



FACT SHEET

Applied Forage & Cow-Calf Research Lardner Lab

#2026.03

APPLICATION OF DNA PARENTAGE TESTING AND ENVIGOUR HX™ TO EVALUATE BULL PROLIFICACY AND HEIFER PERFORMANCE IN BEEF CATTLE BREEDING PROGRAMS IN WESTERN CANADA

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Introduction

Multi-sire breeding pastures are widely used in Western Canadian cow-calf systems because they simplify breeding management. However, when multiple bulls are run together, producers typically do not know which bull sired which calf. This limits the ability to evaluate individual bull fertility, breeding dominance, and long-term genetic contribution to the herd. DNA parentage testing now provides accurate sire identification, while EnVigour HX™ genomic testing quantifies individual hybrid vigor. This study evaluated how combining these technologies can improve bull selection, optimize replacement heifer development, and accelerate genetic progress in commercial beef herds. This study aims to:

- (i) Determine individual bull prolificacy in multi-sire breeding pastures using DNA parentage testing.
- (ii) Develop a Bull Prolificacy Index (BPI) to compare sire contributions.
- (iii) Assess repeatability of bull prolificacy across years and age classes.
- (iv) Quantify genomic hybrid vigor using EnVigour HX™ testing.
- (v) Evaluate relationships between genomic vigor score and age at first calving, conception rate, average wean weight per calf and lifetime productivity of replacement females.

Data Source and Analysis

The study was conducted on a commercial cow-calf ranch in southwest Saskatchewan over six breeding seasons (2014–2019). A total of 46 bulls were used annually in four multi-sire breeding groups consisting of mature cows, three-year-old cows, and replacement heifers. Bull-to-cow ratios ranged from 1:19 to 1:27. Bulls included purebred Angus sires and crossbred Beef Booster composite sires. Calving occurred in a defined season, allowing assessment of first-cycle calving performance. DNA parentage testing was conducted to assign calves to their respective sires, allowing calculation of a Bull Prolificacy Index (BPI). The BPI was defined as the ratio of the number of calves sired by an individual bull relative to the average number of calves sired by all bulls within the same breeding group and year. Bulls with BPI values greater than 1 were considered highly prolific. Genomic breed composition and hybrid vigor scores were



determined using the EnVigour HX™ test. Replacement heifers were followed across multiple parities to evaluate the effect of hybrid vigor on age at first calving, conception rate, average wean weight per calf and lifetime productivity, including cumulative kilograms of calf weaned.

Results and Discussion

Bull Prolificacy and Calving Distribution

Substantial variation in bull prolificacy was observed within and across breeding seasons. Bull Prolificacy Index values ranged from very low to more than three times the group average, indicating that a small number of sires contributed disproportionately to calf crop size. Yearling bulls generally exhibited lower BPI values compared with two-year-old and mature bulls. However, high-performing yearling bulls tended to remain high-performing sires in later years, indicating moderate repeatability of bull prolificacy. Therefore, early DNA parentage testing of yearling sires provides an opportunity to identify superior breeding bulls before producers invest in additional seasons of use or semen collection. By contrast, low-performing yearling bulls rarely improved substantially with age. Removing these bulls early can reduce breeding risk and improve herd reproductive efficiency.

Regardless of BPI group as low-, average- or high-BPI, most calves were born early in the calving season; however, high-BPI sires produced a significantly greater proportion of calves during the first 21 days of calving. This early calving advantage is economically important, as calves born earlier tend to have greater weaning weights and replacement heifers born early are more likely to remain productive in the herd. Therefore, selecting bulls that sire more first-cycle calves directly improves both calf performance and subsequent cow fertility.

Performance of Replacement Heifers and Grand-Calves

As bull prolificacy increased, the number of daughters sired, retained, and subsequently produced calves also increased. Daughters of high-BPI sires generated more grand-calves over their productive lifetimes compared with daughters of low-BPI sires. While average weaning weight per calf did not differ substantially among low, average and high BPI sire groups, total kilograms of calf weaned per sire increased markedly with increasing BPI. High-BPI sires produced approximately two- to five-fold greater cumulative kilograms of weaned calf through their retained daughters compared with low-BPI sires.

Genomic Vigor Scores and Female Performance

Genomic testing using EnVigour HX™ revealed clear differences in hybrid vigor among animal groups. Purebred Angus bulls averaged approximately 34% genomic vigor, while crossbred Beef Booster composite bulls averaged 86% vigor, reflecting their higher heterozygosity and crossbred origin. Replacement heifers showed increasing average vigor over successive years, rising from approximately 53% to 72%, indicating that the producer progressively selected higher-vigor crossbred females as replacements. Calves born into the herd averaged approximately 73% genomic vigor, confirming successful retention of heterosis in the breeding system. These results demonstrate that genomic vigor testing



provides an effective and objective method for monitoring crossbreeding outcomes in commercial herds.

Increasing heifer's hybrid vigor was associated with improved age at first calving, conception rate, average wean weight per calf and cow lifetime kilograms of calf weaned productivity. However, little additional benefit was observed beyond 75% vigor score, suggesting diminishing returns beyond this threshold in commercial production environments.

Implications

Parentage and genomic results reveal a powerful combined strategy for herd improvement. DNA parentage testing identifies high- and low-contributing bulls on long-term herd productivity and profitability in multi-sire pastures. Genomic vigor testing ensures replacement females maintain optimal heterosis. Bulls with high prolificacy and crossbred genetic backgrounds offer dual advantages: increased calf numbers and enhanced hybrid vigor in offspring. Also, genomic vigor testing provides a practical tool to guide replacement heifer selection, with optimal performance observed at 70–75% vigor score. The integration of these technologies enables commercial producers to move beyond visual selection and pedigree alone, adopting data-driven breeding decisions that improve fertility, longevity, and lifetime herd productivity.

Acknowledgements

Funding for this research was provided by the Saskatchewan Ministry of Agriculture's Agricultural Development Fund and the Saskatchewan Cattlemen's Association. The authors acknowledge the cooperating ranch for access to herd records and thank technical staff and students for assistance with data collection and genomic analyses.

References

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