiency and Methane Efficiency will be bundled as sustainability traits. Starting with the April 2023 genetic evaluation release, Methane Efficiency RBVs will be automatically published for all Holstein females that are linked to a DHI herd inventory. Progeny proven sires that have an official evaluation for Methane Efficiency based on their milk recorded daughters in Canada with MIR data will also automatically have Methane Efficiency published. All other males and females will require Methane Efficiency to be purchased. More information regarding how to purchase Methane Efficiency evaluations will be available in our next article.

Correlations With Other Traits

Methane Efficiency does not have a significant undesirable correlation with any other trait, including LPI and Pro$ as well as the production traits (Figure 2). This is expected since Methane Efficiency is designed to be genetically independent of milk, fat and protein yields. There is a slight positive relationship between the Health and Fertility component of LPI and Metabolic Disease Resistance.

Figure 2. Holstein Proof Correlations Between Methane Efficiency and Other Traits (shaded area represents correlations within ± 15%)



Summary

After years of collaboration and ground-breaking research, April 2023 marks Lactanet's introduction of Methane Efficiency evaluations in the Holstein breed. This evaluation was made possible by collecting methane

(CH4) emission and milk MIR spectral data on individual cows in various research herds. Canada's new Methane Efficiency evaluation focuses on selection for reduced CH4 emissions without affecting production levels. Methane Efficiency is not yet included in the LPI or Pro$ formula but inclusion in these indexes will be considered in the future, after more research and experience with this new trait. Using Methane Efficiency evaluations is an easy and cumulative way to contribute to the environmental sustainability of the dairy industry!

References

1. Benchaar, C. 2023. Nutritional Strategies to Mitigate Enteric Methane Emissions From Dairy Cows: State of Knowledge and New Perspectives Presentation at the Second virtual symposium of the Sherbrooke Research and Development Centre, Agriculture and Agri-Food Canada, January 24, 2023.

By Hannah Sweett, Ph. D.

Hannah discovered her passion for agriculture during her undergraduate degree at the University of Guelph and through work experience in the dairy industry. She holds a B.Sc. in Molecular Biology and Genetics and a Ph.D. in Animal Genetics, focusing on the genetic improvement of dairy cattle fertility.

By Brian Van Doormaal