GENETICS FOR THE EVERYDAY DAIRY HERD

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GENE EXPRESSION

Todays' science allows us to determine the **genotype** or actual genes our dairy cow/ bull poses for a given trait. These traits are expressed as the **phenotype** or physical characteristics that you can observe or measure on an individual animal such as 305-day milk production.

Phenotypes are expressed as one of two types of traits: **qualitative** and **quantitative**. Qualitative traits are a "Yes or No" trait such as gender, coat color, and horns. Usually, a single gene or small group of genes control qualitative traits. Quantitative traits are controlled by many genes with each gene having an effect on the overall phenotype for that trait. Examples of quantitative traits include milk production, and milk component percentages. These traits can be significantly influenced by the animal's environment.

AS AN IMPORTANT FOUNDATION OF PROFITABLE HERD, GENETIC CHANGE IS PERMANENT AND ACCUMULATES OVER TIME.

- HOLSTION FOUNDATION

GENETIC PROGRESS

The primary goal of most dairy producers is to maximize the profitability of their herd. One way to achieve this goal is to have genetically superior cattle.

Four factors influence genetic change

1. **Accuracy of Selection** - ability to select animals that truly are genetically superior for a given trait
2. **Selection Intensity** - a measure of how "choosy" breeders are in deciding which individuals are selected
3. **Genetic Variation** – indicates the relative differences among animals within a population for a trait under selection
4. **Generation Interval** - the average age of a parent when all offspring are born

Genetic change is predicted using the following equation:

$$\frac{\text{Accuracy of Selection} \times \text{Selection Intensity} \times \text{Genetic Variation}}{\text{Generation Interval}} = \text{Genetic Change}$$

THE BASICS

An animal's genetic information is in the form of chromosomes, housed within the nucleus of every cell. Dairy cattle have 30 pairs of chromosomes for a total of 60. Chromosomes are made up of many strands of DNA. Genes, the basic unit of inheritance are specific portions of a cell's DNA. Each gene codes for a specific trait, such as pulled vs. horned animals.

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When deciding what traits to improve in your dairy herd, one must consider the heritability and correlations of each trait of interest. **Heritability** is the proportion of variation in a trait due to genetic factors, which are measured in numbers ranging from 0.0 to 1.0, with higher numbers being more heritable. The more heritable the trait the faster genetic progress can be made by selecting for that trait. **Correlated responses** mean that selecting for one trait may result in genetic changes in other traits. Correlations may be positive or negative between traits. Highly correlated traits are traits that are regulated by a large portion of the same genes.

Heritability's of Holstein Association USA Type Traits

Trait	Heritability
Stature	0.42
Strength	0.31
Body Depth	0.37
Dairy Form	0.29
Rump Angle	0.33
Thurl Width	0.26
Rear Legs – Side View	0.21
Rear Legs – Rear View	0.11
Foot Angle	0.15
Feet & Angle Score	0.17
Fore Attachment	0.29
Rear Udder Height	0.28
Rear Udder Width	0.23
Udder Cleft	0.24
Udder Depth	0.28
Front Teat Placement	0.26
Rear Teat Placement	0.32
Teat Length	0.26

Tradeoffs among the Elements of Genetic Change

- **Accuracy vs. Generation Interval** – To wait for more progeny records to enhance accuracy would increase the generation interval. A strategy is to choose the better young sires with the highest accuracies and use for only one year.
- **Accuracy *vs.* Intensity** –To wait for more progeny records to enhance accuracy for only a few sires would decrease the intensity of selection (i.e., the percentage selected). One solution is to test more sires that have fewer progeny records.
- **Intensity *vs.* Generation Interval** – Being too "choosy" usually results in a longer generation interval. However, the real trade-off is between selecting females *vs.* males (e.g., a lower replacement rate dictates that animals remain longer in the population).
- **Intensity *vs.* Risk** – A problem may exist if very few sires are used that have low accuracies, whereby their breeding values turn out to be poorer than what was initially reported.

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