

F94L Is The Limousin 'Power' Gene

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Unprecedented private and public investment in genomics research is beginning to yield intriguing new selection information for cattle producers. As with most new technologies, wise and cost-effective use of DNA tests requires careful study. Such is the case for a new diagnostic test now available for myostatin F94L—a powerful gene found predominantly in Limousin cattle.

Dubbed the “Limousin muscling gene” by the Australian researchers who discovered it, F94L is a “friendly” modification of the normal myostatin gene. In distinctly different and “less friendly” forms, other versions of the myostatin gene cause double muscling in Piedmontese and Belgium Blue cattle. The F94L gene causes increased muscularity without double muscling and its side effects—namely, serious calving difficulty and significant reduction in reproductive performance.

Prevalence

The F94L version of the myostatin gene occurs in most Limousin cattle but in few or no animals of other breeds. Table 1 provides genotypic and gene frequencies of 69 high-accuracy U.S. Limousin sires and 199 registered Australian Limousin animals. Seventy-three percent of myostatin alleles in the U.S. animals and 95 percent in the Australian animals are F94L.

In contrast, research indicates the frequency of F94L in Angus and Hereford cattle is 0.6 percent and zero, respectively.

Most of the Limousin animals are either homozygous (AA) or heterozygous (AC) for F94L (where “A” represents the F94L allele and “C” indicates the normal form of the allele for myostatin). A minority of Limousin animals, six percent of the U.S. animals and one percent of the Australian

animals, did not carry the F94L allele—most likely due to the grading-up process allowed by both associations.

Influence on Carcass Traits

Australian researchers reported a single copy of the F94L allele was associated with a 10.5 percent increase in longissimus-muscle area [ribeye area (REA)], a 7.3 percent increase in meat weight, a 16.5 percent reduction in fat weight and an 8.2 percent reduction in intramuscular fat (IMF, or marbling) content. The effect of the F94L allele on birth and growth traits—and on tenderness, pH level and cooking loss—was not significant, but there was a shear-force advantage of between six percent and 11 percent (depending upon the cut) for animals with two copies of the gene.

Adelaide University researcher Wayne Pitchford said, “Animals with two copies of the gene consume the same amount of feed as animals with no copies of the gene so they are much more feed-efficient at producing beef.”

Australian scientists concluded those results provide strong evidence that the myostatin F94L variant provides an intermediate and more useful phenotype—without correlated negative effects—than the more extreme double-muscling phenotypes caused by other modifications of the myostatin gene.

Here at Home

To gauge the effect of F94L on performance traits further, the North American Limousin Foundation (NALF) computed the average expected progeny differences (EPDs) for the high-accuracy

	U.S. Limousin animals (69 high-accuracy sires)	Australian Limousin animals (199 head)
Genotype / No. of F94L alleles *	Genotypic frequency	Genotypic frequency
AA/2	52%	91%
AC/1	42%	8%
CC/0	6%	1%
Allele	Allele frequency	Allele frequency
A	73%	95%
C	27%	5%

*A = F94L allele *C = normal myostatin allele

	Carcass weight	Ribeye area	Fat thickness	Yield grade	Marbling
Genotype / No. of F94L alleles *	EPD	EPD	EPD	EPD	EPD
AA/2	16	0.60	-0.02	-0.17	-0.08
AC/1	12	0.13	0.00	0.01	0.01
Difference	4	0.47	-0.02	-0.18	-0.09

*A = F94L allele *C = normal myostatin allele

sires genotyped by MMI Genomics. Those sires' average accuracy was greater than 0.75 for all carcass-trait EPDs.

Similar to the Australian research, the 36 Limousin sires with two copies of F94L had REA EPDs that were 0.47 sq. in. larger than those of the 29 sires with one copy (Table 2). Slightly favorable effects also were found for fat thickness, carcass weight and yield grade. There were not enough sires with zero copies of F94L to include them fairly in the comparison.

Also consistent with the Australian results, sires with two copies of F94L had an average marbling EPD that was about 0.1 marbling-score unit lower than the average marbling EPD of sires with one copy. Based on that data, breeders must balance selection for the F94L allele against marbling to maintain genetic merit for quality grade.

Calving-ease, Growth, Maternal Traits

While insignificant in the Australian study, U.S. Limousin sires with two copies of F94L had birth weight EPDs that were almost two pounds heavier than sires with one

copy (Table 3). There was a corresponding reduction in direct calving-ease EPD for sires with two copies of F94L, indicating breeders should practice selection for moderate birth weight and acceptable calving-ease in combination with selection for F94L.

While readily corrected through multiple-trait selection, there appeared to be at least slightly unfavorable effects on maternal traits caused by two copies of F94L. On average, two copies of F94L equated to slightly lower maternal calving-ease, less milk and notably smaller scrotal circumference EPDs.

In contrast, there was no meaningful difference in the average weaning weight, yearling weight, docility and stayability EPDs of sires represented in the two F94L genotype groups, substantiating the "friendly" effects of F94L.

The Role in Selection

It is important to remember, although F94L is a powerful gene, many other genes—perhaps hundreds or even thousands—contribute to the total genetic merit of animals for each individual performance

trait. For example, among the 36 proven U.S. Limousin sires genotyped as having two copies of F94L, the range in REA EPDs is -0.28 to +1.4 square inches. Among that same group of homozygous F94L sires, there are proven trait leaders for low birth weight, high milking ability, large scrotal circumference and high marbling, despite preliminary findings of slightly adverse influences on those traits from F94L.

While breeders need more information to evaluate the return on investment in DNA tests and selection for F94L, researchers have identified few other single genes or markers with that magnitude and range of effects. That makes F94L an ideal candidate for inclusion in genome-enabled and -enhanced selection tools for Limousin and Lim-Flex® cattle.

The F94L allele is uniquely prevalent in Limousin cattle and has meaningful, favorable effects on REA, fat thickness, yield grade, retail product yield, tenderness, beef healthfulness and the efficiency with which they convert feed to case-ready, retail product. Based on EPD data from a limited number of proven U.S. Limousin sires, F94L appears to have slightly unfavorable—yet manageable—effects on birth weight, direct calving-ease, milk production, scrotal circumference and marbling.

Testing and selection for that Limousin "power" gene should yield favorable results when practiced in combination with selection based on EPDs and functionality for other economically relevant traits. **LW**

Table 3.

Mean EPDs for Calving Ease Traits, Milk, Scrotal Circumference by F94L Genotype

Genotype / No. of F94L alleles *	Birth weight EPD	--- Calving ease ---		Milk EPD	Scrotal circumference EPD
		Direct EPD	Maternal EPD		
AA/2	3.2	3.8	3.1	18.6	0.08
AC/1	1.4	7.1	4.1	22.1	0.44
Difference	1.8	-3.3	-1.0	-3.5	-0.36

*A = F94L allele *C = normal myostatin allele