Behind the Scenes of a Dairy Cattle Genetic Evaluation: The Foundation

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- Genetics Tools
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When a dairy producer opens the Genetic Evaluation Summary page for a bull or a cow on Lactanetgen.ca, they will see breeding values for a whole host of different traits, such as, Milk Yield, Daughter Fertility, Conformation, Herd Life, Mastitis Resistance, Calf Health, or Methane Efficiency. Behind each of these published numbers, lies a complex and carefully coordinated process involving producers, milk-recording organizations, breed associations, veterinarians, laboratories, geneticists, data analysts, and computing systems. A national genetic evaluation may combine millions of performance records, generations of pedigree information, and genotypes from hundreds of thousands or even millions of animals.

The goal of this process is to answer a difficult question:

How much of an animal’s performance is determined by genetics, rather than management, environment, or chance?

Over the course of this article series, you’ll learn that genetic evaluations are much more than rankings of highest-producing or healthiest animals. Instead, they are designed to identify the genetic differences among animals while accounting for the many non-genetic factors that also affect performance.

It Starts with the Phenotype

Every genetic evaluation is driven by phenotypes. A phenotype (record) is an observed or measured characteristic of an animal. Examples include:

- Milk yield recorded during a lactation
- Somatic cell score from a test-day sample
- Number of days from calving to conception
- Producer-recorded case of mastitis
- Hoof-trimmer record of a hoof lesion
- Veterinarian-recorded case of metritis
- Conformation score assigned by a classifier

If you participate in milk recording, entered a health event into DairyComp or other software, or had your herd classified, you have contributed phenotypic data. These observations provide the raw material needed for genetic evaluations. Every breeding value on LactanetGen.ca ultimately traces back to performance records collected on farm.

Quality In, Quality Out

Once phenotypes are collected and transferred to the genetics team at Lactanet, they cannot simply be passed directly into the evaluation. The first step is quality control, where records are examined to determine which can be used with confidence and which may introduce more uncertainty. This involves a series of checks, such as: Is the phenotype or date of recording possible? Is herd information complete? Records that fail these checks may be removed before the evaluation begins.

The reason is simple: a genetic evaluation is only as accurate as the information it is given. It does not know that an unusually high value may be the result of a recording error and, without appropriate quality control, may treat that error as a genuine difference between animals. Accurate information on factors such as herd, age, season, and stage of lactation is also important, as it helps separate differences caused by management and environment from those that may be inherited. In simple terms, a genetic evaluation is trying to find the genetic signal within a large amount of environmental variation. Poor or inconsistent phenotypes add extra "noise," making that signal harder to detect. High-quality, consistently recorded phenotypes make differences between animals clearer and allow breeding values to be estimated with greater confidence. Ultimately, the quality of a genetic evaluation begins with the quality of the information recorded on farm.

Phenotypes Power Genotypes

While genomic testing has transformed modern breeding programs, there is a common misconception that genotypes have replaced the need for phenotypic data in genetic evaluations (Read more in the Progress Report, page 8). In reality, the value of genomic information depends heavily on the phenotypes behind it.

Genomics allows us to identify differences in the DNA animals inherit from their parents, but DNA alone does not tell us whether those differences are associated with higher milk production, better fertility, improved health, or greater longevity. To learn this, geneticists compare the genotypes of animals with their actual performance records, helping to identify which regions of the genome are consistently associated with better or poorer performance. This is why continued phenotypic recording remains so important. Populations change over time and management practices evolve, so genetic evaluations need a continued supply of accurate, representative phenotypes to maintain and improve their predictive ability. In simple terms, genotypes tell us what genetic differences exist; phenotypes teach us what those differences mean.

Key Takeaway

High-quality performance records provide the foundation for genetic evaluations, helping identify the genetic differences that drive long-term genetic progress.

In the next article, we will explore how genetic evaluation systems make fair comparisons among animals raised in different herds and environments. You will learn how factors such as herd, season, age, and management conditions influence performance records and why accounting for these factors is essential for untangling environment from underlying genetic merit.

Author: Hannah Sweett, Genetics Extension Expert, Lactanet Canada

Colin Lynch, Lactanet Canada

For further information, please feel free to contact Lactanet Canada staff.

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 Colin Lynch Ph.D