Extension
UNIVERSITY OF WISCONSIN–MADISON

Using Genomics as a Decision-Making Tool for Commercial Replacement Heifers

Genomic testing can save beef producers time and money when deciding which heifers to retain within their herd. A comparison of two commercial heifers explains how to interpret genomic reports.

Introduction

Which of these commercial heifers would you keep for breeding?

Photo: Kim Kester

Animal selection criteria such as conformation, docility, and body size can be accurately judged by visually evaluating an animal. These visual characteristics are known as an animal's phenotype. Registered animals have expected progeny differences (EPDs) or EPDs from the sire and dam to help make decisions about retention within the herd.

However, commercial animals may not have pedigree data available, and their selection must be made by other means. Visual evaluation is an excellent starting point, and incorporating the use of genomic reports can further improve selection decisions in your herd.

Basics of Genomic Evaluation

Genomics utilizes an animal's complete DNA, or genome, to predict future performance. It's similar to reading the blueprint for each individual animal. Thousands of genetic markers called SNPs (single nucleotide polymorphisms), or "snips", are responsible for the genetic variation within an individual. SNPs allow the animal's genome to be read and interpreted into molecular breeding values (MBVs).

MBVs are the genetic version of estimated breeding values (EBVs), which are calculated using performance data from the individual, sire and dam, and any progeny. EBVs indicate the performance of the individual and are halved to predict performance of progeny, resulting in EPDs. Sire summaries typically show EPDs for traits.

Traits Included

Genomic reports can include a variety of traits used for different selection purposes. Genetics companies offer beef animal genomic testing for maternal, performance, and terminal traits, as well as indexes that combine multiple traits from different categories. A limited number of companies offer a hybrid vigor (heterosis) test. Hybrid vigor is not heritable and is used to assess increased vigor of an individual due to crossbreeding. An example genomic report is shown in Figure 1 and Figure 2.

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When to Use

Numerous tools are available to inform cattle producers' breeding decisions, whether it be on the bull or heifer and cow side of the equation. Animal data from genomics should be used to improve confidence in decisions, not to replace the use of phenotypic characteristics or performance data with EPDs. Phenotypic data is still necessary to create data pools for EPDs and genomics.

Hair or blood samples can be taken from calves at weaning or from bred heifers to make replacement decisions. Having genomic reports available can also add value for marketing purposes if selling as replacements.

Benefits

Since samples can be pulled from calves, genomics can help accelerate genetic improvement in the herd by allowing decisions to be made at a younger age. It also provides deeper insight than "eyeballing" crossbred animals who may not have extensive data from pedigrees.

Take advantage of hybrid vigor that cannot be determined through performance data. Hybrid vigor has a strong influence on traits with low heritability, such as maternal and fertility traits. Better hybrid vigor typically translates to better fertility, feed efficiency, and stayability in the herd. Identify your best and worst future performers. If you have a large group of replacement heifers and need to make cuts, genomics easily identifies the animals with the least potential in a group.

Genomic reports include easy to understand indexes and scores for quick decisions, and more in-depth genetic effect and detailed reports are also available for making specific adjustments within your herd.

Save on rearing costs by culling sooner. On average it costs about $2,000 per head to raise a replacement heifer. Early screening can prevent spending money on heifers with poor potential. The cost of genomic testing is roughly $40 per animal, depending on which base test and add-on tests you select.

Decision-Making Example

Eleven commercial replacement heifers were selected from the University of Wisconsin beef herd at Lancaster Agricultural Research Station (LARS) to demonstrate how genetic merit can be used as a selection tool.

Igenity® Beef and Igenity® Envigor™ reports were generated on all heifers. The heifers were ranked by their Total Cow Index score, which most closely aligned with the LARS herd goals. All replacement heifers' genomic results are included (Figures 1 & 2) to show how decisions might be made within the group. Scores are on a 1 to 10 scale, with higher scores typically being more favorable. Also included is a more in-depth comparison of the top and bottom heifers' genomic reports side-by-side (Table 1) with descriptions of how their scores differ and how it informs selection decisions.

Heifer #L026, Total Cow Index of 6.62.

Photo: Kim Kester

Heifer #L066, Total Cow Index of 4.13.

Photo: Kim Kester

Figure 1. Example genomic report for a group of commercial beef heifers.

Animal Information				*Decision Indexes*				*Maternal*							*Production*					*Carcass*				
Animal ID Number	Sample Barcode Number	Gender (M/F)	Breed	Igenity Rank*	Igenity Maternal Index	Igenity Production Index	Igenity Terminal Index	BW	CED	CEM	HPR	MILK	STAY	DOC	WW	ADG	YW	RFI	SC	MARB	REA	FAT	TEND	HCW
L026	92223025612	F	AN	Top 25%	6.55	6.45	6.65	4	7	7	6	5	6	6	8	7	8	5	6	6	5	6	7	8
L004	92223025632	F	AN	Top 25%	6.55	6.55	7.00	5	7	7	8	4	5	5	9	10	10	7	7	8	6	7	4	9
L103	92223025611	F	AN	Top 25%	6.25	6.45	6.85	4	7	7	8	6	5	6	7	8	7	8	8	7	5	7	10	9
L018	92223025613	F	AN	Maternal	6.1	6.40	6.25	6	6	6	6	6	6	6	8	9	8	8	5	8	7	7	6	7
L038	92223025610	F	AN	Maternal	6.05	5.55	5.70	5	7	7	6	5	4	6	8	7	7	6	8	6	5	7	9	6
L030	92223025614	F	AN	Terminal	5.2	6.10	6.55	4	7	6	4	4	5	4	6	6	6	7	7	6	7	6	7	8
L011	9823084351	F	AN	Terminal	5.65	6.35	6.55	5	7	7	6	3	5	4	7	9	8	8	7	7	8	7	6	8
L042	9823084350	F	AN	Bottom 25%	5.95	6.45	6.05	4	7	7	6	6	7	3	5	5	5	8	6	7	6	6	6	7
L073	9823084349	F	AN	Bottom 25%	5.8	5.35	5.65	5	7	6	8	6	4	7	7	7	7	9	5	6	5	7	9	7
L037	9823084352	F	AN	Bottom 25%	4.95	5.55	6.15	6	6	4	7	5	4	5	5	5	5	7	5	7	6	7	7	7
L066	9823084343	F	AN	Bottom 25%	4.5	5.05	5.80	4	5	5	5	6	2	6	7	9	8	10	8	8	5	8	9	7

***Igenity Rank calculation requires ten or more animals reported within this order.**

Figure 2. Example genomic report for add-on tests for a group of commercial beef heifers. In this case, the add-on test was hybrid vigor.

Animal Information				*Screening*	
Animal ID Number	Sample Barcode Number	Gender (M/F)	Breed	Igenity Total Cow Index	Envigor Score
L026	92223025612	F	AN	6.62	7
L004	92223025632	F	AN	5.72	1
L042	9823084350	F	AN	5.66	4
L103	92223025611	F	AN	5.61	2
L018	92223025613	F	AN	5.34	1
L038	92223025610	F	AN	5.29	1
L073	9823084349	F	AN	5.23	2
L030	92223025614	F	AN	5.17	5
L011	9823084351	F	AN	5.1	2
L037	9823084352	F	AN	4.66	3
L066	9823084343	F	AN	4.13	2

Table 1. Genomic data for heifers #L026 (Heifer A) and #L066 (Heifer B) for comparison. Unless otherwise noted, scores are on a 1 to 10 scale to easily compare heifers to one another. Table adapted from the Igenity® Beef Handbook (Neogen, 2023).

	Trait / Index	Description	Results		Decision
			A (#L026)	B (#L066)	
	Breed	Cattle breed. Designed for commercial and composite (CO) animals comprised of Angus (AN), Gelbvieh (GV), Hereford (HF), Limousin (LM), Maine-Anjou (MA), Red Angus (AR), Shorthorn (SH), and Simmental (SM).	AN	AN	Both heifers were listed as Angus since they are progeny from a mostly Angus herd and are black-hided. Herd records indicate L026 is by an AI Angus sire out of a 50% Angus/50% Hereford dam. L066 is by an unknown Angus sire and out of a 87.5% Angus/12.5% Hereford dam.
	Envigor™ Score	Estimation of **hybrid vigor**. Higher score indicates increased fertility and longevity with fewer negative health events.	7	2	Heifer A has a 20% greater chance of breeding as a yearling, a 20% greater chance of staying in the herd, and 10% lower chance of a negative health event. (A score increase of 1 leads to a 4% increase in probability a heifer will breed as a yearling, 4% increase in probability of a cow staying in the herd for 6 years, and 2% decrease in chance of a negative health event.)
DECISION INDEXES	Igenity® Rank	Animals are ranked when 10 or more animals are submitted as a group. Ranks are based on an animal's Maternal and Terminal Index within the group.	Top 25%	Bottom 25%	Top 25% means they rank in top half of the group for both Maternal and Terminal Indexes. Bottom 25% rank in bottom half for both Maternal and Terminal Indexes. Being ranked as solely Maternal or Terminal indicates an animal would produce offspring with traits more suited as a replacement heifer or as a slaughter animal. Heifer A is the superior animal based on this index.
	Total Cow Index	Uses both Maternal Index and Envigor™ to help select heifers with better hybrid vigor and maternal traits.	6.62	4.13	Heifer A is the superior animal based on this index.
	Maternal Index*	Helps select heifers with greater fertility, longevity, and higher weaned calf weights.	6.55	4.5	Heifer A is the superior animal based on this index.
	Production Index**	Helps select replacement heifers that perform well across maternal, production / growth, and carcass traits.	6.45	5.05	Heifer A is the superior animal based on this index.
	Terminal Index***	Helps select heifers that will produce calves with improved carcass traits.	6.65	5.8	Heifer A is the superior animal based on this index.

* Maternal Index: Index comprised of 10% CED, 15% CEM, 20% STAY, 15% HPG, 10% MILK, -10% RFI, 20% WW.
** Production Index: Index comprised of 10% CEM, 25% STAY, -10% RFI, 20% HCW, 10% REA, 20% MARB, 5% TEND.
*** Terminal Index: Index comprised of -15% RFI, 40% HCW, 10% REA, 20% MARB, 5% TEND, -10% FAT.

Table 1. Genomic data for heifers #L026 (Heifer A) and #L066 (Heifer B) for comparison. Unless otherwise noted, scores are on a 1 to 10 scale to easily compare heifers to one another *(continued)*.

	Trait / Index	Description	Results		Decision
			A (#L026)	B (#L066)	
MATERNAL	BW	**Birth Weight.** Higher score indicates potential for heavier calves at birth.	Igenity Score **4** Genetic Effect 3 lbs.	Igenity Score **4** Genetic Effect 3 lbs.	Heifer A's daughters will be similar weights at birth compared to Heifer B's daughters.
	CED	**Calving Ease Direct.** Higher score is better calving ease. Greater probability for first-calf heifers to calve without assistance, based on birth weight and shape of calf.	Igenity Score **7** Genetic Effect 11.9%	Igenity Score **5** Genetic Effect 7.9%	Heifer A contributes 4% greater calving ease compared to Heifer B.
	CEM	**Calving Ease Maternal.** Higher score is better calving ease. Greater probability for first-calf heifers to calve without assistance, based on all factors that influence calving such as pelvic area and genetics for birth weight.	Igenity Score **7** Genetic Effect 10.7%	Igenity Score **5** Genetic Effect 7.2%	Heifer A contributes 3.5% greater calving ease compared to Heifer B.
	HPR	**Heifer Pregnancy Rate.** Higher score indicates better ability to successfully conceive compared to other heifers.	Igenity Score **6** Genetic Effect 6.8%	Igenity Score **5** Genetic Effect 5.4%	Heifer A's daughters will have a 1.4% higher chance of conceiving during the breeding season compared to Heifer B's daughters.
	MILK	**Milk.** Higher score indicates more pounds of calf weaning weight due to milk production (not milk weight).	Igenity Score **5** Genetic Effect 19 lbs.	Igenity Score **6** Genetic Effect 23.8 lbs.	Heifer B will wean calves 4.8lbs heavier than Heifer A's calves due to milk produced.
	STAY	**Stayability.** Higher score indicates greater chance a heifer will remain a productive member of the herd until at least 6 years old.	Igenity Score **6** Genetic Effect 29.8%	Igenity Score **2** Genetic Effect 6%	Heifer A's daughters have a 23.8% higher chance of staying in the herd until 6 years old compared to Heifer B's daughters.
	DOC	**Docility.** Higher score indicates genetic potential to be calm and throw calm calves.	Igenity Score **6** Genetic Effect 9.4%	Igenity Score **6** Genetic Effect 9.4%	Heifer A's offspring are 0% more likely to be calm and easier to handle.

Table 1. Genomic data for heifers #L026 (Heifer A) and #L066 (Heifer B) for comparison. Unless otherwise noted, scores are on a 1 to 10 scale to easily compare heifers to one another *(continued).*

	Trait / Index	Description	Results		Decision
			A (#L026)	B (#L066)	
PRODUCTION	WW	**Weaning Weight.** Higher score means heavier calves. Indicates difference in 205-day weight.	Igenity Score **8** Genetic Effect 39.4 lbs.	Igenity Score **7** Genetic Effect 33.8 lbs.	Heifer A's offspring will weigh 5.6lbs more at weaning or 205 days of age.
PRODUCTION	ADG	**Average Daily Gain.** Higher score indicates greater potential for post-weaning growth base on pounds of gain per day.	Igenity Score **7** Genetic Effect 0.18 lbs.	Igenity Score **9** Genetic Effect 0.24 lbs.	Heifer B's offspring will gain 0.06lbs more per day than Heifer's B's offspring, and will weigh 9lbs more after 150 days on feed.
PRODUCTION	YW	**Yearling Weight.** Higher score means heavier yearlings. Indicates difference in 365-day weight.	Igenity Score **8** Genetic Effect 67.7 lbs.	Igenity Score **8** Genetic Effect 67.7 lbs.	Heifer A's offspring will weigh the same as Heifer B's at a year of age.
PRODUCTION	RFI	**Residual Feed Intake.** Lower RFI means less feed consumed to achieve same daily gain as other heifers. Indicates feed efficiency.	Igenity Score **5** Genetic Effect 0.31 lbs.	Igenity Score **10** Genetic Effect 0.69 lbs.	Heifer A's offspring will eat 0.38lbs less feed per day than Heifer B's offspring to achieve the same daily gain.
PRODUCTION	SC	**Scrotal Circumference.** An indicator of fertility in both males and females, larger circumference is related to earlier puberty in heifers.	Igenity Score **6** Genetic Effect 0.88%	Igenity Score **8** Genetic Effect 1.23%	Heifer B's offspring will have 0.35% larger scrotal circumferences, leading to increased fertility and/or earlier puberty in females.
CARCASS	MARB	**Marbling**. Higher marbling in the ribeye at the 12th rib indicates higher USDA quality grade.	Igenity Score **6** Genetic Effect 83 units	Igenity Score **8** Genetic Effect 117 units	Heifer A's offspring will have more marbling units than Heifer B's offspring, improving quality grade and consumer eating experience.
CARCASS	REA	**Ribeye Area.** Estimates muscling at 12th rib. Higher REA contributes to yield grade.	Igenity Score **5** Genetic Effect 0.8 sq. in.	Igenity Score **5** Genetic Effect 0.8 sq. in.	Heifer A's offspring will have the same ribeye area as Heifer B's.
CARCASS	FAT	**Fat.** Estimates backfat thickness at 12th rib. Higher FAT indicates lower lean yield.	Igenity Score **6** Genetic Effect 0.14 in.	Igenity Score **8** Genetic Effect 0.2 in.	Heifer B's offspring will have 0.06 inches more fat. Too much fat can reduce cutability and yield grade.
CARCASS	TEND	**Tenderness.** Potential for greater tenderness based on shear force. Higher score means more tender.	Igenity Score **7** Genetic Effect -0.8 lbs.	Igenity Score **9** Genetic Effect -1 lbs.	Heifer B's offspring will take 0.2lbs less of Warner-Bratzler Shear Force to cut, making the meat more tender for the consumer.
CARCASS	HCW	**Hot Carcass Weight.** Higher score indicates greater dressing percentage.	Igenity Score **8** Genetic Effect 79.7 lbs.	Igenity Score **7** Genetic Effect 68.3 lbs.	Heifer A's offspring carcasses will weigh 11.4lbs more. At a carcass price of $290/cwt for Choice, this would be roughly $33.06 more per head.

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