Gateway to Profit Part 2

Committees take a deeper look at factors affecting beef improvement.

Themed "Gateway to Profit," the 2010 Beef Improvement Federation (BIF) Research Symposium and Annual Meeting was hosted in Columbia, Mo., June 28-July 1, 2010. More than 500 producers were on hand to listen to the program in which experts from across the United States and abroad discussed leading genetic advancements and offered practical solutions to help attendees adapt technologies to individual operations.

In September, the *Angus Journal* provided coverage of the general sessions. This month, we explore some of the more technical presentations presented during five committee breakout sessions.

Hair Shedding Rate May Affect Weaning Weight

How quickly cows shed their winter coats in the spring may have an effect on their calves' weaning weights. Research led by Trent Smith, Mississippi State University, with funding from the American Angus Association, shows a probable link between the two. Smith presented his findings June 29 during the Producer Applications Committee breakout.

"The objectives of this three-year study were to develop a method to measure hair shedding, determine the variation in shedding and estimate shedding's effects on 205-day weights and body condition scores (BCS)," says Smith. "We observed 532 cows from 2007-2009 in North Carolina and Mississippi to determine if the perception is true that cows who do not shed or shed later are not good performers. Cows seem to perform better when they are in a thermo-neutral zone (TNZ), where heat stress does not suppress reproduction, milk production and appetite."

A 1-to-5 scoring system to describe hair shedding was established, and visual evaluations were done by the same technicians on a monthly basis from March through July. Data analysis revealed that BCS was not significant, so researchers focused only on weaning weights. In the adapted score analysis, Smith found that cows that shed by May had, on average, 589-pound (lb.) calves. Cows that shed after May had, on average, 565-lb. calves, for about a 24-lb. difference.

PHOTOS BY TROY SMITH

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"What we concluded is that cows that shed later weaned lighter calves, but more data is really needed to confirm the findings," Smith said. "We believe hair shedding is moderately heritable, which means it may be possible for producers to select for this. There is some variation."

Smith further notes that animals with little or later hair coat shedding might be good candidates for culling, especially in the Southeast where the evaluations were made. However, more studies are again needed to determine if the advice would be the same for other environments. In addition, researchers would like to consider the effects of prolactin concentrations, hair regression, changes in the type of diet and temperatures to assess the rate of shedding.

"Our next steps would be to try the same observations in different (geographic) areas, as well as see if any other traits are related to hair shedding," says Smith. "Over the three years, these results were repeatable. The same cows tended to shed at about the same time each year. We would need to find out if that is true in other environments."

— by Barb Baylor Anderson

Understanding Cow Size and Efficiency

When confronted with the challenge of trying to determine the "right-size cow," Jennifer Johnson and J.D. Radakovich, Texas A&M University-Kingsville, set out to define efficiency and help find tools producers could best use to evaluate cow efficiency in their own herds.

"Different cattle are efficient in different environments and production systems. Gaining a better understanding of the interrelated components is critical to maximizing profit," Radakovich told attendees of the Producer Applications Committee June 29.

The pair began by defining efficiency as measured by the ratio of total costs to total animal product from females and progeny over a given period of time. But despite a concise definition, defining optimum efficiency is complicated. It is a combination of biological efficiency, or feed consumed to beef produced, and economic efficiency, or dollars spent to dollars returned.

"Optimizing the relationship between the two is a complicated process, and doing so

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requires understanding and managing the genetic potential of cattle, the environment in which cattle are asked to perform, and decisions about when and what product to market," he says.

The proceedings available from the BIF symposium detail the various factors that can affect efficiency optimization.

When considering tools producers can use to improve efficiency, the ratio of total pounds weaned divided by number of cows exposed is the best measure for the entire herd, Johnson said. The ratio recognizes the most important maternal trait of efficiency — reproduction. Producers who are able to increase the ratio without increasing input costs will see an increase in net profit.

"Selecting for genetic change in a cow herd through female culling is not an effective method for changing overall efficiency," she added. "Since an individual cow contributes little to the overall genetic makeup of a calf crop, it is much more effective to select for efficiency through bulls."

Capturing genetic potential in a given environment and market will also optimize efficiency. Crossbreeding programs take advantage of breed similarities and differences, she said, making them a way to positively and relatively quickly produce genetic change for efficiency.

"Availability of low-cost feed should

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also affect decisions about efficiency. That availability varies by region and by ranch," she said. "Market end point is another factor. Increased milk potential is most beneficial when calves are sold at weaning and maximum preweaning growth is rewarded. In retained ownership, the calf's own growth potential will capture profit."

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"Each producer must evaluate their unique system and determine, based upon biological and economic determinants of herd size, what is most profitable for them," Johnson said. "For the majority of producers, the most efficient cow is the one with the highest milk potential that can, without reducing the percentage of calves successfully weaned, repeatedly produce a calf by bulls with growth and carcass characteristics valued most in the marketplace."

"There is no silver bullet or home run," Radakovich added. "As long as your cow type is within given environmental and economic guardrails, size difference has little impact on profitability."

— by Barb Baylor Anderson

The 2000 Sires Project at USMARC

Can breeders of beef seedstock use whole-genome selection (WGS) like breeders of dairy cattle? According to U.S. Meat Animal Research Center (USMARC) geneticist Larry Kuehn, genetic predictions from WGS are being used for Holstein sire selection. However, the beef industry involves more breeds and seeks to select for more economically important traits.

During the Emerging Technologies Committee breakout, Kuehn noted how WGS uses gene markers spanning the bovine genome to predict genetic merit for a variety of traits. In contrast to single-gene or marker approaches, WGS makes a more realistic assumption that a trait is likely influenced by multiple genes, Kuehn explained. WGS research in cattle has been made feasible by the BovineSNP50 (50K) BeadChip, a technology providing genotypes on approximately 50,000 single-nucleotide polymorphism (SNP) markers within the bovine genome.

"We believe that successful implementation of WGS will require a high degree of organization and broad participation by the beef cattle industry," Kuehn stated. "To be most effective, WGS should be incorporated into the national cattle evaluation (NCE) system."

Toward that end, USMARC scientists embarked upon the 2000 Bull Project in 2007. Genotypes were obtained on more than 2000 influential beef sires representing 16 different breeds. Many of the sires have high-accuracy EPD values for various traits.

The selected sires were used to breed cows from USMARC's Germplasm Evaluation Project — a population from which extensive phenotypic data had been collected. Phenotypic data, as well as genomic profiles, are being collected from resulting progeny. Preliminary results suggest positive correlations for several traits. The goal is to develop prediction equations for various traits.

"The challenge is to find markers that hold up across populations," Kuehn said, noting inconsistencies across breeds. While there remains much work to be done, he said the process promises to provide learning experiences for breed associations.

— by Troy Smith

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Genetics of Heifer Fertility

It's costly to put replacement females into a cow herd. Ideally, a replacement candidate will conceive in timely fashion the first time and every time thereafter for a good many years, but some females seem to have an advantage in reproductive performance compared to their contemporaries.

►"We've discovered 'hot spots' (regions likely associated with multiple genes) that regulate traits like yearling heifer pregnancy rate and first-service conception rate," Milt Thomas explained.

University of New Mexico researcher Milt Thomas and his collaborating colleagues want to find out why some cows have a genetic advantage. During the 2010 BIF breakout session addressing emerging technologies, Thomas talked about ongoing studies to identify genes

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responsible for expression or suppression of fertility traits.

"The long-term goal is to understand in detail the genetic pathways regulating reproductive performance in beef cattle, with the intent of developing genetic improvement programs for fertility," Thomas said.

The project involves collection of data and DNA from herds representing different environments and production systems. As a start, Texas-based Camp Cooley Ranch allowed access to its database and DNA resources for the study. Data and DNA from more than 800 Brangus heifers, representing multiple sires, have been used to initiate discovery of genes and gene markers that influence reproductive performance. Researchers are using the 50,000 single-nucleotide polymorphism (SNP) technology to identify regions of influence across the 30 bovine chromosomes.

"We've discovered 'hot spots' (regions likely associated with multiple genes) that regulate traits like yearling heifer pregnancy rate and first-service conception rate," Thomas explained.

The same genotypes are being used to investigate genetic regulation of first-calf heifer rebreeding rate. Project plans call for validation of all findings with data and DNA from an additional 10,000 females from various other collaborative sources. Thomas said there is much work still ahead, but the project's ultimate goal is development of marker-assisted selection tools to help producers identify replacement female candidates with higher levels of fertility.

— by Troy Smith

Genetics of Healthfulness of Beef

Most genetic research of beef cattle has focused on developing tools for selecting breeding animals that possess sought-after performance traits and should, therefore, pass these same traits on to their offspring. Iowa State University Animal Scientist Jim Reecy explained a research project having a different goal.

"The public is bombarded with statements saying certain foods are good or bad for human health. As a result, the public is becoming increasingly interested in the healthfulness of food," Reecy said, speaking before Emerging Technologies Committee breakout session. "So what can we do to make beef healthier for consumers?"

Iowa State University initiated the search for answers, but Cornell University, Oklahoma State University and the University of California-Davis joined the project, along with collaborating producers. Reecy said the project goal is to develop tools to select for animals that produce more-nutritious beef, without jeopardizing eating quality (tenderness and flavor) and without making its production cost-prohibitive. He believes genetic evaluation for nutrient composition of beef could result in development of genomic-enhanced expected progeny difference (EPD) values to aid selection for a favorable fatty-acid profile, lower levels of cholesterol and saturated fat, and higher concentrations of minerals and vitamins.

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According to Reecy, a number of genetic markers have been identified that are associated with nutrient composition of beef. For example, 54 markers appear to account for 45% of the variation in myristic acid — a healthful fatty acid.

While beef is a source of many nutrients, evidence suggests there is considerable variation in nutrient composition among beef from different animals. The content of iron and other minerals can vary significantly. Some animals produce highly marbled beef that has a favorable fatty-acid composition. But marker heritability appears to be relatively high. Therefore, with marker-assisted selection, Reecy believes producers should be able to breed for animals that produce beef whose nutrient composition is more consistent, more healthful and just as enjoyable.

— by Troy Smith

Genetics of Feedlot Health

Bovine respiratory disease (BRD) takes a terrible toll on the U.S. cattle feeding industry. Colorado State University Animal Scientist Mark Enns said the industry's disease prevention and treatment costs are estimated to be in excess of $3 billion annually. To a geneticist like Enns, that's ample reason to ponder whether susceptibility to disease is, in part, controlled by genetics.

In a presentation to the Emerging Technologies Committee, Enns described how he and a research team are looking for ways to reduce susceptibility to respiratory disease through genetic selection. For two years, data has been collected on cattle fed according to a "typical" feedyard protocol. Along with animal performance and carcass data, the cattle were evaluated for stress and behavior, as well as incidence of disease. Stress was evaluated by assigning exit velocity scores as individual animals were released from the processing chute, plus scoring of general behavior when handled.

"You can't select for a trait unless it is heritable," Enns said. "According to our preliminary results, there appears to be genetic variation for susceptibility to disease. Its heritability is about 0.15."

What comes next is more analysis. Enns said he is hopeful that the results will reveal markers for genes associated with an animal's ability to cope with stress and markers for genes related to immunologic ability to resist disease. Together, he said, they could be used to select breeding animals with reduced susceptibility to respiratory disease.

— by Troy Smith

Evaluation of Genetics by Environmental Interactions

Artificial insemination (AI) allows bulls to produce progeny that are theoretically raised in a variety of environments around the world. But even with similar genotypes, not all of those progeny will have the same phenotypic response to a change in environment.

Bill Lamberson, University of Missouri

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animal science professor with a research focus in livestock genetics, has studied the genotype × environment interaction. He told BIF participants that the classic example comes from research done with cattle from Florida and Montana. Basically, Florida cattle outperformed Montana cattle in Florida, and Montana cattle outperformed Florida cattle in Montana.

"The genotype × environment interaction is found in the relative change in performance expressed," Lamberson says. "We used a reaction norm regression of data from bulls to measure the phenotypic response of a genotype to a change in environment. ... One of the things we looked for was a stability of or constant performance for bulls in multiple environments."

"We looked at the heritabilities of the Angus progeny weights and found enough genetic variation for birth weight, weaning weight and yearling weight that you could probably produce an EPD and make progress in selection."

— Bill Lamberson

Lamberson and colleagues studied Brazilian Nelore and U.S. Angus bulls to determine if there were differences in reaction norms, and whether enough genetic difference existed to develop an EPD. They reviewed the performance of all progeny of the bulls that qualified for the study and the performance of the progeny of specific sires in specific environments. Several criteria were established to screen bulls for the research.

"We looked at the heritabilities of the Angus progeny weights and found enough genetic variation for birth weight, weaning weight and yearling weight that you could probably produce an EPD and make progress in selection," he says. "There were highly significant differences among bulls for birth weight and perhaps an opportunity to estimate genetic merit for the trait."

Lamberson is not completely sure why the differences exist, but he notes previous work shows consistency increases with heterosis. Genes may be present that impact robustness. Likewise, other components not studied, such as maternal components, could affect results.

"The best followup to this research might be to look at bulls in specific environments and see what happens with the data," he says. "Low genetic adaptability and high performance environments (for example), might yield different results than what we found in this study."

Lamberson spoke June 30 during the Selection Decisions Committee breakout session.

— by Barb Baylor Anderson

Use Of BovineSNP50 To Select For Feed Efficiency

While the beef industry has made strides in improving genetic merit for economically relevant traits (ERTs) like calving ease, growth and carcass quality, little work has been done on production inputs, including feed inputs, that can have a significant influence on profitability. Megan Rolf, a doctoral candidate at the University of Missouri, shared promising research on the topic during the Selection Decisions Committee breakout.

"Much improvement has been made possible with expected progeny differences," she says. "Feed efficiency is a trait with enormous economic importance, but selection for efficiency has remained elusive. We looked at average feed intake (AFI), average daily gain (ADG) and residual feed intake (RFI), but it is difficult and expensive to gather phenotypic data."

Since the past few years have led to a rapid increase in the use of molecular genetic technologies in beef cattle, including SNP markers, Rolf set up three research objectives:

- to explore genomic relationships for feed efficiency;
- to develop diagnostic tests for feed efficiency; and
- to evaluate novel uses for existing feed data.

"Genomic selection methods are exceptionally valuable for traits that are difficult and expensive to measure (such as RFI)," she says. "Large panels of SNPs are available and animals have been genotyped, so the best use of such data will likely be in the form of genomic selection, where marker information is used with genetic prediction and EPDs."

Rolf performed a number of analyses involving diagnostic tests for feed efficiency and use of existing feed data, which are detailed in her proceedings from the conference (available in the newsroom at *www.bifconference.com*). She found that incorporation of feed intake data with genetic evaluation has the potential to dramatically influence selection on maintenance efficiency. Genomic selection has the potential to make the most of limited data for genetic prediction on a large number of animals using either large marker panels or smaller panels of markers, such as the BovineSNP50, associated with ERTs.

"Feed efficiency is a trait with enormous economic importance, but selection for efficiency has remained elusive."

— Megan Rolf

"A large number of SNPs were identified that could be included in commercial marker panels for use in Angus cattle for selection on feed efficiency traits," she confirms. "These models account for large amounts of genetic or phenotypic variation in these populations, and may be the first work to examine the use of a predicted feed efficiency phenotype in a genome-wide association analysis that compares model predictions to observed phenotypic records in beef cattle."

Rolf concludes that additional comparisons using actual feed intake data, gain and RFI in studies with larger numbers of animals and larger heritabilities is essential to further explore the use of these data for genetic evaluation and selection decisions in commercial cattle populations.

— by Barb Baylor Anderson

Find more

Angus Productions Inc. (API) provides comprehensive online coverage of the symposium at *www.bifconference.com.* Summaries of the sessions, along with PowerPoints, audio and proceedings, are provided in the site's newsroom. You can also find photo galleries from the pre-conference and post-conference tours in the "Photos" page and announcements of the award winners in the "Awards" page. The online coverage is made possible through a reciprocal agreement with BIF and the sponsorship of Biozyme Inc. through its significant gift to the Angus Foundation.