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Project Summary

Improvement of Feed Efficiency, Carcass Traits, Fertility and Profitability in Commercial Beef Cattle

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Summary: Genomic tools can help the beef industry address challenges in global competitiveness, production efficiency, and sustainability. **This project bought together international leaders in beef genomics to leverage vast amounts of genomic data and deliver commercial value to producers.** The first 'made in Canada' genomic tool was developed to assess hybrid vigour. High hybrid resulted in a net return of $160/cow/year. Two multi-trait indices are being developed for commercial crossbred cattle in Alberta. 1) Feeder Profit Index to improve growth, feed efficiency, carcass quality and profitability in feeder cattle and 2) Replacement Heifer Profit Index to improve hybrid vigour, feed efficiency, fertility and lifetime return for cows in the herd.

Why it Matters

The Canadian beef industry contributes more than $20B each year to the national economy, yet is challenged to remain globally competitive, use resources efficiently, and address health concerns, climate change and environmental sustainability. To address these challenges, the beef industry must continue to evolve using advanced technologies such as genomics. The development of new, lower cost and more accurate breeding values can improve traits related to carcass quality and feed efficiency and increase the use of genomic tools in the Canadian beef industry.

The goal for this project was to accelerate genetic improvement of Canadian seedstock through increased use of genomic technologies, combined with multi-trait value indices that perform in commercial crossbred beef cattle.

What was Done

Internationally recognized leaders in beef cattle genomics and an engaged network of end-users came together for this project. Cattle genomic data from the Canadian Cattle Genomics Project, the 1000 Bulls Genome Project and a research center in Ireland were combined and analyzed. The data were screened for functional impact on traits of interest and incorporated into the Functional Annotation of Animal Genomes global initiative.

Additionally, 1966 crossbred steers and heifers in AB were characterized for feed intake, feed efficiency and performance traits. Another 5053 slaughter heifers and steers were characterized for carcass quality traits. Finally, 564 cattle were measured for enteric methane and carbon dioxide emissions. Replacement heifers (412) were followed for 5 parities and characterized for feed efficiency and fertility traits.

All animals, plus potential herd bulls, were genotyped. Genomic information from these animals was combined in a dataset totalling 27,000 animals from different sources. Genome-wise association analyses and genomic predictions were conducted for 18 growth, feed efficiency and carcass quality traits.

What was Found

1) **Progress in Genomic Analyses**

In total, 43 million genomic variants were detected and screened for functional impact on traits of interest. Additionally, a comprehensive database for future research was developed, representing >500 bulls from 17 breeds. Molecular breeding values, which predict the transmitting ability of traits to offspring, in crossbred cattle were developed for 18 growth, efficiency and carcass traits with improved accuracy.

2) **Benefits of Hybrid Vigour**

Increased hybrid vigour optimized fertility, stayability, adaptability and lifetime productivity. It also improved feed efficiency and health resilience, and reduced methane emissions. **High hybrid vigour resulted in an increased economic benefit of $160/cow/year.** Based on these benefits, the first 'made in Canada' genomic tool for crossbred cattle was released - EnVigour HX™. This tool provides parentage, breed composition and a Vigour Score that measures hybrid vigour. EnVigour HX™ was licensed to Neogen Canada in 2019.

3) **Development of Multi-Trait Selection Indices for Commercial Crossbred Cattle**

The **Feeder Profit Index** (FPI) was developed to improve the growth, feed efficiency, carcass quality and profitability of feeder cattle. The FPI was validated using 124 sires to produce 1929 feeder progeny. There was greater than 500 units of difference in FPI between sires and for every 100 units of improvement in FPI, there was **an increase of $29 in net income per feeder.**
Development has also started on the **Replacement Heifer Profit Index** (RHI) with the goal of improving the hybrid vigour, feed efficiency, fertility and lifetime productivity of cows in the herd.

What it Means

This project was able to leverage vast amounts of genomic data and identify genetic variants of interest. This data was also used to develop molecular breeding values, specific to commercial cattle in Alberta, with improved accuracy for 18 important growth, efficiency and carcass traits. The continued collection of genomic data in beef cattle and improvement in genomic analyses will help to generate new, more efficient and less expensive tools to improve cattle and the industry.

One such tool, EnVigour HX™, is used to measure hybrid vigour. The Canadian beef industry could benefit from increased crossbreeding as high hybrid vigour can optimize traits that are difficult to improve through genomic selection, including fertility, health, and lifetime productivity. High hybrid vigour was also shown to improve efficiency and sustainability.

Two multi-trait selection indices specific to commercial crossbred cattle in Alberta have also begun development through this project. The FPI increases profit and carcass value of feeders by selecting for superior sires and/or cows. While development has started on the RHI, work is on-going to refine, test and validate the index in commercial herds.

Work is still being conducted on the genomic database amassed in this project, with the goal of supporting future research and development of genomic tools for the commercial beef industry. We are always looking for more producers to participate in genotyping, as well as industry partners to continue delivering value to the beef industry. **Please contact us with any questions.**

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