



Penn State Cooperative Extension
Capitol Region Dairy Team

GENETICS OF FEET AND LEGS AND IMPORTANCE OF BULL SELECTION

Mary Beth Grove
Dairy/Environmental Agent
Lancaster County

How important is it to select bulls that transmit good (above-average) feet and legs for your herd? How should these bulls be selected?

Common sense tells us that when deciding which A.I. bulls to use for the dairy herd, the traits we select should have a definite economic value. Everyone knows the economic value of milk pounds and butterfat percentage — in most cases, more milk means more money in your pocket. Unfortunately, the relationship between foot and leg traits and production or cow longevity is much more difficult to measure.

Dr. Ben McDaniel at North Carolina State University conducted interesting research to evaluate the importance of feet and legs on production. Much of this work was done at several state-owned dairy herds in the Carolinas. The researchers actually measured the hoof angle

and hoof length on several thousand cows to determine if these measurements could be associated with production traits. Table 1 exhibits the finding of this study.

These results showed that as foot angle increased (became steeper) by 5 degrees in first calf heifers, there was an associated 503-pound increase in second lactation milk production. A decrease in 10 mm of toe length in first calf heifers equated to a 1,475-pound increase in second-lactation milk production. Steeper foot angles and shorter claw length were associated with fewer days open, earlier breedings, and a greater survival to five years of age. Deeper heels tended to increase days open, but also increased longevity of that cow in the herd. Cattle with deeper heels did exhibit more sole ulcers.

Longer claws and lower angles were also associated with lower survival rates. It was also suggested that legs that are neither too straight (posty) nor too crooked (sickled) are apparently the best for increasing longevity in cattle.

As you can see from this research, there is an economic value in steeper foot angles in dairy cattle. Unfortunately, this does not mean that they are easily improved by using better genetics.

There is another important factor in making bull breeding decisions — the "heritability" of that trait. What is heritability? In simple terms, it is the portion of the "visible" differences in a trait that are due to genetic factors. The higher the heritability,

Table 1. Correlations between measured foot traits and production/longevity characteristics of dairy cows in North Carolina institutional herds.

Trait	Foot Angle	Claw Length	Heel Depth
Milk, pounds	.01	.18	-.12
Fat, pounds	-.40	.24	-.06
Days Open	-.44	.26	.59
Survival to 5 years of age	.21	-.01	.36
Age at culling	.87	-.34	.47

the greater is the genetic control on the trait, and the more rapidly selection will result in genetic progress.

Some traits are highly heritable. For example, stature has a heritability of about .42 or 42 percent. This means genetics accounts for 42 percent of the variation in stature (measured at hip height), and the environment (or the way the animal was raised) accounts for the remaining 58 percent. Unfortunately, foot and leg traits are not nearly as heritable, in part because the animal's environment can easily affect the feet on a cow. In Table 2, you will see the linear score and heritabilities for the foot and leg traits.

This data suggests that, while increased foot angle and proper leg set are very important for cow longevity, much of the improvement to be made on feet and legs on individual cows will be through environmental changes. These environmental changes might include grooved concrete and more stall bedding, allowing cows access to pasture, and an adequate nutritional program.

Unfortunately, with these "low to

moderate" heritability values, bull selection to improve feet and legs through genetics will be a long, slow process. This also explains why you may not always be able to see measurable changes from generation to generation in regards to foot confirmation. This does not mean you should ignore foot and leg composite or foot angle PTAs on bulls — just that you may want to make it a secondary trait to select.

Why not choose bulls that meet your production goals first, and then choose from this pool of bulls for those with higher foot angle and more intermediate leg set traits? When attempting to correct a "two-way" trait such as rear legs (side view), select an intermediate (+.00)

bull — this bull will tend to sire daughters with legs of an intermediate set. Using a bull that tends to sire daughters with straight "posty" legs will not correct a "sickled" cow faster.

There are also some indexes that include the sire's genetic merit for foot angle in the overall index. One such index is Net Merit. According to many industry leaders, the top Net Merit bulls transmit the best combination of superior genes for production, longevity, somatic cell score, and type traits for most commercial dairy herds.

For more information on sire selection for improved feet and legs, call Beth Grove at (717) 394-6851 or contact your local extension office.

Table 2. Heritabilities for Foot and Leg Traits of Dairy Cattle

Trait	Heritability
Foot angle	.10-.15
Rear Legs (Side)	.15-.21
Rear Legs (Rear)	.10-.15



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