

Faith and Focus

Line 1 Herefords ushered in the age of performance testing and genetic evaluation.

by *Wes Ishmael*

Line 1 Hereford cattle — relatives to an outsized proportion of Hereford cattle registered each year — are often noted for their performance, consistency and predictability. These attributes are a byproduct of astute selection and strategic, disciplined linebreeding across generations.

However, Line 1 cattle also are at the root of performance testing and the genetic evaluations for all breeds, which are often taken for granted.

It's a story worth hearing again, or for the first time, because it highlights and connects so many pivotal moments in both breed and U.S. beef cattle history.



Advance Domino 20



Advance Domino 54

Researchers at USDA's Agricultural Research Service (ARS) Fort Keogh Livestock and Range Research Laboratory (LRRL) in Miles City, Mont., founded Line 1 in 1934, to focus on methods of measuring performance in beef cattle. At the time, the eye, showring success and pedigree were often the primary selection criteria for seedstock producers.

Miles City researchers aimed to define the heritability of production traits such as weaning and post-weaning growth and demonstrate how they could be improved through selection. They succeeded and their successful demonstration has continued for almost 90 years. Early on, those researchers also set parameters for performance testing, such as length of the feeding period and adjusting phenotypic weights for sex, age and age of dam among others. These researchers contributed the first heritability estimates and genetic correlations, which comprise the bedrock of modern genetic evaluation.

Stacking desired traits

Linebreeding was an apt breeding mechanism for what researchers were trying to demonstrate.

In simple terms, if applied correctly, this controlled form of inbreeding enables maintaining close relationship of subsequent generations to an identified sire or dam of superior merit.

Although a less intense form of inbreeding, the rationale behind linebreeding is the same: increase homozygosity for traits within a population and decrease heterozygosity. In simple terms the more identical genes shared (homozygous), the more alike the population. But Mother Nature is an equal opportunity employer. Identical genes can be positive or not. So, it's not something for the careless, casual or faint of heart.



Jack Cooper



Les Holden

History commonly credits Robert Bakewell and Thomas Coke, both 18th-century British agriculturalists, as the originators. At the time, Bakewell was focused on selecting for meat production in both cattle and sheep rather than on their respective aptitudes for being oxen or growing wool, which were the traditional aims.

So, when researchers began Line 1 Herefords, linebreeding was already a dog-eared, if not commonly practiced concept in the cattle industry and the breed.

For instance, Anxiety IV 9904 — considered by many to be the “Father of American Herefords” — was the product of

linebreeding. Charles Gudgell and Thomas Simpson imported the bull from England in 1881, intending to continue harnessing the power of linebreeding, which they did.

When ARS began the Line 1 program, agricultural producers were also keenly aware of the how recent gains in corn production were achieved.

“Through work at the Carnegie Institution and at the University of Connecticut, corn producers achieved great success with hybrid varieties that greatly out-performed previously available stocks,” explained Mike MacNeil in the January 2009 issue of *Beef Breeding Research*, dedicated to the 75th anniversary of developing Line 1 Hereford cattle. “It was these scientific and practical foundations that sparked development of inbred lines of livestock in the 1930s.”

MacNeil, a noted ARS geneticist, was the Line 1 project leader at Fort Keogh for a number

of years beginning in 1989. He is a member of the American Hereford Association (AHA) Hall of Merit.

“In the 1930s, research with the Line 1 Hereford focused on methods of measuring performance of beef cattle. The implied breeding objective was economic return above feed costs, with return derived from carcasses of steers harvested at 900 pounds,” MacNeil explained. “It was established that gain per 100 pounds of total digestible nutrients consumed had the greatest correlation with the economic breeding objective and progeny groups of different sires varied significantly with respect to this objective and its indicator.”

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— Hop Dickinson, past AHA executive vice president

Sowing the seeds of growth

Line 1 began in 1934 with two sons of Advance Domino 13 — Advance Domino 20 (L1 Domino 20) and Advance Domino 54 (L1 Domino 54). Both sons were purchased from Fred C. DeBerard, Kremmling, Colo.

“Daughters of L1 Domino 20 were bred to his paternal half-sibling L1 Domino 54 and vice versa,” MacNeil explained.

“Since that time, the Line 1 Hereford cattle maintained by USDA at Miles City descend solely from this foundation, with the increase in level of inbreeding per generation being reduced as Line 1 expanded in numbers and mating of close relatives was avoided.”

Ultimately, MacNeil explained the project included 14 lines of genetically diverse cattle at

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Miles City and 34 more at other agricultural experiment stations throughout the western United States. This was in the August 1996 issue of *Agricultural Research* magazine, published by ARS. Each line was intended to be the equivalent of parent stock used to develop hybrid seed corn.

“The eventual ascendance of Line 1 was due, I am sure, to the superior genetics for growth in the initial selections, and perhaps to some extent, in the large numbers available in this line,” explained Ray Woodward, at the LRRL field day in 1984. He was a beef cattle geneticist at Miles City from 1946 until 1960 and returned to Fort Keogh as research leader from 1976 to 1979.

“The increase in pounds produced in 1953 versus 1975 (or approximately four generations) was 9 pounds at birth, 41 pounds at weaning and 82 pounds off test,” Woodward explained. “Remember that this is sire effect alone, measured by mating unrelated cows. Obviously, we would expect progeny from L1 sire and cows to be again superior.”

Hop Dickinson was AHA executive vice president at the time and presented at the same field day program.

“While other lines rose and fell based on their showring winnings and subsequent price structure, the Line 1 cattle made its inroads into the breed through years of selection based on performance criteria,” Dickinson explained. “Herein lies the main difference between the continued and stable demand for this line as compared to the sharp rise and fall of other popular lines. Line 1 cattle became a part of the breed when economics dictated that breeders become more objective in their breeding programs. The emergence of the Line 1 cattle as a significant force in breeder programs coincided with the introduction of performance genetics and the need for a different type of animal for our breed.”

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Dickinson pointed out Line 1 cattle were also unique because they were not the product of a single sire.

“This has expanded the genetic base for this line and allowed more versatility in selection for breeders using these cattle,” Dickinson said. “In other words, this research project also fit the needs of a breed from the standpoint of how it was developed. Few lines or few breeds can withstand the impact of a single sire line. Spreading the genetic base is important for a breed, and the Line 1 program complemented rather than deteriorated the genetic base.”

Spreading the word

Keep in mind, Line 1 Herefords came along at a time when Hereford cattle were the classic belt-buckle variety — shorter and smaller were all the rage. Line 1 cattle were the opposite, being bred for growth.

So, when the LRRL began offering Line 1 genetics to the industry in the 1940s, one can imagine only the most independent-minded cattlemen were interested. Among them were Jack Cooper and Les Holden, half-brothers who believed in performance and the power to make genetic improvement.

Ray Woodward also happened to be their brother-in-law. He helped convince Cooper and Holden about the merits of linebreeding and performance-based selection, according to MacNeil.

“I think it’s fair to say that three breeders of Line 1 could be singled out as having the first impact on sending Line 1s into the mainstream of the breed. Those are Les Holden; his son, Scott; and Jack Cooper, longtime advocates of not only Line 1 cattle but of the total performance and selection guidelines used in this project,” Dickinson explained.

In fact, the same families continue to make a lasting impact as they hone their Line 1 families. Check out Episode 3 of AHA's 1881 podcast to hear personal Line 1 insights from Mark Cooper of Cooper Hereford Ranch, Willow Creek, Mont., and Jack Holden of Holden Herefords, Valier, Mont.

Shifting direction

The Line 1 project at Miles City was 20 years old before the first state Beef Cattle Improvement Association was organized (see When Performance Testing Went National). The project established much of the foundation. It demonstrated the need for performance testing, showed what could be accomplished with it and established the measures and records required.

"The fact that they (Line 1) were the product of a rigid performance program gave breeders a confidence in performance concepts that couldn't be communicated through talks and articles," Dickinson explained. "That the Line 1 emergence coincided with the acceptance of performance concepts by this breed is more than just a coincidence. When the breeders discovered Line 1s, they also found that Line 1 breeders were performance advocates and that they applied these concepts to their breeding programs. Perhaps this aspect, more than anything else, is the basis for the breed's strength today. Miles City and Line 1 cattle played a major role in this positive development."

Line 1 at Miles City continues to progress after almost nine decades.

"Needless to say, when finally completed, heritability estimates placed the seal of approval upon the validity of performance testing and ensured the continuation of the linebreeding program." Woodward said.

When the project turned 75, MacNeil explained, "Periodic assessments of genetic trends have shown selection for growth to one year of

When Performance Testing Went National

"Programs for genetic improvement must be based on accurate measures of performance of individual animals. The traits must be measurable and heritable if selection is to be effective. Traits that are measurable early in life and are moderate to high in transmissibility are more amenable to rapid progress through selection ..."

When Thomas Marlowe wrote that in the introduction to *Development of Beef Cattle Performance Testing in the United States*, the observation was still new to many cattle producers. He was hired by Virginia Tech University in 1955 to run the state's Beef Cattle Improvement Association (BCIA), the first of many to come in the U.S. That same year, he explained a small group of cattle breeders in Texas and Oklahoma organized Performance Records International (PRI). Subsequently, he said those two groups encouraged and assisted the organization and development of numerous other state and breed association programs.

"With the newfound knowledge that: 1) beef cattle differ in their inherent productivity; 2) these differences are fairly highly heritable; 3) that efficiency and rate of gain are rather highly correlated; and 4) that brood cow performance is important to the total economy of beef production and that it is a repeatable trait, a great impetus was provided to develop efficient and effective performance testing programs," according to Marlowe.

If this knowledge didn't originate with the Line 1 project at Fort Keogh Livestock and Range Research Laboratory in Miles City, Mont., it certainly coalesced there.

"One of the major efforts of PRI was to recommend uniform procedures in adjusting performance data and reporting for the convenience of cattlemen throughout the nation ..." Marlowe explained. "The Beef Improvement Federation (BIF) was organized in 1968 to extend and further improve numerous state and breed association programs of performance testing. The major difference between BIF and PRI is that major emphasis by BIF has been on establishment of uniform procedures for measuring and recording data to permit widespread use of the results in animal evaluation and selection, whereas PRI was also a data gathering and processing organization." Over time data processing shifted from PRI to state BCIA's and then to breed associations. **HW**

age as efficacious throughout the 75 years Line 1 has existed as a closed herd. Genetic potential for growth continues to increase at all ages less than one year. Even in populations with small effective size as result from linebreeding and intense selection fostered with tools such as artificial insemination and embryo transfer, breeders should be encouraged that genetic improvement will continue." **HW**