

A Genome Milestone

Bovine DNA sequencing provides a significant road map for future genetic management.

by *Kindra Gordon*

Can we pinpoint animals that are more efficient with less feed? Can we increase the reproductive rate among beef females? Can we select cattle that are resistant to bovine respiratory disease (BRD), and maybe even bovine spongiform encephalopathy (BSE)?

We are one step closer to answering those questions — and possibly developing the technology to make them a reality — with the October announcement that scientists have deciphered the bovine genetic code. This landmark accomplishment means researchers can now begin to read the three billion DNA “letters” in cattle, which will help them determine exactly where traits are located within the cattle genome.

Until now, researchers have only been able to identify and work with a handful of gene markers, primarily for the carcass traits of marbling and tenderness. While this research, much of which was conducted through the National Cattlemen’s Beef Association (NCBA) Carcass Merit Project during the last decade, has helped bring DNA tests like GeneStar® and Igenity™ to the marketplace, researchers say having a map of the entire bovine genome should open the door for more DNA tests in the areas of health, reproduction and disease resistance.

Ronnie Green, U.S. Department of Agriculture (USDA) Agricultural Research Service (ARS) national program leader for food

animal production, believes that in addition to being able to identify specific genotypes among cattle, the real value will be in the ability to better manage for specific traits.

“To have the ability to genotype animals for a variety of genes and then have the proxy to know how to best manage those genotypes and not mess them up — that’s the real value,” Green says.

Complementing EPDs

That said, Green also believes future DNA tests will not be stand-alone selection or management tools. Instead, he says DNA technology and existing expected progeny difference (EPD) information will need to be used to complement one another.

“We (the beef industry) have very valuable EPDs, which breeders and associations have invested a pile of money in developing for genetic evaluation. Those will be the basis for what you put this DNA information together with. DNA won’t replace it,” Green says.

He says the result will be marker-adjusted EPDs — something the scientific community is already working on incorporating into EPDs with the existing DNA tests for tenderness and marbling. Green believes merging the two together is important to keep DNA technology practical and usable for the industry. “Producers still have to be able to

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Who’s offering DNA tests?

Presently, three different business models are emerging with their own DNA tests for the beef industry, reports the U.S. Department of Agriculture’s (USDA’s) Ronnie Green. They include:

- ▶ **Companies with their own intellectual property (IP).** An example of this is MetaMorphix Inc., formerly Celera Genomics, that did sequencing of bovine and swine genomes itself a few years ago. It owns the intellectual property to that research and is developing DNA tools from it to measure genotypes for genetic traits. It has already developed partnerships with Cargill and Monsanto for use of this proprietary technology at a corporate level.
- ▶ **Companies taking intellectual property developed in the public sector and then commercializing that in the form of a DNA test as a service provider to the industry.** The GeneStar® tests currently provide an example of this model.
- ▶ **Animal health companies offering DNA tests.** The current offering of the Igenity™ test by Merial is an example of this model, and it is a means for them to offer the DNA test as a service, as well as to provide an opportunity to consult to clients on all products they sell.

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take this information and boil it down in a form they can use to sort bulls," he says, emphasizing that marker-adjusted EPDs will help them do that.

Green calls it dangerous to rely on either DNA or EPDs alone. "You're going to need to use all of the information you have," he says, citing an example of data from the Roman L. Hruska U.S. Meat Animal Research Center (MARC) for twinning rates on four females. When the animals were ranked solely by EPDs compared to when genetic markers for quantitative trait loci (QTL) were added to the information, the females ranked differently. Thus, he emphasizes, it's important to use all the data available.

Cornell University's John Pollak reports that researchers in the National Beef Cattle Evaluation Consortium (NBCEC) are working to incorporate DNA information into the calculation of EPDs. This fall the American Simmental Association (ASA) genetic evaluation for tenderness (shear force) will include genotype information for the test of μ -Calpain.

Looking ahead, Green admits one of the

challenges to developing marker-adjusted EPDs will be getting DNA data on a large number of animals — likely due to cost. "To get the industry to utilize DNA technology on a wide enough basis to get the information we'll need means DNA tests have got to be affordable," Green says.

Because of these challenges, and the fact that several genes can affect a single trait, Green predicts that the practical applications of DNA technology are still several years off. "This is complicated technology. It will take a long time to evolve and mature. I do think we will see it in the next generation of technology, but it is still more than five years away," he says.

What's ahead?

Despite the challenges, as the scientific community moves forward with genomic research, there is real hope that it will offer the beef industry new efficiencies.

"Currently, DNA research has been focused on carcass traits, but the real push in genomics will come in terms of funding research on input traits. That's where the future lies in developing these gene tests,"

Green says. Those input traits are things we have difficulty measuring, such as feed efficiency, reproductive rate and animal health factors such as BSE and BRD.

"I call them 'peace of mind' traits. Not production traits necessarily, not more is better, but things that give us sustainability," Green says. "Through identifying the genes that impact these traits, then we know how to best trigger them to do their job."

Green also sees the possibility of adapting DNA for animal identification (ID). "It's very controversial, but I suspect we'll be talking seriously about it in the future," he says.

Lastly, Green cautions producers that, as more of this technology becomes available, they will need to weigh what is sustainable costwise to use.

"Many genes affect a trait. We could eventually have large numbers of DNA tests. So producers have to be practical in evaluating which tests will offer the most economic value to their operations in the future."

