Improving Dairy Bull Selection

Genetic markers reduce guesswork

By Susan McGinley and Lorraine Kingdon

To get a good dairy cow, you start with a good bull. The dairy industry relies on identifying bulls that have all the right genes for producing milk in the next generation of daughters. Artificial insemination (AI) companies take the lead in this search by selecting and maintaining the kinds of bulls their customers need and want. This process can be expensive and time-consuming, because to prove a bull's genetic worth for milk production you have to look at his daughters.

AI companies first identify the top 1% of the cows in the country and mate them to the very best bulls, using multiple-ovulation and embryo transfer. Bull calves born from these matings are then selected to enter a progeny testing program to "prove" their worth as sires. Currently, proving the value of young bulls in the dairy industry costs AI companies between $25,000 and $45,000 per bull and requires about five years while waiting for their daughters to grow up, get pregnant and start producing milk. Even though the young bulls are selected from those sired by top bulls out of superior cows, only one out of every nine becomes an active sire because he received the right set of genes from his parents. The average investment in every successful AI sire is between $225,000 and $405,000.

"If we could improve the chances of selecting sires with the best genetic merit, then AI companies would see a substantial drop in investment per bull," says Sue DeNise, a professor in the UA Department of Animal Sciences. "We are now accumulating evidence about regions of chromosomes that affect performance characteristics in cattle."

This type of research will help take some of the guesswork out of breeding dairy cattle, saving the dairy business both time and money, according to DeNise. "Molecular biology will allow companies to identify important regions of chromosomes, identify important genes, and improve the accuracy of selecting young sires," DeNise says. "Also, companies will be able to narrow their testing to include only those potential bull mothers that possess the best genetic combinations."

In her research, DeNise extracts DNA from samples of milk, blood and tissue taken from daughters of bulls that have milk production records and from the sire himself. Chromosomes come in pairs and each daughter will only inherit half of the chromosomes of a bull. Using molecular markers, the chromosomes are identified so that DeNise can determine which chromosomal segment was inherited by each daughter. Each cow's performance record can be evaluated using these chromosomal segments. If DeNise finds differences between daughters that inherit different chromosomes, then there must be genes nearby in the sequence that influence performance. She can use this information in selecting among bulls of future generations, to choose those likely to have inherited favorable genes, improving their probability of being a successful AI bull.

The same technology can be used to identify bulls that are carriers of genetic defects. For example, Weaver Syndrome is a neurological genetic disease found in Brown Swiss cattle. In the early 80s some of the best bulls in the breed were discovered to be carriers of the Weaver gene. As the good bulls became more prominent, the deleterious gene occurred more frequently in the population.

DeNise has developed a marker test to identify animals that have a high probability of carrying the deleterious gene if either of their parents are known to have it. Her lab in the UA College of Agriculture and Life Sciences is the official test location for the Brown Swiss Cattle Breeder's Association. The commercial animals DeNise tests are also used to study the Weaver gene's influence on milk production.

Animals with just one copy of the defective gene show no outward appearance of the disease. However, if an animal has two copies, the condition develops. Although the high mortality from Weaver Syndrome can be devastating economically for a dairy producer, cows that have a single copy of the defective gene produce more milk. DeNise thinks the gene for this characteristic is located somewhere near the gene for Weaver Syndrome. By finding and characterizing the high milk production gene she will be able to assist AI companies in identifying bulls that carry this gene.❖

C.Renfrow

Dairy cows at the UA Campus Agricultural Center