Focus on Efficiency

Researchers seek ways to increase beef cow efficiency.

*by **Stephanie Veldman, Troy Smith, Steve Suther** and **Shauna Rose Hermel***

The Beef Improvement Federation (BIF) held its 34th Annual Research Symposium and Annual Meeting in Omaha, Neb., July 10-13. The theme was "Focus on Efficiency," and discussions were centered around increasing the efficiency of the beef production system. Nearly 700 people representing 40 states and seven countries attended the four-day event.

Connee Quinn, 2001-2002 BIF president, spoke during the awards luncheon on July 12 on why she has chosen to devote the last five years to BIF. She said that Ivan Rush put it into perspective for her when he said, "There is only so long that you can take away from the industry. There comes a time when you need to give back." Quinn added that she has a passion for cows, which adds to her desire to see the industry succeed.

During a road trip from New Mexico to Nebraska, Quinn grasped the opportunity to quiz five other cattlemen about their predictions for the beef industry.

"It is not the most scenic route in the world, and I always like to use my time well, so I gave those — mainly feedlot people — the charge to describe what they thought a pen of cattle would look like in five to 10 years and how that pen of cattle would be managed," Quinn said. She shared with BIF attendees their predictions:

1. Calves and yearlings going into feedlots may be purchased on a grid, similar to how finished cattle are purchased on a grid now.
2. Those cattle may not receive a feed-grade antibiotic or an implant.
3. Color will not matter.
4. Permanent identification (ID) will be the norm for information transfers.
5. A large percentage of the fed cattle might be owned or directed from conception, with tighter management of genetics, nutrition and animal health.
6. For smaller herds, there will be more cooperatives for marketing calves.
7. Corn will still be the cheapest energy source, but we might use feeds that we don't even recognize today.
8. Calves will be weaned earlier.
9. There will be tighter specifications for carcass targets.
10. Ultrasound or newer types of technology will be used for sorting cattle.
11. Pens of cattle will have feed efficiency predictors.
12. People who provide genetics will be more accountable for performance.

Quinn said that although the beef industry is currently facing difficult times, she thinks it will be successful. "The philosopher Horace said, 'Adversity reveals genius, prosperity conceals it,' " she said. "We should have a lot of genius showing up in our business."

She challenged BIF members to continue to foster a level of thinking that can solve the problems.

Discussions at the symposium focused on improving the economical and biological efficiency of beef cattle production. Wednesday night's opening session focused on how to define both biological and economic efficiency in beef production, while Thursday's presentations highlighted measuring efficiency and cow-calf profitablity. Friday's sessions featured methods to predict efficiency.

In addition, BIF committees addressed emerging technology; multiple-trait selection; the live animal, carcass and end point; genetic prediction; producer applications; and whole-herd analysis. The following pages provide synopses of some of the speakers and roundtable discussions.

More information on the 2002 BIF Conference, audio files of the speeches, and proceedings papers can be found at *www.BIFconference.com.* This Web site, sponsored by Boehringer Ingelheim Vetmedica Inc., provides Angus Productions Inc.'s (API's) online coverage of the event.

Defining economic efficiency

Gordon Dickerson used to say we've spent a tremendous amount of effort trying to determine how fast we could go somewhere, but not much emphasis on which way we should go. "I would suspect that same comment would still be valid today," Montana State University animal scientist Mike Tess told attendees of the opening session of the BIF symposium. The symposium was dedicated to Dickerson's life work (see sidebar on page 259).

Dickerson believed biological objectives should be the basis of most management decisions in production agriculture, Tess said. Dickerson defined biological objectives as "the relative economic importance of the major components of performance in terms of the approximate direct effect of each on cost per unit of production."

Tess said the fact that these "biological" objectives were based on economic costs and returns rather than just biological inputs and outputs was intuitive.

It's difficult to separate economic and biological efficiency, but biological inputs are only important if they are associated with an expense, Tess said. "The things that are important are always economic, and the things we measure and choose to select for and change are things that have some economic impact."

When looking at biological inputs, not all inputs cost the same, and not all outputs are equally valuable, Tess said. "So some measures of economic efficiency that allow these things to be taken into account are important."

Dickerson believed efficiency (cost per unit of value produced) should be the focus rather than profit. He called profit an "illusory criterion," contending sales prices tend to fluctuate and profit margins tend to hover near zero in a competitive system. Efficiency, he believed, is a more realistic focus.

For more on this presentation, visit the newsroom at *www.BIFconference.com.*

Defining biological efficiency

It's nearly impossible to define "biological" efficiency without considering economic efficiency. According to animal scientist David Notter, Virginia Polytechnic Institute, the separate but significant contributions to beef production of grazed forages and harvested concentrates, and the potential substitution of one feed source for the other, dictate that economic considerations must influence the definition of biological efficiency.

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Notter said key economic factors include costs of grazed forages vs. harvested concentrates, and the complex U.S. beef marketing system. With these factors in mind, Notter defines biological efficiency as "the capacity to convert physical inputs (feed) into marketable product (beef) under prevailing production conditions."


Danny Fox

Traits that support biological efficiency in the brood cow are generally different from those associated with efficient postweaning calf growth, Notter admitted. However, he said biological efficiency reflects options as much as optimums.

Most biological characteristics of the cow are negotiable, depending on environment and market goals, but efficient cows are those that produce calves regularly and easily. Biological efficiency of the calf is more dependent upon the market and the association between intramuscular fat and quality.

"Biological efficiency is the servant of economic efficiency," Notter said, "and that master is best served by having the biological diversity to rapidly accommodate changes in markets and economic variables."

For more on this presentation, turn to page 263 or visit the newsroom at *www.BIFconference.com.*

Measuring cow-calf profitability

Rather than net income (NI), return on assets (ROA) is a comprehensive measure of profit and managerial efficiency, according to Barry Dunn of South Dakota State University's department of animal and range science. Profit, as defined by ROA, is a relationship between production, marketing, annual expenses and investment of a beef cattle business.

"Profit can arise from many combinations of these four basic units," Dunn said. "However, there is strong indication that in consideration of risk and opportunity, a management strategy of low levels of investment, average levels of production, low levels of total annual costs, and above average marketing will help cattlemen achieve profitability and financial efficiency."

For more on this presentation, turn to page 262 or visit the newsroom at *www.BIFconference.com.*

Postweaning feed efficiency

A 10% increase in feed efficiency can mean $28 more per head at harvest, but how can you measure feed requirements for individuals in pen-feeding systems? Try using the Cornell Value Discovery System (CVDS), urged Cornell's Danny Fox.

The Cornell computer model accounts for variations in breed type, management and environment as it determines the amount of specific feed ration needed to reach a target final weight and finish. Most value-based markets favor a Choice or higher quality grade, Fox noted, justifying an equivalent 28% empty body fat (EBF) target. Like other default values in the CVDS, that can be adjusted for different targets.

A frame-score final-weight predictor interacts with formulas for net energy required for gain by stage of growth and such past management factors as wintering or placement of weaned calves directly on feed, and the effect of implant history. The model reconciles total pen dry matter intake (DMI), ration and ingredient analysis, pen size, environment, and weather with individual starting and final weight targets, breed, sex, frame, implant, projected days on feed and daily gain to account for more than 80% of variation in individual feed efficiency, Fox said.


Tom Jenkins

"Producers sometimes wonder if they are being billed fairly in the steer futurities where they pay a share of the pen's feed bill," he added. "Our work indicates that with five head or more, there is only a 1% to 2% risk of error." But big differences in starting weights can still mask individual feed efficiency among five head.

Cornell is beta-testing the CVDS software Version 1.0.0, available via e-mail to Michelle Cole at mlc44@cornell.edu. For more on this presentation, visit the newsroom at *www.BIFconference.com.*

Size, energy and efficiency

Two widely held contentions are that a beef animal's "type" affects its ability to convert feed to weight, and that a direct relationship exists between an animal's size and its efficiency. U.S. Meat Animal Research Center (MARC) scientist Tom Jenkins said studies have demonstrated how production traits may contribute to differences in biological efficiency.

For example, cows representing breeds that exhibit moderate growth and milk production were more efficient when subjected to limited feed availability because of higher conception rates. Under the same circumstances, breeds with higher genetic potentials for growth and milk production were less efficient because females did not cycle or conceive while nursing a calf. With high levels of feed, however, those higher potentials for growth and milk production are expressed more efficiently than among cows representing more "moderate" breeds, which became fat.

Cow-calf producers have sought to reduce energy requirements for cow maintenance through genetic selection. According to Jenkins, however, stabilizing energy requirements over a wide range of nutritional scenarios may be more desirable.

"Enhancing an animal's genetic potential [to] conserve energy under sparse energy environments (feed resources and/or body fat) could be counterproductive to developing an efficient cow," Jenkins suggested.

A cow that is efficient for one producer may be ineffective under a different management system, but Jenkins predicted that genomic information will aid producers in identification of heifers that are suited to producing a calf every year, within a defined production environment.

For more on this presentation, visit the newsroom at *www.BIFconference.com.*

Economically relevant traits

Colorado State University (CSU) staffers consider expected progeny difference (EPD) values most useful when the numbers represent sensible traits, said Bruce Golden and Mark Enns. The typical sire summary offers EPDs for many traits that do not directly affect producer profitability, they added.

"Economically relevant traits (ERTs) are those directly associated with the revenue stream or cost of production," Golden said at the BIF Multiple Trait Selection Committee roundtable. "They affect future profitability. Indicator traits are those that add accuracy to the prediction of ERTs."

While calving ease is an economically relevant trait, Golden calls birth weight, pelvic area and gestation length indicator traits for calving ease. Similarly, calving interval, milk production and fleshing ability would be included among indicators of mature cow fertility. While measurement of

indicator traits is necessary, Golden and Enns suggest that EPDs be calculated only for economically relevant traits.

Their suggested list of ERTs includes weaning weight direct, weaning weight milk, yearling weight, carcass weight, mature weight, cow maintenance feed requirement, docility, stayability, probability of heifer pregnancy, probability of calving ease, calving ease maternal, days to 1,200 pounds (finish), days to 0.4 inch backfat and days to quality grade.

According to Enns, a focus on ERTs would remove extraneous information and make it easier for producers to evaluate their genetic selection decisions.

"With ERTs, we can develop an individualized selection index for a producer and increase the probability of making profitable decisions," Enns states.

Genetic evaluation Down Under

Rather than EPD values, Australia's genetic evaluation system calculates expected breeding values (EBVs). Researchers at the University of New England, in New South Wales, have developed a system for combining the EBVs of 19 standard traits into a single selection index.

According to David Johnston of the Animal Genetics and Breeding Unit, BreedObject software is a decision aid for seedstock breeders and commercial bull buyers. A selection index can be customized to a producer's specific breeding goal and market objective. Utilizing EBVs for various traits, BreedObject will assign — to bull candidates under consideration — a single index value representing potential profit per cow in that particular herd.

David Johnston

Johnston said research is under way to develop EBVs for feed efficiency and traits such as structural soundness and temperament. Also coming is a system for making comparisons across breeds and with hybrids.

Maintenance efficiency genomics

A reduction of up to 10% in maintenance requirements appears to be possible in some populations of beef cattle, Marlyn Nielson, University of Nebraska-Lincoln (UNL) animal scientist, told attendees of the Emerging Technologies Committee breakout session.

Animals consume food for energy, Nielson explained. After it's consumed, that energy is metabolized. The metabolized energy is used in two ways — maintenance for the animal, which is lost as heat, and in production for growth, lactation, etc.

UNL researchers are working on a study measuring heat loss, instead of feed intake, to compare what individual animals require for maintenance. Using 9- to 11-week-old male mice, Nielson said, the study compares genetic lines selected for high heat loss (MH) and low heat loss (ML) to that of a control group (MC).

So far, Nielson said, the study has shown the MH group to be leaner than the ML group, even though the MH group eats up to 81% more. The MH group was also twice as active as the ML group. Nielson said they can explain up to 35% of feed intake by differences in activity levels.

Nielson said he thinks the study may be a unique resource for QTL (quantitative trait loci) searches. They are working on three large searches and have found five QTL for heat loss, 10 QTL for body weight and five QTL for liver weight.

Nielson said desirable genetic relationships do exist. He said a reduction of up to 10% in maintenance seems possible for some populations of beef cattle, but the last increments of the study are slower to accomplish because of the possible correlations with other traits.

Ohio State DNA Marbling Test Update

Ohio State University research scientists Daral Jackwood and Francis Fluharty explained the basis of their DNA test for marbling potential during the BIF Emerging Technology Committee session. The work, sponsored by Certified Angus Beef LLC (CAB), is based on association rather than linked studies, Jackwood said. That was necessary to avoid rejecting possibly significant markers in the initial search across a population of crossbred cattle, he added.

Only one significant marker has been discovered so far, he said, detailing the significance of the "613" marker for marbling

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Have we made a difference today?

The Wednesday evening symposium at the Beef Improvement Federation (BIF) 34th Annual Research Symposium and Annual Meeting was dedicated to the late Gordon Dickerson, Lincoln, Neb. Dickerson spent his career studying the genetic progress in the livestock industry, including improving biological efficiency, maternal breed effects and heterosis.

He was an early leader in the use of principles of quantitative livestock genetics for livestock improvement. The main focus of his research revolved around the net life-cycle biological efficiency in several types of animals, including swine, sheep and beef cattle. He also focused on the definition and estimation of direct and maternal breed effects, heterosis and inbreeding. His studies included the effects of twinning and composite breed experiments.

Ronnie Green, a former graduate student advised by Dickerson, said Dickerson was a man who liked to ask questions that required a lot of thought. To kick off the conference, Green presented a series of questions Dickerson might have asked attendees of the BIF conference had he been there:

1. What is the breeding objective of the beef industry? Is it definable? Is BIF taking an active role in continually refining this definition?
2. For the better part of three decades, BIF has been discussing multi-disciplinary "systems" approaches to defining genetic changes. Has BIF accelerated the movement of breeding systems to a true "systems" approach?
3. Given that the reproductive rate in beef cows is one of the greatest limiting factors in making further advances in the efficiency of beef production, and that maintenance energy cost of the cow herd is the resulting economic efficiency "opportunity area," what role is BIF playing to define economically relevant traits, in standardized form?
4. Who are you working for in your efforts? Dickerson would remind BIF members to always remember that the consumer is the boss. He was devoted to making a better product at a cheaper price for the consumer, Green said.
5. The concept of hybrid production has yet to be fully utilized by the beef industry. Huge challenges lie ahead in this area. Dickerson would ask, will BIF be a leader in addressing them, or will it choose to sit on the sidelines?

Green said that if Dickerson had been at this year's conference, his conclusion would be relatively simple. Dickerson lived by the question, "Have we made a difference today?" And, in the end, that is what defined the man.

—by Stephanie Veldman

potential. In the initial test population of Angus and Simmental-Angus-cross steers, there was little difference in marbling potential between individuals with 0 and 1 allele for 613, but some 89% with 2 alleles graded mid-Choice or higher.


John Pollak

Research partner Fluharty said in a follow-up study of Angus steers grading 93% Choice or better, 96% of the steers grading Prime had 2 alleles of the 613 marker.

Fluharty said the test could be useful for seedstock producers in taking a year or more off of the time required for generational selection decisions. It could be useful for feeders in targeting management and marketing.

The scientists declined to estimate when the test would be commercially available, saying only that discussions were ongoing. They also said the significance of the test should not be overemphasized. "This will be a marketing focus tool, a piece of information, but no silver bullet," Fluharty said. "Management will always be critical in whether an animal realizes its marbling potential."

Genetic prediction: A U.S. perspective

"We have done a very good job historically in data collection, genetic evaluation and selection for weight," said John Pollak, Cornell University, adding that the industry has had moderate success in analyzing traits such as calving ease and carcass quality. However, establishing genetic predictors for traits such as reproductive performance and efficiency is much harder.

The problem today is not in finding the genetic evaluation systems to analyze this type of information, but in developing adequate means of data collection and processing, Pollak said. Whole-herd reporting is a sign of progress, allowing producers to look at heifer pregnancy and cow longevity. Ultrasound is improving the ability to collect large amounts of data on carcass characteristics.

"We are having to think more and more … about what kinds of programs need to be in place to get that data," Pollak said.

Pollak said he believed the future of genetic prediction of efficiency would necessitate using biological modeling, such as that used in the CVDS Danny Fox had described in an earlier presentation.

Pollak also described a project being done at Bell Ranch in New Mexico. The objective of that project is to set up a protocol for collecting data and progeny testing in commercial herds, including herds with multiple-sire breeding pastures, with the goal of generating EPDs on commercial bulls. One of the EPDs the study is hoping to look at is feedlot efficiency using predicted phenotypes. For more information about the project, visit *www.thebellranch.com.* For more information about Pollak's presentation, visit the newsroom at *www.BIFconference.com.*

Genetic prediction: An Australian perspective

The cost of feed is an important variable affecting the profitability of beef production. And while feed intake and measures of feed efficiency are heritable, no selection based on feed intake data has occurred in the beef industry. However, Australian research has led to development of an EBV to aid selection for net feed intake (NFI). Results suggest that selection for reduced NFI may enhance efficiency achieved by animals being genetically able to eat less, without reducing growth.


William Herring

According to David Johnston, additional studies are underway to further knowledge of feed intake, and particularly for the purpose of reducing the cost of obtaining genetic predictions and implementation into selection programs.

"Science is rapidly advancing our understanding of the genetics of feed intake and efficiency, but the challenge is to gain widespread adoption by industry such that selection decisions on young bulls in seedstock herds can use knowledge of genetic differences in NFI," Johnston said.

The incentive exists for innovative Australian seedstock breeders to test their young bulls through two testing options. Breeders may purchase their own facility for on-farm testing, or use mobile testing units. Secondly, several commercial central test facilities exist to measure individual feed intake.

For more information about this presentation, visit the newsroom at *www.BIFconference.com.*

Multi-trait prediction of feed conversion

It's time for the beef industry to catch up with those of swine and poultry, which have systems in place to alter feed conversion, said William Herring, University of Florida geneticist. Referring to his profit selection index work with Circle A Angus Ranch of Iberia, Mo., Herring described ways to prioritize selection emphasis aimed at maximizing profit in terminal Angus systems. The work serves as an example in the development of an EPD for feed efficiency.

A handful of traits — DMI, weight gain, feed conversion, feed efficiency and NFI — describe the area of focus, he said.

"Calculating feed conversion by mathematical model is problematic," Herring said, because low DMI can be mistaken for favorable feed conversion. NFI measurements are better, but require observation and records.

Citing no phenotypic relationships for feed conversion, Herring said the traits tend to be moderately to slightly heritable, depending on breed types, and moderately correlated to yearling weight and feed intake. Working from the strong correlation between DMI and residual feed intake, Herring designed progeny testing for Circle A's Angus Sire Alliance.

He used the Miles City (Mont.) Experiment Station Simumate computer model to gauge the effect of trait selection on profitability, characterizing high- and low-profit sires by applying weighted averages to economically relevant EPDs.

Herring said his work with the Angus Sire Alliance indicates a 10% improvement in feed conversion could lead to savings of $120 million annually.

For more information about this presentation, visit the newsroom at *www.BIFconference.com.*

Maintenance energy requirements

Research has shown that approximately 70% of a cow's feed expenses go toward her maintenance energy requirements. John Evans, Oklahoma State University animal scientist, said his research has shown

Mean EPDs reported by breeds

Larry Cundiff, chairman of the Genetic Prediction Committee, said that it is important to know how expected progeny differences (EPDs) for an individual animal compare to the current breed average. Cundiff presented the mean EPDs for 18 breeds at the Genetic Prediction Committee meeting of the Beef Improvement Federation annual meeting July 12, 2002. These results can be found in the proceedings for the Genetic Prediction Committee, accessible from the "Schedule" page of *www.BIFconference.com*.

Cundiff also presented the postweaning growth and carcass traits for F_1 steers (see Table 1). He said that the British breeds have caught up to the Continental breeds in growth traits, with most weighing in at more than 1,300 lb. at harvest. More on this study can be found at *www.marc.usda.gov.* Open the online information link, and click on progress report #21.

Table 1: Sire breed means for postweaning growth and carcass traits of F_1 Steers in Cycle VII of the GPE Program (1999 calf crop, 448 days)

Sire breed	No.	Postweaning ADG	Slaughter wt., lb.[a]	Carcass wt., lb.[a]	Dress %	Marbling score	% USDA Choice	YG score	Fat thick, in.	REA, sq. in.
Hereford	50	3.46	1,363	832	60.7	538	79.1	3.35	.55	12.74
Angus	59	3.40	1,375	846	61.2	577	93.6	3.32	.58	13.48
Red Angus	52	3.40	1,362	839	61.3	589	96.0	3.76	.60	12.21
Simmental	52	3.47	1,390	854	61.4	536	61.2	2.95	.42	13.71
Gelbvieh	49	3.33	1,348	826	61.3	514	63.0	2.80	.39	13.43
Limousin	53	3.30	1,308	815	62.3	507	44.8	2.63	.41	14.02
Charolais	53	3.43	1,370	843	61.6	517	75.7	2.77	.43	14.01

[a]Estimates for Hereford, Angus and Red Angus sires were adjusted to the level of heterosis expected in three-way F_1 crosses (estimates of 14.6 lb. was added for slaughter weight and 13.5 lb. was added for carcass weight) to provide for unbiased comparisons to three-way F_1 crosses by Continental sire breeds.

maintenance energy requirements to be heritable, with differences across breeds.

Because of its direct effect on the profitability to the cow-calf enterprise, Evans suggested the development of an EPD to predict the difference in feed energy requirements of mature cows.

Studies completed at CSU and the USDA-ARC Fort Keogh Laboratory, Miles City, Mont., included mature weights and milk EPDs in their equations to predict maintenance requirements. These two traits were used, Evans explained, because mature weight and weaning weight data was readily available, and the milk EPD adequately represents the differences in actual milk yield. The genetic merit of an individual for higher or lower milk production would affect their prediction for cow maintenance energy requirements. Consequently, animals that have the same mature size, but different levels of milk production would have different maintenance requirements.

John Evans

Evans said the benefits of a maintenance energy requirement EPD include improving the selection of animals that are more feed efficient, improving the selection of animals for certain production environments, and getting a straightforward value estimation, which can be especially useful in years with poor feed conditions.

For more information about this presentation, visit the newsroom at *www.BIFconference.com.*

Whole-herd reporting

According to CSU's Mark Enns, commercial cattlemen expect seedstock suppliers to be accountable for what they sell. For that to happen, Enns told the BIF Whole-Herd Reporting Committee that data submitted to the national genetic evaluation program must be accurate and a true reflection of the cattle population.

Stressing the importance of whole-herd reporting, Enns said selective reporting (representing only a portion of the herd) results in biased data. As a result, poor-performing animals may be made to look better, while superior performance may be penalized.

"You get biased EPDs, inappropriate ranking of animals and less reliable predictions for traits," Enns said.

For reliable data, Enns said breeders must emphasize complete and accurate reporting and appropriate grouping of contemporaries to minimize differences due to environmental factors.

Bruce Golden, also from CSU, explained how data submitted for national genetic evaluation is "filtered" prior to calculation of EPDs. Golden said filtering systems identify improper data, including extreme or fabricated values. Approximately 25% of all data submitted is filtered out as "noncontributing information" and eliminated.

A decision support tool

Keith Long, of New Mexico's Bell Ranch, addressed commercial producers' expectations regarding information that breed associations provide to assist with seedstock selection. According to Long, cattlemen would benefit from increased genetic analysis and new tools to simplify decision-making.

"I can't assimilate 15 to 20 trait EPDs in my head. We need a way to combine them into a selection index tailored to your own ranch," Long explained.

Development of EPDs for additional traits is fine, he added, as long as they are linked to profitability. Long would particularly like to see an EPD for annual cow cost. However, EPDs should be components for calculating a single number that is useful for making animal comparisons.

"In a perfect world," Long stated, "we would have whole-herd reporting by every (breed) association. All databases would be sent to a central location, annually, for calculations of EPDs, including across-breed EPDs. And all the numbers, including selection indices, would be available over the Internet."