PROCEEDINGS

Beef Improvement Federation 32nd Annual Research Symposium and Annual Meeting

July 12-15, 2000
Hyatt Regency
Wichita, Kansas

Hosted By:

Kansas State University
and
The Kansas Livestock Association

2000 - 2001 BEEF IMPROVEMENT FEDERATION BOARD OF DIRECTORS

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2000 Beef Improvement Federation Conference
Hyatt Regency
Wichita, Kansas
July 12-15, 2000

Wednesday, July 12, 2000
(All activities at the Hyatt Regency)

2 p.m. – 6 p.m. BIF Board of Directors Meeting
3 p.m. – 9 p.m. Convention Registration
5:30 p.m. – 7 p.m. Welcome Reception
Enjoy hors d'oeuvres and fellowship before the convention begins.
Sponcered by Schering – Flough Animal Health

7 p.m. – 9 p.m. OPENING SESSION
FOCUSING ON:
ECONOMICALLY RELEVANT TRAITS
Moderator – Bruce Golden, Colorado State University
7 p.m. – 7:30 p.m. What is Profitable Selection?
Dorian Garrick, Massey University,New Zealand
7:30 p.m. – 8 p.m. The Principle of Economically Relevant Traits
Bruce Golden, Colorado State University
8 p.m. – 8:30 p.m. Economically Relevant Traits Versus Indicator Traits
Mark Enns, University of Arizona
8:30 p.m. – 9 p.m. Economically Relevant Traits in Total Genetic Resource Management
Scott Newman, CRC for Cattle and Beef Quality and CSIRO Tropical Agriculture, Australia

Thursday, July 13, 2000
7 a.m – 5 p.m. Registration and Information – Hyatt Regency

8 a.m. – Noon GENERAL SESSION
Century II Convention Center
EMERGING TECHNOLOGIES
Moderator – Ronnie Green, Colorado State University
8 a.m. – 8:15 a.m. Welcome and Introductions
Biotechnology
8:15 a.m. – 8:35 a.m. Cloning
Steve Stice, Prolinia
8:35 a.m. – 8:55 a.m. DNA
Daniel Pomp, University of Nebraska
8:55 a.m. – 9:15 a.m. Sexing Semen and Embryos
Daune Garner, XY Inc.
9:15 a.m. – 10 a.m. Question and Answer Panel
10 a.m. – 10:30 a.m. Break
Sponsored by: Consolidated Nutrition, Cross Country Genetics, Cy Agra, Elanco Animal Health and Vigortone

Electronic
10:30 a.m. – 10:50 a.m. Video Imaging
Glen Dolezal, Excel
10:50 a.m. – 11:10 a.m. On-line Eating Quality Evaluation
Keith Belk, Colorado State University
11:10 a.m. – 11:30 a.m. Identification and Tracking
Bill Bowman, American Angus Association
11:30 a.m. – Noon Question and Answer Panel

Noon – 2 p.m. Lunch – Hyatt Regency Grand Ballroom
Introduction of Nominees for Outstanding Seedstock and Commercial Producer Awards
Sponcered by: Farm Credit Services Purina and Certified Angus Beef

2 p.m. – 5 p.m. CONCURRENT COMMITTEE SESSIONS
Century II Convention Center
Emerging Technology Committee
Ronnie Green Chair
Focus: DNA-base selection technologies presented at a lay-person's level. Topics include:
- The fundamentals of DNA-based genetic evaluation tools
- Gene mapping and DNA markers
- Searching for QTL from gene maps and other data
- Marker-indentified QTL versus actual QTL
- How do DNA tools change beef cattle evaluation?

Live Animal, Carcass & Endpoint Committee
Robert Williams, Chair
Focus: Coordinated relationships within the industry that are now making it possible to accumulate additional data that have been difficult to collect in the past. Topics will include:
- Canada's four-breed alliance
- Sire selection for feed efficiency – building relationships between researchers and the industry
- Sorting feedlot cattle into the most profitable groups
- Panel discussion on coordinated relationships

Multiple Trait Selection Committee

Kent Anderson, Chair

Focus: A follow-up panel of speakers from the opening session on economically relevant traits. Topics will include:

- Using EPDs from actual carcass data versus EPDs from scan data
- What is needed to make genetic improvement in lifetime reproductive performance?
- Opportunities to improve components of longevity
- Enhancing accuracy of multiple trait selection through advanced data screening techniques
-

5:30 p.m. Load busses at Hyatt

6:30 p.m. – 8:30 p.m. Kansas Kick-Off

Hosted by Doyle Creek Land & Cattle CO.

Renew friendships and make new acquaintances during this relaxed evening. Busses will transport guests from the Hyatt, east through the beautiful Flint Hills. Guests will learn about the history of the Flint Hills and this productive grazing region before enjoying a beef dinner. The Randy Mills' Family earned the BIF Outstanding Commercial Producer of the Year award in 1996 and the Cattleman's Beef Association Businessman of the Year award in 1999.

Sponsored by: Farmland Beef Feed, Farmland Black Angus Link and Bayer Animal Health

FRIDAY, JULY 14, 2000

7 a.m. – 5 p.m. Registration and Information – Hyatt Regency

8 a.m. – 11:30 a.m. GENERAL SESSION

Century II Convention Center

WHO IS THE KEEPER OF THE TECHNOLOGY

Moderator – Jerry Lipsey, American Simmental Association

Simplifying Technology

8 a.m. – 8:15 a.m. Breeding Objectives – Beef

Larry Leonhardt, Shoshone Angus Ranch

8:15 a.m. – 8:30 a.m. Breeding Objectives – Dairy

Steve Strickler, Strickler Holsteins

8:30 a.m. – 8:45 a.m. Breeding Objectives – Swine

Russ Nugent, The Pork Group, Tyson Foods, Inc.

8:45 a.m. – 9:30 a.m. Question and Answer Panel

9:30 a.m. – 10 a.m. Break

Sponsored by: ABS Global, Accelerated Genetics, Alta Genetics, High Plains Journal, Midwest Microsystems, Select Sires

The Future of Technology

10 a.m. – 10:20 a.m. What is the public perception of technology?

Janice Swanson, Kansas State University

10:20 a.m. – 10:40 a.m. Who will develop the technology?

John Pollak, Cornell University

10:40 a.m. – 11:30 a.m. Who will broker the technology?

- Panel Discussion

11:30 a.m. – Noon Annual Meeting and Director Elections

Noon – 2 p.m. Awards Luncheon – Hyatt Regency Grand Ball Room

Presentation of Awards for Outstanding Seedstock and Commercial Producers.

Sponsored by: Moormans and Pfizer Animal Health

2 p.m. – 5 p.m. CONCURRENT COMMITTEE SESSIONS

Century II Convention Center

Genetic Prediction Committee

Larry Cundiff, Chair

Focus: The development of revisions for the genetic prediction section of BIF's Guidelines. Topics will include:

- Multi-Breed Evaluations
- Across-Breed Evaluations
- Multi-Trait Prediction
- Approaches to International Evaluation

Additional discussion on developments needed to facilitate use of genomic markers in genetic prediction.

Producer Applications Committee

Sally Dolezal, Chair

Focus: Simplifying available performance technology as well as preparing for what's to come in the future. Topics will include:

- A producer's perspective on data overload – prioritizing performance information.
- Interpreting carcass data to make better breeding decisions.

The closing portion of the session will outline technology resources available. All those in attendance will have an opportunity to voice suggestions on needed BIF resources in the future.

Whole Herd Analysis Committee

Robert Hough, Chair

Focus: A review of where various breeds are in regard to whole herd reporting and inventory based fee structure. Topic will include:

- What will breed associations' role be in the future?
- Will whole herd reporting and inventory based fee structures be the end or just the beginning in reshaping breed associations?

5:30 p.m. Load busses at Hyatt Regency

6 p.m. – 8:30 p.m. "An Evening With Baxter Black"

Convention attendees will enjoy the relaxed rustic ranch atmosphere of Eberly Farm for a steak dinner and all the fixins.

Sponsored by: Biozyme Inc., Emerge Interactive, and IBP

Additional Day Tours – Tours to local attractions including Historic Old Town District, museums and shopping on Thursday and Friday morning. Thursday afternoon visit to Exploration Place, a state-of-the art futuristic learning, creative and community gathering center. On Friday afternoon experience the Old West with a tour to Old Cowtown Museum, a 17-acre living history museum with over forty exhibits. Registration available on site.

SATURDAY, JULY 15, 2000

6:30 a.m. – 10:30 a.m. KANSAS BEEF INDUSTY TOURS

Tours will highlight both state and national BIF Seedstock and Commercial Producers of the Year nominees and recipients plus visit the state's commercial feeding industry.

SOUTHWEST KANSAS SWING

This tour will take participants through the beautiful Gyp Hills and on to southwest Kansas, home of Kansas' commercial feeding industry and many progressive cow-calf producers. Featured tour sites include:

- Giles Ranch, Ashland
- Gardiner Angus Ranch, Ashland
- Hitch Feeders II, Garden City
- Reeve Cattle Company, Garden City
- Triangle H Grain & Cattle, Garden City

POST ROCK COUNTRY

This tour will treat guests to a look at the rolling hills of central Kansas and the famous Post Rock country. Limestone fence posts and progressive cow herds are home to this area of the state. Visits include:

- Green Garden Angus, Ellsworth
- Huseman Ranch, Ellsworth
- Thielen Ranch, Dorrance
- Dickinson Simmental & Angus, Gorham
- Lane County Feeders, Dighton

TOUR WRAP UP AND DINNER

The full day of viewing Kansas' beef industry will conclude with a beef dinner hosted by Pelton Simmental and Red Angus, Burdett. Along with the Pelton's seedstock, will be a breeders' showcase with cattle on display from neighboring herds representing several breeds. Busses will return to Wichita at the conclusion of the day.

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WHOLE HERD ANALYSIS COMMITTEE – (Robert Hough, Chairman)

FRANK BAKER MEMORIAL SCHOLARSHIP AWARD RECIPIENT ESSAYS

BIF
32ND ANNUAL RESEARCH SYMPOSIUM AND ANNUAL MEETING

OPENING SESSION

FOCUSING ON: ECONOMICALLY RELEVANT TRAITS

A Framework for the Next Generation of EPDs

B. L. Golden[1], D. J. Garrick[2], S. Newman[3], and R. M. Enns[4]

[1]Colorado State University, Fort Collins, [2]Massey University, Palmerston North, New Zealand, [3]Tropical Beef Center, CSIRO, Rockhampton, Australia, and [4]University of Arizona, Tucson.

Introduction

One key to the success of an enterprise is accurate assessment of the risks and potential returns of decision alternatives. To make informed assessment of breeding decisions breeders must have appropriate information. Extraneous and misleading information can reduce the probability a breeder's selection and mating decisions will achieve his goals.

Presumably the objective of new trait development has been to provide more complete descriptions of breeding stock (Bourdon, 1998). Some breeds now make EPDs available for nearly twenty different traits and their components such as direct and maternal effects. However the procedures used to identify the traits that are candidates for the development of EPDs have often been *ad hoc*, without scrutinizing the merit to the industry of introducing the EPD. We illustrate that many EPDs in current national cattle evaluations are extraneous. More formally these EPD add to the prediction error of the aggregate prediction of merit.

There exists a need for a framework to consider the role of traits in national cattle evaluation programs. **The aim of this paper is to provide a principle and framework to guide the process of identifying traits for which EPDs should be produced in the next generation of national cattle evaluations.** Our paradigm is based on the contribution of each trait to profit and risk.

This framework revives a foundation concept for beef cattle improvement programs that was first communicated over half a century ago. In the future, expected phenotypic expressions will be used to forecast profit and risk. We provide a vision for the evolution of genetic information systems in the beef cattle industry to increase their emphasis on business objectives.

Economically Relevant Traits

Many if not most traits which are measured on animals do not directly affect profit. For example, birth weight is measured not because a commercial producer gets more or less money due to the weight of a calf at birth. Rather, birth weight is used to help predict the genetic merit for other traits such as growth rate or the probability of a difficult birth. It is very difficult to assess the economic value of birth weight because larger birth weights are favorably associated with growth rates and unfavorably associated with calving difficulty. When growth rate and calving difficulty are already being considered, birth weight has no economic value.

Another example is scrotal circumference. Testicular size in normal post-pubertal bulls is not a trait with any economic value to the commercial producer. Scrotal circumference in a sire is favorably correlated to the age at which the sire's daughters will reach puberty and is, therefore, an indicator of age at puberty (Brinks, 1994). However, age at puberty is not a trait that is associated with revenue or costs. Age at puberty *indicates* the ability of daughters to conceive and have calves as two-year-old heifers. When EPDs for heifer pregnancy rate are considered, knowledge of EPDs for testicular size or age at puberty will not lead to increased progress in heifer fertility. In fact, using testicular size or age at puberty will reduce the rate of genetic progress for heifer fertility, a trait that directly influences profit.

Traits such as birth weight or scrotal circumference, that are used to indicate the merit an animal has for another trait, are called *indicator traits*. The traits that we are trying to improve we call *economically relevant traits (ERT)*. Economically relevant traits are the traits that directly affect profitability by being associated with a specific cost of production or an income stream. Indicator traits add information to the prediction of economically relevant traits.

Consider a list of traits thought to influence profit. The development of a formal selection objective requires that the economic value of each trait in the list be determined. The economic values reflect the change in profit for a unit change in the trait, when all other traits in the list are held constant. An indicator trait will have no economic value when the economically relevant traits with which it is associated are included in the list. In contrast, an economically relevant trait's economic contribution should be considered regardless of the presence or absence of any other traits in the objective.

Virtually every economically relevant trait in beef cattle production has multiple indicator traits. Table 1 contains a list of economically relevant traits and shows typical indicator traits for these economically relevant traits. Undoubtedly there are production and marketing circumstances where other traits are economically relevant.

Any trait that has a systematic genetic and/or environmental relationship to an economically relevant trait is a potential indicator trait. A non-zero genetic correlation describes only a linear relationship. Other types of systematic relationships are possible. For example, Evans, et al. (1999), reported a genetic relationship between scrotal circumference and heifer pregnancy rate, but the genetic correlation was zero. The authors devised a method for using this nonlinear relationship to enhance the accuracy of heifer pregnancy EPDs.

Table1. Proposed economically relevant traits and their indicators.

Economically Relevant Trait EPD	Indicators[1]
Sale Weight [2] Weaning Direct Weaning Maternal (Milk) 600 d Direct Carcass Weight Direct Salvage Cow Weight	205 d Weight 365 d Weight Carcass Weight Birth Weight Fat Thickness Cull Cow Weight
Probability of Calving Ease	Calving Ease Score Birth Weight Gestation Length
Cow Maintenance Feed Requirement	Mature Cow Weight Cow Condition Score Milk Production[3] Gut Weight
Stayability (or LPL[4])	Calving Records Days to Calving Calving Interval Milk Production[3]
Heifer Pregnancy Rate	Pregnancy Observations Scrotal Circumference
Tenderness	Amount of Intramuscular Fat Shear Force
Days to a Target Finish Fat Thickness Days to a Target Weight Finish Endpoint Days to a Target Probability of Grading Finish Endpoint	Backfat and Age at Slaughter Weight and Age at Slaughter Grade and Age at Slaughter
Docility	Docility Scores

[1]"Indicators" means traits which are measured to provide information to produce the economically relevant trait EPD. This list contains just the most obvious indicators. It is likely that different situations will be able to use other indicators.

[2]Sale weight is a category of EPDs. Different breeders will have different times at which they believe that future sales will occur for calves resulting from the current breeding decision. Each situation will require the breeder use only one of the sale weight EPDs.

[3]Milk production will most likely be measured using the maternal weaning EPD.

[4] LPL means Length of Productive Life. It is conceptually the same as stayability (Snelling et al., 1995) but expressed on a different scale.

It is usually straightforward to distinguish economically relevant traits from indicator traits. However, there are traits that are often identified as being economically relevant in the analysis of a business enterprise, such as so-called fundamentals, or key performance indicators. Some typical fundamentals in beef enterprises include feed conversion ratio and number of calves weaned per cow exposed. We do not consider these to be economically relevant traits in the context of ERT principle. These are composite traits, obtained from non-linear functions of economically relevant traits. We accept that fundamentals such as calves weaned per cow exposed may be useful for enterprise analysis but genetic progress in these composite indexes are more rapidly and predictably achieved by direct selection on a linear combination of the components of the index.

We limit our definition of ERTs to those with EPDs obtained directly from BLUP analyses (or from linear functions of BLUP analyses). This includes traits which have a linear relationship between the observed scale and an underlying liability or hazards scale (e.g., calving ease, pregnancy rate, or longevity). Economically relevant trait EPDs (and their accuracies) are applicable to individual animals and are interpreted in the conventional manner.

PROFITABLE SELECTION – HISTORICAL RATIONALIZATION FOR ERTs

The genetic basis for constructing selection indices was developed and communicated more than fifty years ago. Index construction begins by specifying the goal of the enterprise. A usual goal is increasing the level of satisfaction and this can be achieved by increasing profitability and managing risk. Having defined the goal, the next steps in the construction of an index are to identify the list of traits that influence the goal and to determine the relative importance of each of the traits in this list. Measured characteristics are then used to predict the aggregate economic merit of each candidate animal (Hazel, 1943; Hazel and Lush, 1943).

Determining the economic value of traits that influence the goal is not a trivial task. It is more difficult to achieve in beef cattle production systems than almost any other livestock species. Goals that are limited to income traits are more easily derived, as these ignore the complications of variation in costs, particularly feed costs. Evaluating feed costs is problematic, as many beef cattle graze forages that are unsuitable for other purposes except perhaps wildlife. In intensive pastoral systems such as in New Zealand, beef cattle undergo mixed grazing with sheep and the value of feed is related to the opportunity cost of forage in other enterprises which varies markedly at different times of the year. Relative economic values for traits influencing beef profitability are therefore not well characterized and probably less robust than for many other livestock enterprises.

Dr. C. R. Henderson (1951) expanded the findings of Hazel and Lush to show that aggregate economic merit could be constructed in a two step process. In the first step, EPDs were calculated, and these were combined with their economic values in a second step. With that knowledge animal breeders felt justified in calculating EPDs from measured characteristics and leaving the economic interpretation of these values to livestock breeders.

Some traits that influence the goal will not be subject to genetic influence or will contribute little to variation in profit. Such traits are typically ignored in index construction. Genetic evaluation comprises the task of predicting genetic merit for each of the economically relevant traits remaining in the objective for all the candidates that are available for selection.

In order to predict genetic merit analysts must have knowledge of factors that influence the trait in question and of relevant variance parameters. In simple cases where the trait of interest is a measured characteristic such knowledge can be obtained by collecting and analyzing field data. For example, if the trait of interest were a sale weight such as at weaning, observed phenotypic weaning weights would allow the development of suitable analytical procedures.

In practice some of the traits in the objective are not readily observed. For example, maintenance feed requirements are very expensive to measure. It is more feasible to predict maintenance feed requirements solely from indicators such as live weight, gut weight, and milk production. In this circumstance Schneeberger, et al. (1992) showed that the EPD for an unobserved trait can be readily calculated as a linear function of the EPDs for the indicator traits. Animal breeders may therefore have felt justified in producing EPD for measured traits with the knowledge that it was trivial to construct the EPD for the unobserved economically relevant traits.

Length of productive life is another example of a trait that cannot be easily observed. Measurement of this trait is further complicated by so-called incomplete records resulting from that fraction of female animals that are still present in the cowherd at the time of analysis.

In the absence of inventory recording systems, the actual length of productive life is not typically obtained and has therefore been historically difficult to predict. Accordingly, single trait analysis of individual components or indicators such as days to calving provided a sensible first step towards a goal of characterizing economically relevant traits. However, more recent research has resulted in analytical methods for predicting complex and difficult to measure economically relevant traits. For example, using methods described by Snelling, et al., (1995), Ducrocq and Solkner (1999), and more recently by Hyde (2000), it is possible to predict sustained conception rates in mature females or probable lengths of productive life, even with censored data or incomplete observations on lifetime production.

Length of productive life is associated with adult fertility traits such as days to calving and calving interval. Analytical methods to predict length of productive life can be developed from multiple trait analysis of actual productive lifetimes in conjunction with adult fertility measurements. Multiple trait analysis enables the genetic and phenotypic relationships between these traits to be estimated and used to increase the accuracy of EPDs for young animals.

The current best practice for the genetic evaluation of beef cattle falls well short of the approach originally envisaged more than fifty years ago. The vision was developed in advance of computing power, which limited lifetime reporting procedures, and analytical methods. The absence of economic values has limited the use of indexes of aggregate economic merit and poor knowledge of relationships between characters measured as selection criteria and traits in the breeding objective has precluded prediction of EPDs for many of the economically relevant traits. Sire summaries have therefore done little more than communicate the merit of animals with respect to a rapidly increasing list of indicator traits. However, focusing our research efforts on the few remaining economically relevant traits in table 1 for which there is not yet an EPD will bring us to a more useful approach to selection.

PROPOSED ERTS AND THEIR INDICATORS

The economically relevant traits in table 1 are meant to be a general, but not exhaustive list that would apply to many typical production circumstances. Evaluating the selection of bulls to produce replacement females will use a different set of ERT EPDs than selecting terminal sires. Furthermore, every producers' ERT are not necessarily included in table 1. For example, a high mountain producer (typically above 7,000 feet) may benefit from an EPD for incidence of brisket disease (pulmonary edema) a common cause of death loss. Some producers in tropical environments can benefit from a tick resistance EPD. This EPD would be economically relevant because of the cost of treating susceptible animals to control ticks.

An EPD for sale weight is essential in all production systems. Cow-calf producers have several alternatives for the age when they market their calves. Some producers market at weaning, others at a year of age, and yet others at harvest. For most breeders only one of the sale weight EPDs will be economically relevant. In 1999 over 80% of calves were sold at weaning. It is likely that few of the producers of these calves were given a premium for calves with superior post weaning gain or carcass weight. To maximize profit and minimize risk, these producers should consider only the weaning EPDs (direct and maternal) and their associated accuracies. Data on many of the indicator traits are currently recorded.

Cow-calf producers incur losses and veterinary/labor costs when cows have difficult calvings. Data that can be used to produce the probability of calving ease include calving ease score, birth weight, and gestation length.

The costs associated with feeding and maintaining cows accounts for a large proportion of expenses. Genetic evaluation of cow maintenance feed requirement does not currently exist; although, efforts are underway to develop such an EPD (Evans, 2000; MacNeil and Mott, 2000). Mature weight and milk production (in the form of the maternal weaning weight EPD) are used as indicators of maintenance feed requirements. It has been shown that cows with higher milk production have increased maintenance requirements, even when dry. Fatter cows have lower maintenance requirements than lean cows with the same mature weight. Therefore, condition score may improve the accuracy of the maintenance EPD by partitioning energy requirements into fat versus lean tissue requirements. A large portion of maintenance energy is used to maintain visceral organs (e. g., liver, intestine, etc.). It has been proposed that gut, or gut component weights may be useful indicator traits for cow maintenance EPD; these may be obtained by live animal ultrasonic or carcass observations.

The two economically relevant female fertility traits are heifer pregnancy rate (Evans et al., 1999) and stayability (Snelling et al., 1995). Heifer pregnancy rate predicts ability to conceive at a year of age. Stayability predicts ability to remain in the herd producing calves after having produced a calf as a two-year old. Data used to predict heifer pregnancy rate are pregnancy observations (or calving records) and may include scrotal circumference on related male animals. Indicators for stayability include calving records (did the cow calve in a given year), cow weight, days to calving (or calving interval), and milk production (maternal weaning weight). Data on some of these indicator traits already exists in many databases so genetic evaluation for these reproduction ERTs is currently feasible.

The length of time required to produce a harvest-ready animal is an economically relevant trait for the feeding and finishing phase. For producers that are selling weanling calves these traits are economically relevant if sale price reflects the merit of the calves for these traits. Animals are fed to a variety of finish endpoints including target backfat level, target weight, or target quailty grade. For animals fed to a target .4 inch backfat the logical choice of indicators would be backfat at harvest and age at slaughter. For a weight target endpoint age and weight at slaughter are indicators. Marbling score, including ultrasonic measures, with age at slaughter are indicators for finishing programs with quality grade endpoints.

An EPD for the time it takes to finish animals substantially simplifies the calculation of differences in costs to finish progeny of alternative sires. Time to achieve alternative finish endpoints will account for some of the differences in feed consumption to finish endpoints. There is likely to be additional variation in feed consumption but collection of individual feed consumption data is not currently practical. The days to target endpoints is a pragmatic compromise

HOW TO USE ERT TO PREDICT PROFIT AND RISK

It is likely that many, or even most producers use a heuristic approach to selection that often involves a mix of truncation selection and an intuitive emphasis on different traits that is analogous to an ad hoc selection index weight. Developing sire summaries with economically relevant traits become even more important when this approach to selection is used. There are three sources of the error that can be reduced in heuristic indexes, or more correct selection indexes, by sire summaries with only economically relevant trait EPDs. The first source of error occurs when a non-zero emphasis is placed on an indicator trait EPD, especially when the economically relevant trait EPD is in the sire summary. The indicator trait EPD cannot add more information to the selection process, so any emphasis on the EPD adds only prediction error due to the prediction error covariance. The literature contains examples of this type of error occurring in selection index procedures (e.g., Schneeberger, et al. 1992) such as BreedObject.

The second source of error occurs when an indicator trait EPD is available but not the EPD for its economically relevant trait. The producer often over- or under-emphasizes the value of the indicator trait EPDs ability to predict its economically relevant trait. By having an economically relevant trait, even when it is solved using only information from the covariance with an indictor trait, the producer has access to an accuracy value more appropriate for assessing risk of the decision.

The third source of error is often called information overload. Requiring producers to wade through an overwhelming amount of often extraneous and incomplete information will load to poor decisions. It is likely that most producers realize that without a detailed technical understanding of the relationships between traits and profit their decisions based on indicator traits are at best imprecise. We should anticipate that they will often not invest that necessary effort, largely out of frustration.

Genetic evaluation programs have attempted to meet client's expectations by providing EPD for traits perceived to be of economic importance. While this has increased the number of EPD available, breed associations and genetic evaluation providers have not efficiently exploited data reduction techniques such as ERT or selection indexes. The result is a number of EPD that on the one hand provides a description of an animals' genetic merit but does not attempt to correlate these with profit. Alternatively, the use of selection indexes (and the implementation of ERT in the decision-making framework) will require more information, but it is likely that the cost of collecting that information will be small in relation to the increased potential for profitability and efficiency in an integrated decision-making platform.

Decision Support Systems

Economically relevant traits will be delivered to industry in the form of Expected Progeny Differences (EPD). However, to be used in an optimal manner, ERT-EPD should be used in a decision-making framework incorporating the breeder's/producer's desires for longer-term viability of their production system. Thus, their use must be integrated into a framework that simultaneously incorporates technical, logistical and costs issues. Decision support tools will be required to achieve this task.

Decision support systems (DSS) are computer systems that assist the user in complex problem solving or decision-making. They are an integrated approach to the age-old problem of helping people make better decisions. Decision support systems typically have quantitative output and place emphasis on the end-user for final problem solving and decision-making (implementation). Jenkins and Williams (1998) and Newman and Stewart (1997) summarized examples of DSS within the animal production area.

Table 2 provides some examples of decision support tools developed for use in beef cattle breeding and production (this is not an exhaustive list, but provides a general overview of what is available). Many applications have taken advantage of distributed information technology environments through the use of WWW-based information dissemination. Table 2 describes increasingly greater levels of complexity toward integrated decision-making in livestock production as you move from top to bottom. Achievement of total integration depends on the level of complexity the user requires, because a greater amount of data is needed.

Table 2 Examples of beef decision support tools to address breeding program design issues

Examples of decision support tools	**Example(s) programs, references, contact information**	Distributed	Expert Intervention required?
Sire summaries / sire selectors Developed and disseminated by breed associations in cooperation with genetic evaluation provider Provides EPD, accuracies, pedigree information	www.studyweb.com/links/2489.html	Paper and WWW	No
Crossbreeding program design Allows comparison of a large number of breeds and designs Incorporates combinations of environments, management schemes and marketing arrangements in industry	HotCross (www.beef.crc.org.au/Commercialization) Simumate (mike@larrl.ars.usda.gov) CrossChoice (web.missouri.edu/~anscbeef/expert.html) Newman and Stewart (1997)	As part of workshop diskettes from developers download from WWW	No
Breeding objectives tools (combine production information and breeding values) Facilitates formal definition of breeding objective Derives appropriate selection index for a given breeding objective from available	BreedObject (www.breedobject.com)	Consultant's report and WWW-based catalogues	Yes

genetic evaluation and production system information Applies index to rank animals on profit			
WWW-based sire selectors with indexes Utilises elements of on-line sire selectors and breeding objective software Allows commercial producer to directly target particular markets	Australian Angus Society (www.angusaustralia.com) New Zealand Charolais Society (sireselector.massey.ac.nz/)	WWW WWW	No
Integration of breeding program and management decisions Integrates genetics, nutrition, growth, body composition, reproduction and management to simulate and predict beef cattle life-cycle production	Decision Evaluator for the Cattle Industry (DECI) Tom Jenkins (jenkins@marcvm.marc.usda.gov)	CD-Rom	No
ERT effects on profit allows user to model cash flow of production system with user-specified ERT, herd structure information and income and expenses	ERT Profit/Modelling Prototype Bruce Golden bgolden@ops.agsci.colostate.edu	WWW	No
Tactical Optimisation of Breeding Programs Balances technical, costs and logistical issues in breeding programs User-driven through specification of desired outcomes Uses mate selection to incorporate decisions on animal selection and mate allocation	Total Genetic Resource Management (TGRM) (www.beef.crc.org.au/Commercialization)	Consultant's report	Yes

CONCLUSIONS – WHAT NEEDS TO HAPPEN NEXT

The approach recommended in this paper reflects a long-term vision that is consistent with the scientific innovators of the 1940's. First, EPD should be calculated for all economically relevant traits. This involves BLUP analyses of existing data. Concurrently, EPDs for indicator traits that are not themselves economically relevant traits, should not be subject to publication and we should focus our research and development efforts to produce EPD for the few traits in table 1 which are not currently available.

Economically relevant traits EPD give us the opportunity to improve the delivery of decisions analysis software and procedures. By having a sensible standard set of trait to parameterize decisions analysis it is possible do develop a host of computer-based software that will calculate the economic value of economically relevant traits. It is clear that public investments in this type of development effort will have a very high potential for return. We should make a host of software tools accessible via the web, in association with electronic sire or animal summaries. These would allow animals to be presented in index order, and may allow bull buyers to make informed decisions about the relative impact of prospective sires on their enterprise profitability and risk.

Economically relevant traits and business decisions should be integrated into a framework that is an integral part of the overall business strategy, and not merely play a supporting role. Breeding program decisions are long-term investments and cannot be made in isolation of other important business decisions.

Finally, systems that are better than EPDs should be developed for presentation to bull breeders and bull buyers. Breeders and buyers are not interested in EPDs as much as they are interested in the actual phenotypic performance of future offspring. In the simplest setting, EPDs are adequate for this task. However, with added complications such as maternal influence, inbreeding, heterosis in crossbred systems, and variation due to production and management circumstances, the EPD is somewhat limiting. Computer-based systems should predict the phenotypic performance of offspring from various mating options. Such look ahead mate allocation strategies, in concert with new analytical techniques such as from evolutionary algorithms will facilitate adoption and add considerably to the benefit that can be harvested from existing evaluation systems.

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BIF
32ND ANNUAL RESEARCH SYMPOSIUM AND ANNUAL MEETING

GENRERAL SESSION #1

EMERGING TECHNOLOGIES

FUTURE COMMERCIAL UTILIZATION OF ANIMAL CLONING

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Introduction

Recent progress in cloning mammals is attributed to improvements in treatment of the donor nucleus and better understanding of the nuclear reprogramming ability of the unfertilized oocyte. Despite these advances, the procedures used in cloning (nuclear transfer) are still inefficient, thus limiting commercial applications of this technology. In cloned cattle and sheep, the limited viability of embryos and/or offspring is reportedly a result of problems during nuclear reprogramming of the donor nucleus. Pigs are even more problematic, since the advances made in cloning in other species apparently are not sufficient for producing offspring derived from reprogrammed differentiated cells in pigs. The first cloned pigs were produced through serial transfer back through a fertilized embryo (PLL Therapeutic, 2000). Clearly, new and innovative approaches to inducing and monitoring nuclear reprogramming of donor nuclei are needed.

Commercial opportunities

In the 1980s cattle genetics companies envisioned using nuclear transfer technology to multiply genetically superior cattle; however, today the field of biomedical appears to be the first major commercial opportunity for cloning technology. Nuclear transfer technology can produce transgenic cattle faster and more efficiently than traditional microinjection techniques. Microinjection techniques were used to produce transgenic rabbits, pigs, goats and sheep able to secrete blood proteins in their milk. These products are in human clinical trials and are expected to gain regulatory approval and be marketed in the next several years. Therefore, microinjection procedures are useful but they are very inefficient. In cattle only one in 1000 embryos injected with the DNA construct results in a transgenic calf. Nuclear transfer presents many advantages over microinjection. One is the fact that fewer embryos need to be produced to obtain a transgenic offspring. Second, all offspring produced are transgenic thus eliminating the cost of carrying non-transgenic pregnancies to term. All of the offspring are transgenic because all of the cells used to produce the nuclear transfer embryos were selected for the gene of interest being present in the donor cells. Thirdly, the sex of the cloned offspring is known since the sex of the starting donor cell is predetermined. All female offspring are of interest in this case since they will produce a product earlier than having to wait for the next generation of female offspring when using a microinjection founder bull. Nuclear transfer offers the potential of having a herd of cloned animals producing the pharmaceutical protein in three years. An estimated two years of developmental research can be eliminated when a herd of cloned transgenic females are produced. This means clinical trials can be started two years earlier. This shortcut is a great attraction to pharmaceutical companies.

Nuclear transfer technology may also be used to enhance cell and tissue therapies. Previously we transplanted neural tissue derived from cloned transgenic bovine fetuses into a rat model for Parkinson's disease. This significantly reduced the Parkinsonian symptoms in the treated rats (Zawada et al., 1998). Therefore, therapeutic transgenes may be added or endogenous genes knocked out through nuclear transfer to produce a consistent source of genetically engineered animal fetal cells to be tested in rats prior to clinical trials. Cloning and transgenic improvements will eventually impact these disease states through more consistent sources of cells (genetically identical) for cell therapies and new and better animal models.

Yet another biomedical opportunity is developing porcine nuclear transfer technologies for organ transplantation applications. The potential of using this technology in this field is large and some suggest it could become a $6 billion global market at maturity. The attraction is to use cloning to add or remove (knockout) genes; however, first the cloning procedures must be developed for pigs to make these valuable animals. Therefore, cloned pigs produced through novel techniques will have an impact on this field and the increased efficiencies will facilitate the necessary genetic modifications faster than conventional microinjection techniques.

In animal agriculture, cloning still has the potential for broad-based economic benefits. This will fill the needs of animal production industries that desire reliable sources of high quality breeding stock. Development of cloning and transgenics for use in food producing animals will provide the opportunity to develop animals with traits that improve both the efficiency of production and the quality of products for consumers.

Widespread commercialization requires improved nuclear transfer efficiencies.

The following is a general schematic of the nuclear transfer procedure in mammals (Figure 1.), developed first in the late 1980s and basically the same today. Some of the minor changes in the procedure, developed since then, will be described in following sections.

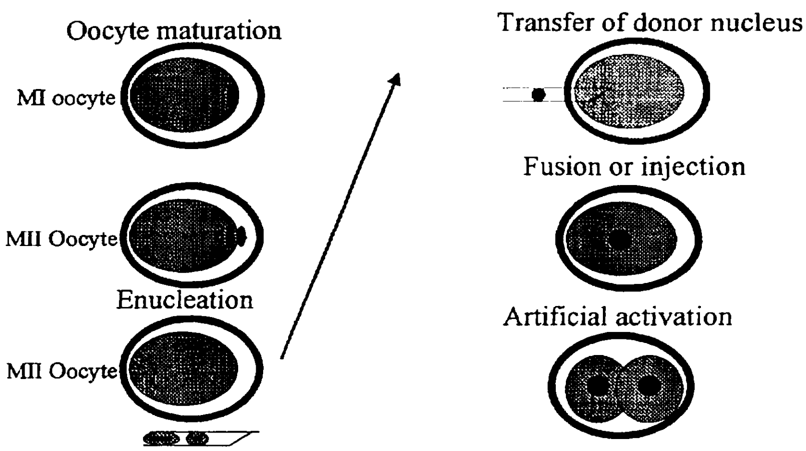

Figure 1. Traditional nuclear transfer procedures.

Over the last 11 years, the source of the donor nuclei has changed, but the basic nuclear transfer procedure has not changed dramatically. The first cloned rabbit (Stice and Robl, 1987) was produced using embryonic cells, whereas recently, the first cloned transgenic calves were produced using fetal cells (Cibelli et al., 1998; Table 1). Although 11 years separate those experiments, both studies used unfertilized M II oocytes that were enucleated and then fused with the donor cell. The major difference other than donor cell type is the timing of fusion and activation appears to separate the use of embryonic verses differentiated donor cells. Bovine embryonic cell derived clones developed at a higher rate when the oocyte was activated first followed by introduction of the donor nucleus into the activated oocyte (Barnes et al., 1993; Stice et al., 1994). Thus, bovine fetal and adult cell cloning was successful because the donor nuclei were exposed to the reprogramming properties of the unfertilized oocyte for an extended period. This was accomplished by reversing the fusion and activation steps in the cloning process, and resulted in the first cloned cattle fetuses from differentiated cell lines (Stice et al., 1996), and later in offspring from fetal cells (Cibelli et al., 1998; Table 2). Thus, with differentiated cells, the basic nuclear transfer procedures and starting oocyte stage have not changed, but the donor nucleus is exposed to the enucleated M II oocyte cytoplast prior to activation.

Table 1. Species and donor cell type used to produce cloned mammals.

Species	Cell type used to produce a nuclear transfer offspring (clones)		
	Embryonic	**Fetal**	**Adult**
Mouse	Cheong et al., 1993	NO	Wakayama et al., 1998
Rabbit	Stice and Robl, 1988	NO	NO
Cattle	Prather et al., 1987	Cibelli et al., 1998	Kato et al., 1998
Sheep	Willadsen, 1986	Campbell et al., 1996	Wilmut et al.., 1997
Pig	Prather et al., 1989	NO	PPL Therapeutics, 2000

Adult fibroblast and cumulus cell nuclei have now been shown to direct development to offspring in cattle (Table 2). Again, a key difference appears to be an extended exposure to the reprogramming factors associated with the oocyte prior to initiating activation (Kato et al., 1998; Wells et al., 1999). The use of quiescent donor cells may have played a role in the success as well. Extended oocyte exposure also helped produce the first cloned adult mice (Wakayama et al., 1998). The results are less clear in sheep, since Dolly was produced using simultaneous activation and fusion (Wilmut et al., 1997). However, another laboratory working in cattle used non-quiescent bovine cell nuclei fused to activated oocytes and produced offspring (Vignon et al., 1999).

Table 2. The use of various cell types and procedures in the production of bovine nuclear transfer offspring.

	1998 (Kato et al.,)	1999 (Wells et al.,)	1999 (Vignon et al.,)
Cytoplast	MII oocyte	MII oocyte	MII oocyte
Donor	Quiescent cumulus	Quiescent granulosa	Proliferating fetal &
Procedure	Fusion to non-	Fusion to non-	Fusion to activated
Outcome	Offspring	Offspring	Offspring

Dolly was produced using a quiescent nucleus, the authors= theory being that a quiescent differentiated cell would facilitate nuclear reprogramming (Wilmut et al., 1997). However, more recent studies in the mouse using various cells that are naturally in a quiescent state when harvested (cumulus cells, sertoli cells and neural cells), produced very different results (Wakayama et al., 1998). The cumulus cells gave rise to offspring while the other quiescent cells did not. Arguably, the least quiescent of the three cell types is the cumulus cells since these are often mixed with granulosa cells which will propagate very well in culture (Wells et al., 1999). Therefore, the role of quiescence in the success of nuclear transfer is debatable and there is no conclusive evidence that quiescence is or is not mandatory for nuclear reprogramming.

Certain cell types like cumulus/granulosa cells and fibroblast cells do result in offspring when used in the nuclear transfer process (Table 2). Based on the data from cattle and mice, it may be more important to have a functional cell type (either G0 or G1) capable of immediately directing development in the resulting nuclear transfer embryo than merely quiescence. This is the primary reason for using dividing or arrested fibroblast cells rather than non-dividing neural cells, truly quiescent donor nuclei. Successful cloning requires cell cycle synchrony between the donor nucleus and the recipient cytoplasm and/or the additional time that the donor nucleus is reprogrammed by the recipient oocyte.

Although cloned cattle were produced using either fetal or adult cells, the efficiencies are still low and losses of late term pregnancies and neonatal anomalies make the current procedures problematic. We have only limited knowledge of what causes these problems. Using fetal fibroblast cells as donor nuclei 13 cloned fetuses progressed into the third trimester of pregnancy (Hill et al., 1998). Of the 13 fetuses, eight live calves were born and six survived past one month of age. In the other pregnancies, four fetuses were recovered from three dead cows between seven days-and two months before parturition. The 13th fetus was aborted at eight months gestation but the surrogate cow survived. Placental edema was associated with the calves and fetuses with cardiopulmonary abnormalities. Hydrallantois and/or placental edema were observed in six cows resulting in only one of the six surviving calves. Six cows without hydrallantois or placental edema had five live calves and one aborted fetus. Therefore, five of the seven dead fetuses or calves were from pregnancies that showed obvious placental abnormalities.

Improvements in the nuclear transfer procedure that reduces or eliminates neonatal losses will improve the commercialization potential of cloning especially in animal agriculture. Alternatively, if embryos that produce late term abortions or neonatal losses could be diagnosed early than these problem pregnancies could be avoided. Ideally viable embryos would be diagnosed prior to transfer into recipient females. However, the best solution to this problem is a better basic understanding of the nuclear reprogramming process leading to normal offspring.

Nuclear reprogramming

Definitions for nuclear reprogramming vary greatly; for our purposes, the desired result in cloning is to modify an adult nucleus so it is capable of directing development from the one-cell embryo stage to offspring. This, of course, is the goal of cloning and accomplished in various species using donor nuclei of differing states of differentiation (Table 1). Other parameters, such as ability to produce a blastocyst stage embryo, are an indication of successful nuclear reprogramming. However, early cloning studies using embryonic cell lines indicated that embryo development to the blastocyst stage does not mean that offspring are forthcoming (Stice et al., 1996). Other parameters such as temporal and spatial development patterns were also used. When the first cloned rabbit was produced, we also reported morphological parameters for nuclear reprogramming (Stice and Robl, 1988). In this study, the time required to progress from the zygote to the blastocyst stage was similar for both fertilized embryos and nuclear transfer embryos. However, the donor cell that was not reprogrammed by the recipient cytoplast formed a blastoceole cavity earlier (72 hrs). Therefore, the oocyte cytoplasm at least partially reprogrammed the donor nucleus since it reverted to the same morphological and temporal pattern as the fertilized embryo. There are anecdotal and unpublished observations that spatial and temporal events between fertilized embryos and nuclear transfer embryos are not always the same, but these events have never been quantified. For example, bovine nuclear transfer embryos do not form a distinct compact morula stage but advance quickly from precompacted morula to the blastocyst stages (Stice, unpublished).

There are preliminary data suggesting that in fertilized sheep embryos, the time to development to blastocyst stage may be correlated with birth weight (Kuran et al., 1999). The most advanced staged embryos at day seven of development were more likely to have high lamb birth weights than lambs from earlier stage embryos. Although not quantified, others and we have observed that nuclear transfer embryos in both cattle and pigs often develop to blastocyst stage faster than fertilized embryos. They often form compact morula only briefly before developing a blastocyst cavity. This may indicate incomplete nuclear reprogramming as mentioned in a previous section (Stice and Robl, 1988). Fully reprogrammed nuclear transfer embryos capable of developing to normal offspring would have a developmental pattern similar to that of fertilized embryos.

Others have used ultrastructural and biochemical markers to observe nuclear reprogramming including nuclear lamina epitopes (Prather et al., 1989), nucleolar morphology (An et al., 1994), and protein synthesis (Yang et al., 1995). However, nuclear transfer embryo development within a group is highly variable. These previous techniques are not vital measurements; therefore, measurements in an embryo cannot be compared to the eventual development of each individual embryo.

Genomic imprinting is involved in nuclear reprogramming and may influence development in nuclear transfer embryos. Both the maternal and paternal chromatin compete for hyperacytelated histones (Adenot et al., 1997). Methylation and acetylation of histones are related and could potentially affect genomic imprinting and or nuclear reprogramming. Because the maternal chromosomes are normally removed before activation in the nuclear transfer procedure, genomic imprinting events may be affected more so in nuclear transfer embryos. Several research groups are currently investigating methylation and imprinting patterns in nuclear transfer embryos.

Conclusion

The advances in using differentiated cells as donor cells in the nuclear transfer process have opened new opportunities to commercialize animal cloning. Now improvements in the nuclear transfer efficiencies and the pregnancy outcomes will determine whether we can capitalize on these opportunities.

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EMERGING TECHNOLOGIES FOR GENETIC IMPROVEMENT OF BEEF BIOTECHNOLOGY: DNA

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Introduction

Breathtaking advances are occurring in the knowledge and understanding of the structure, sequence and function of DNA. The entire genetic blueprint, or DNA code, has now been deciphered for humans and a variety of other organisms. This modern-day "Genomic Revolution" may be one of the most important periods in the history of humankind, promising diagnostics and therapeutics for numerous diseases and maladies.

In animal agriculture, and particularly in beef cattle improvement, the payoffs of the "Genomic Revolution" have seemingly been few and far between. DNA information on cattle is routinely used for determining parentage, and a handful of DNA diagnostic tests are available for a small number of relatively simple traits. However, the true potential of harnessing genomic technologies in beef cattle awaits application of DNA testing for production traits such as carcass quality, growth, reproduction and overall health status. These diagnostic tools will assist genetic improvement by increasing the accuracy of the selection process, while simultaneously lowering the time required in order to reach effective selection decisions. In addition, they can be used to optimize management practices at several levels of the production chain. In the long-term, it is inevitable that the cattle genome will eventually be engineered to design new and improved genetically modified animals and products.

DNA Markers I: Identification of Breed and of Parentage

The first application of DNA information in beef cattle genetic improvement has been in providing highly accurate forms of identity testing. By evaluating panels of highly polymorphic genetic markers, an extremely unique genetic "fingerprint" of a breed and of an individual can be obtained. Several uses of this relatively simple technology are apparent. Primary among these is the determination of breed and of parentage. Determination of breed composition can be used to help sort and identify genetic potential of cattle. In addition to the obvious utility of determining parentage for registration, sale, embryo transfer and associated purposes, DNA-based sire verification enables use of multi-sire breeding schemes. This latter application may contribute to genetic improvement by enabling retrospective selection; for example, high or low quality carcasses may be traced from the kill-floor back to sire of origin, allowing for selection/culling of sires with high/low genetic potential for carcass traits. It is likely that miniaturization of the genotyping process (i.e. gene chips), in combination with robotic automization, will render DNA fingerprinting a simple and inexpensive tool for the beef cattle industry in the future.

The ability to trace the identity of a sample throughout a complex production chain-of-custody is another application of DNA-based identity testing. While not necessarily directly related to genetic improvement, "traceability" of DNA from meat to carcass to individual animal may become an integral component of quality control and food safety programs in the beef industry. Tracing DNA may also be used as a tool for verification of identity in shows, contests and competitions.

DNA Markers II: DNA-Assisted Selection

Background and History: Selection based on phenotypic records has been the driving force behind genetic improvement of beef cattle throughout history. By combining information on an individual's performance with the performances of ancestors, sibs and progeny (i.e. EPDs), breeders are able to determine the animal's genetic potential with relatively high accuracy. Selection has proven to be an extremely powerful tool to change production characteristics within a population.

Along the course of animal breeding history, several new tools have emerged to enhance the success of genetic improvement via selection. For example, the ability to freeze semen and use artificial insemination dramatically increased the ability to identify and utilize the best sires in selection programs. Another example is the development of advanced statistical algorithms to combine complex pedigree and performance information into usable selection criteria such as EDPs; these statistical programs, in combination with dramatic enhancements of computer processing power, have been instrumental in the success of beef cattle genetic improvement programs.

EPDs predict the genetic makeup of an animal. This is successful regardless of the fact that the actual genes responsible for controlling the trait being improved, and more specifically, the different alleles at these genes which make animals superior or inferior, are primarily unknown. However, selection is difficult, expensive and/or time consuming to implement for traits that are: expressed in only one sex (e.g. milk production); expressed late in life; difficult or expensive to measure on a live animal (e.g. carcass quality); or not very heritable (e.g. reproduction). Furthermore, significant amounts of data are required before the EPD accurately predicts actual genetic makeup.

The Basic Premise: Clearly, the ability to directly evaluate the genetic makeup of cattle, based on evaluation of their DNA at genes controlling economically important traits, could be of tremendous value to increase the accuracy and efficiency of selection. It is important to realize, however, that the use of DNA-assisted selection would be yet another addition to the toolbox of cattle breeders, and not a complete replacement of existing methods and technologies. In other words, using information on the DNA of animals will be an additional resource to tap when trying to identify which are superior and which are inferior cattle. No genetic manipulations are involved, which renders consumer acceptance of this emerging technology an essentially non-factor.

Simple versus Complex Traits: In one sense, DNA-assisted selection is already a reality. In another sense, the widespread use of DNA information in making selection decisions for most economically relevant production traits remains an elusive goal whose shape is still taking form. To understand this dichotomy, one must first comprehend the clear differences between simple (qualitative) and complex (quantitative) traits. For simple traits, usually one gene is responsible for determining the phenotype, and environmental conditions have little or no effect. Examples of such traits include sex, horns, coat color, certain diseases (e.g. beta-mannosidosis, Pompes, etc.), and rare performance traits (e.g. double muscling). In contrast, complex traits are controlled by many genes (potentially dozens or even hundreds), which can form intricate interactions with each other and with environmental influences such as nutrition, climate and production schemes. Unfortunately, almost all traits of economic significance in cattle production are complex in nature, including growth, body composition, carcass quality, reproduction, milk production and overall disease resistance.

Genetic tests for simple traits are much easier to develop. Indeed, DNA-based selection can already be practiced for many such traits in beef cattle. Embryos may now be sexed based on a simple DNA test. Certain coat color variations (red factor) can be predicted. Various diseases may be diagnosed at the DNA level, including Pompes, DUMPS, beta-mannosidosis, and maple syrup urine disease. Most recently, the gene causing the double-muscling phenotype has been identified (myostatin), and a genetic test can be used to identify positive and negative alleles. These tests identify the actual mutation and/or DNA sequence that directly control each respective trait. Thus, there is no ambiguity and the tests are completely accurate in predicting phenotype.

In regard to complex traits, development of useful genetic testing is still primarily elusive. Evidence from the few powerful studies conducted to date indicate that even for complex traits, it is likely that a few genes may exist that together account for a reasonable percentage of the phenotypic differences between high and of performing cattle. If this is proven to be true, then genetic testing for some complex traits may become a reality in the future. However, it must be emphasized that the widespread application of these tests may be quite limited for some time. This is because it is highly possible that a gene that helps to control a complex trait may have different effects in different breeds and/or in different environments. Thus, for any new genetic test that may be used to help predict breeding value of cattle, research will be needed to evaluate the consistency of the test in different breeds, and across variable environments and management systems.

Despite these complexities, the potential power of DNA-Assisted Selection is enormous. Besides the obvious benefit of increasing the accuracy of selection and decreasing the time required to reach selection decisions, there are additional less obvious payoffs. For example, it is currently difficult to genetically increase intramuscular fat without an accompanying increase in overall carcass fat. However, it is increasingly clear that there are individual genes that can influence one trait without changing the other. By focusing selection decisions on targeted DNA information, these negative genetic correlations can potentially be broken apart to achieve more precise improvements.

The Future: It is likely that significant advances in the tools of genomics will be required to facilitate the use of DNA testing as a widespread and integral tool for beef cattle breeders. However, such advances can be expected. At some point in the future a scenario may eventually arise in which a breeder can take a hair root from a newborn calf, swish it around in a simple buffer, spread the solution on a glass slide called a "DNA-Selection Chip", insert the chip into a special port on a laptop computer, input data regarding the breeder's particular selection needs (e.g. emphasize marbling and birth weight more than weaning weight and reproduction) and management practices, and within minutes obtain a highly accurate EPD.

DNA Markers III: DNA-Assisted Management

It is likely that the first genetic tests for complex traits will focus on carcass quality phenotypes such as marbling and tenderness. While such tests will certainly be useful in breeding programs, they may be even more beneficial for enhancing the efficiency of management and production systems. For example, carcass quality genetic testing could be used as an efficient sorting tool in feedlots. Cattle with different genetic potential for marbling and tenderness can quickly be identified and directed to appropriate management regimes to maximize value. In addition, it is likely that other management based DNA tests will be developed in the future, for practices such as selection of implants for maximal response, increasing efficiency of nutritional regimens, and optimizing drug dosage. In the same vein as the "DNA-Selection Chip" may be used to rapidly estimate EPDs, a "DNA-Management Chip" may eventually be used to rapidly determine how cattle should be treated and managed at various points in the production cycle.

DNA Manipulation: Genetic Engineering and Designer Genes

While DNA-assisted selection and management "simply" attempts to identify the *existing* genetic makeup of cattle to enhance genetic improvement and value, genetic engineering actually *alters* the genetic makeup of cattle. This distinction is critical in understanding the potential promise (and limitations) of this powerful technology.

Traditionally, genetic engineering was considered as a mechanism to enhance production traits of beef cattle by designing animals that produce more (or less) of proteins that impact important phenotypes. For example, cattle could be engineered to have more growth hormone, potentially increasing lean tissue accretion and efficiency of growth. Alternatively, cattle could be engineered to have mutations in myostatin, resulting in various degrees of increased muscling. One reason why genetically modified organisms (GMO) are not currently, nor will be anytime soon, part of beef production is that the methods used to develop and produce such animals are of low efficiency and high expense. Perhaps more importantly, however, is that our knowledge of how complex traits are regulated, and how they can be successfully manipulated, is still at very embryonic stages. Once we better understand how important phenotypes are regulated in beef cattle, our ability to design animals through genetic engineering will be enhanced.

The development of genetically engineered crops such as roundup-ready soybeans and BT-corn showcased the use of genetic modification to create completely novel phenotypes for agricultural organisms. These successes have created a new paradigm for the use of genetic engineering, to design value-added phenotypes dictated by genes that may originate from extremely diverse organisms. In this regard, the potential uses of genetic engineering are only limited by one's imagination, in combination with our knowledge of genes and their functions throughout the spectrum of living organisms. A variety of different health-related products could be delivered via "smart beef" (imagine, for example, a well-marbled, cholesterol-lowering ribeye steak). Alternatively, cattle could be engineered to increase the ease and efficiency of management (for example, through resistance to a variety of pests).

Perhaps the biggest obstacle to commercialization of genetically modified cattle will be public acceptance. Given the current battle regarding GMO crops, the placement of genetically modified hamburgers in school lunch programs is not an appetizing notion. However, given that genetic engineering of beef products will likely not be a reality for quite some time, the battle over public acceptance of GMOs will almost certainly be fought and decided on battlefields other than feedlots and meat counters. The results of this battle will largely shape the future use of GMOs in beef cattle production.

Summary

Traditionally, the merits and payoffs of biotechnology have been oversold to breeders and producers. Expectations of "silver bullets" have come and gone. In reality, the ability to use biotechnology to incorporate DNA information in genetic improvement programs and management systems is directly proportional to our understanding of the sciences of molecular biology and genomics, in close collaboration with industry practices and consumer demands. As we understand more about the genome and how complex traits are controlled, and as our toolbox of techniques and methodologies grows and improves, we will increasingly be able to enhance genetic improvement of beef cattle as well as the management of beef cattle production and development of high quality beef products. Until recently, progress in this regard was a slog. However, we are currently at the cusp of a genomics revolution. While exponential successes may be a tall order, we can and should expect much more rapid implementation of DNA-based biotechnology in the beef cattle industry.

SEXING SEMEN

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Introduction

The sex of calves can be predetermined with 85-95% accuracy using semen sexing (Amann, 1999; Seidel et al., 1999). This is accomplished by sorting live bull sperm using a flow cytometer/cell sorter (SX MoFlo®). This sexing procedure, which was first developed for living sperm by Dr. Larry A. Johnson at the USDA Beltsville Agricultural Research Center (Johnson et al., 1989), is a patented process. The exclusive worldwide license to this technology for all non-human mammals is held by XY, Inc., a private company. This company has invested heavily to the point that application of this technology to cattle and horses has become a commercial reality. This is a global effort in that XY, Inc. has collaborators not only in the United States, but also in the United Kingdom, Switzerland, Australia, Germany, Holland, Argentina and Japan.

Process of Sexing Sperm

Bull semen can be sexed because X-sperm, which produce heifers, contain 3.8% more DNA than the Y-sperm, which produce bull calves (Garner et al., 1983; Johnson, 1992). Freshly ejaculated sperm are stained with a DNA-binding dye, Hoechst 33342, for 1 hr (Johnson, 1992). This dye binds to the sperm proportional to the amount of DNA in the sperm. The stained sperm heads fluoresce bright blue when exposed to a laser beam of short wavelength light. The X-sperm, because they contain more DNA than the Y-sperm, emit more fluorescence than Y-sperm. This difference in fluorescence signal can be can be measured by a detector in the SX MoFlo® sorter at thousands of sperm/sec. The fluorescence intensity is integrated within in a computer so that the DNA content for most, but not all sperm, can be accurately measured as the cells flow through the instrument. As the fluid stream containing the sperm flow through the instrument and exit the nozzle, the stream is vibrated to cause individual droplets to form of about 90,000/sec. Although every droplet does not contain sperm, those that do are charged either positively or negatively, depending on the DNA content information. Accurate measurement of the DNA content of sperm requires that the flattened sperm head be oriented properly (Johnson et al., 1992). The system is designed to orient the sperm so that the maximum number of sperm can be measured precisely (Johnson et al., 1999). When sperm DNA content cannot be measured accurately due to miss-orientation, those droplets as well as those containing more than one sperm, are not charged thereby, allowing such cells to be disposed of as waste. The droplets, either positively or negatively charged according to sperm DNA content, are deflected by a charged metal plate of the opposite polarity to direct each droplet containing sperm into the appropriate collection vessel. Droplets containing X- or Y-sperm are thereby directed to different collection vessels. The streams of droplets are collected into separate vessels, one for X-sperm, one for Y-sperm and one for those droplets with no sperm or too many sperm. The measurement process can accurately sex about 40% of the sperm going through the sorter at a speed of approximately 65 mph. At this speed, about 20,000 total sperm/sec travel through the instrument so that nearly 4,000 sperm/sec of each sex to be sorted simultaneously. With the current system, we can produce approximately 10 to 13 x 10^6 live, sexed sperm/hr with an accuracy of 85-95% (Amann, 1999; Seidel, 1999b; Welch and Johnson, 1999). This sorting process dilutes sperm so they have to be re-concentrated by centrifugation. The sperm, which have been concentrated to about 80 x 10^6/ml are packaged into 0.25 ml straws and then cryopreserved (Schenk et al., 1999).

Insemination Procedures

Approximately 20 x 10^6 sperm/dose are used with conventional AI practices. The numbers of sperm that are used for insemination of sex-sorted sperm, however, is about 1/20 to 1/3 that in a normal insemination dose in that they contain from 1 to 6 x 10^6 sperm/straw (Seidel et al., 1997). Although we can now sort sperm at rates of about 4,000 per second for each sex, it is advantageous to use fewer sperm per insemination than normal. Recent work in Holland demonstrated that normal non-return rates can be achieved with as few as 2 x 10^6 sperm/dose, provided highly fertile bulls are used (den Daas et al., 1998). Thus, selection of the 20% most fertile bulls would expedite use of sexed semen in cattle because low-dose insemination would allow for many more heifers to be bred with sex-sorted sperm.

Optimal use of this technology requires a high level of management at several levels. Not only is selection of bulls important, but reasonable success with sexed sperm has been achieved principally with heifers in that breeding lactating cows with sexed sperm has been less than satisfactory (Seidel et al., 1999). Careful timing of inseminations relative to the time of expected ovulation is especially critical when fewer sperm are used. Under current practices, the ability to cryopreserve sex-sorted sperm successfully has allowed more efficient use in breeding estrus-synchronized heifers. Seidel et al. (1999) have successfully used several regimens to synchronize estrus for insemination of sexed sperm. Synchronized heifers were visually inspected for standing estrus both mornings and evenings. All inseminations, however, were done in the evening after 4:00 pm so that inseminations occurred approximately ½ or 1 d following the onset of the observed estrus.

Straws (0.25 mL) containing the sexed sperm are thawed for 20 to 30 sec in a 34 to 37°C water bath before being immediately inseminated into the lumen of the uterine body, as is done for conventional AI, or placed deep in the uterine horn. This was done to maximize the proportion of low dose of sperm that may reach the oviducts where fertilization takes place. Over the last 3 years nearly 2,000 heifers have been bred with low-dose sexed, cryopreserved sperm. In these field trials, sexed sperm from more than 25 bulls of unknown fertility from various dairy and beef breeds have been used.

Pregnancy and Calving Rates

There has been very little difference in pregnancy rates between insemination of 1.0 to 1.5 x 10^6 vs 3.0 x 10^6 sexed, cryopreserved sperm for more than 1,000 inseminations

(Seidel et al., 1999) . In some recent trials, pregnancy rates for sexed, cryopreserved sperm have been 90% of controls for which heifers had been inseminated with 7 to 20 times more sperm/dose. Relative to the site of insemination, in only one trial did inseminations into the uterine horn result in higher pregnancy rates than when the sperm were placed in the uterine body. Also, no significant differences among 7 inseminators were found. Some bull differences in pregnancy rates, however, were suggested by the resultant data, but confirmation of this phenomenon will have to await larger numbers of inseminations per bull.

Hundreds of live births from sexed sperm have been produced with no gross abnormalities observed (Seidel et al., 1999). Rigorous epidemiological studies, however, need to be done to confirm this conclusion. Nearly a thousand heifers have been followed to term and many more are currently gestating. In the heifers that were followed to term, no increase in embryonic deaths were observed between 1 and 2 months of gestation, with very few abortions occurring between 2 months gestation and calving.

Applications of Sperm-Sexing Technology

Given the possibility of predetermining the sex of offspring, it is possible to utilize a variety of managerial approaches to enhance production efficiency of cattle operations (Seidel, 1999a, 1999b). One approach is to increase the percentage of heifer calves thereby expanding the herd or to produce replacements for sale. This allows rapid expansion of a herd without the risk of introducing disease that sometimes occur with purchased animals. With this system one also could increase the selection intensity by choosing genetically superior dams of replacements (Doyle et al., 1999).

Another advantage to the producer is that breeding heifers with X-sperm to produce females would decrease the incidence of dystocia in that most calving problems associated with first-calf heifers are due to the higher birth weights of bull calves. This could be enhanced by the selection of bulls that sire a low percentage of calves with difficult births thereby minimizing calving problems encountered with first-calf heifers.

Semen sexing can be used to develop an all-heifer system whereby heifers can be used to produce their own replacements. This single-calf heifer system, when combined with early weaning, allows the dams to be put in the feedlot for fattening and ultimately marketed as beef (Ereth et al., 2000). This all-heifer management system eliminates the need to maintain a herd of brood cows. Recently, 3 heifers that were produced from sexed sperm calved as a result of being themselves inseminated with sexed sperm. This second generation of calves from sexed, cryopreserved sperm demonstrates the feasibility of this all-heifer production system.

Semen sexing can be applied to terminal-cross breeding programs where the economic value of bull or steer calves can be significantly greater than that of heifers.
Other approaches are possible through various combinations of selecting dams for production of superior replacement heifers or future breeding sires. The ultimate

application of this approach to producing market animals is to have an all-male terminal cross program. This would, however, would requires that replacements heifers be purchased. This is essentially the opposite of the all-heifer single calf approach. One application of sperm sexing technology at Colorado State University's John E. Rouse Beef Improvement Center, in Saratoga, Wyoming, was to produce superior bull calves from 80 selected 80 Angus cows. This will increase the quality of bulls in their annual sale.

Summary.

Predetermination of sex within 85-95% accuracy is possible using sperm sorting technology whereby living X-sperm and Y-sperm are separated from one another. The application of this technology to cattle and horses has become a commercial reality (Amann, 1999, Seidel, 1999b).

Acknowledgements

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Prediction Of Beef Palatability Using Instruments[1]

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Introduction

Prediction of cooked beef palatability has long relied on marbling scores assessed at the cross-sectional interface of the *longissimus* muscle at the 12^{th}-13^{th} rib, combined with physiological maturity. The decision to include marbling as a primary value-determining characteristic in beef carcass assessment was based on the premise that marbling is associated with eating quality (McBee and Wiles, 1967, Jennings *et al.,* 1978, Tatum *et al.,* 1980, Dolezal *et al.,* 1982). Smith *et al.* (1987) illustrated how marbling effectively sorts carcasses on the basis of expected eating quality when the sample population spans the entire range of possible quality grades experienced in the U.S. beef supply. However, over 80% of U.S. beef carcasses today grade USDA Select or low Choice (USDA Slight and Small degrees of marbling). Within this narrow range of marbling scores, marbling does not do an adequate job of sorting beef carcasses into palatability groups reflecting differences in value at the consumption level (Smith *et al.,* 1995). Despite the best efforts of industry and USDA to continually improve the Quality Grades, new technologies with the ability to more precisely sort carcass on the basis of cooked beef palatability are necessary, particularly as branded beef programs continue to become the marketing methodology of choice.

Instrument Technologies

As part of it's effort to implement value-based marketing, the beef industry began investigating use of instruments to improve characterization, sorting, and pricing of cattle and beef carcasses nearly three decades ago (Cross and Whittaker, 1992). In 1994, the National Livestock and Meat Board (now the National Cattlemen's Beef Association) convened a National Beef Instrument Assessment Planning (NBIAP) Symposium to assess state-of-the-art capabilities in carcass evaluation and to make recommendations as to which technologies new research should focus. The NBIAP Symposium determined that: (1) reliable, accurate tools for instrument assessment hold the promise of more accurately measuring factors that contribute to consumer satisfaction with beef, while reducing production costs and waste, (2) testing experimental technology under real-world conditions is critical to achieving commercial success, (3) VIA technology was ready for commercial testing and was the most promising technology for short-term implementation, and (4) ToBEC, Tendertec, Swatland's Probe and Real-Time Ultrasound for seedstock evaluation were ranked second through fifth in applied research priority, respectively (NLSMB, 1994).

[1] Presented at the Beef Improvement Federation Convention, July 13-14, 2000, in Wichita, Kansas.

Opinions as to how instruments should be used in carcass assessment are diverse. They have ranged from those who would eliminate Federal USDA grading altogether and replace it with services provided by a private grading company that may, or may not, incorporate instruments into the system (Helming, 1996), to those who believe that technology should be used to augment the application of USDA grade standards (Belk *et al.*, 1996). Supporters of augmenting USDA grades are excited about the possibility of increasing both the accuracy and repeatability of the current grade standards using instrument technology; however, they also realize that (1) privatization of the grading system would not prove to be a credible, third-party conformity assessment system, (2) the current system is voluntary and therefore, if grading were not desired by customers of beef packing companies, it could have already been eliminated, (3) eliminating USDA grades would require a change in the Agricultural Marketing Act of 1946, (4) current USDA grades are extremely important merchandising tools in the international market, and (5) elimination of USDA grades would have and adverse effect on other marketing services currently provided by USDA, such as certification and Process Verification programs (Belk *et al.* 1999).

Several instrument systems, some more effective than others, have been researched for use in sorting beef carcasses on the basis of expected cooked eating quality. Some of these systems are considered to be invasive (require the penetration or removal of muscle), while others are non-invasive. Invasive systems can result in lost yield to a packer or potential food safety concerns, while non-invasive systems result in no lost product and minimal food safety concerns. No system, to date, could be considered to be the "silver bullet" relative to perfect beef carcass sorting accuracy.

MARC Tenderness Classification System

Scientists at the Meat Animal Research Center (MARC) in Clay Center, NE advocate use of a system that measures slice shear force (a mechanical measure of cooked beef tenderness that could potentially run at chain speeds) of *longissimus* muscle steaks removed from carcasses after chilling (generally 36-48 hours post-mortem) to sort beef carcasses into groups described as "tender," "intermediate" or "tough." Shackelford *et al.* (1999) recently characterized this system as outlined in Table 1. Although Shackelford *et al.* (1999) showed the system to be effective, samples from carcasses in the study were obtained in a commercial packing plant and then transported to the MARC facility for slice shear force testing. Currently, an online system has not been developed. Furthermore, the MARC tenderness classification system has met with opposition from packers due to the invasive nature of the technology; removal of a steak from each carcass is costly to a packing plant that processes in excess of 5000 carcasses per day.

Tenderness Probes

Many researchers have attempted to develop probe systems that are moderately-invasive, believing that the industry would much more readily accept a system of this type. The first system of this type was the Armour Tenderometer (AT). This system utilized a group of probes that were inserted into the *longissimus* following carcass chilling and that measured the force required to penetrate the muscle and used this information to predict cooked meat tenderness. Carpenter *et al.* (1972) concluded that the AT effectively categorized USDA Choice beef carcasses into tenderness desirability groups, however Huffman (1974) reported that AT reading were related (R^2 = .22) to WBS values, but there was no relationship ($P > .05$) between AT readings and trained taste panel scores for tenderness taken from 192 carcasses ranging in USDA Quality Grade from Prime to Standard. Parrish *et al.* (1973) reported low correlations between AT values and both WBS and organoleptic tenderness ratings from *longissimus* steaks aged for 7 d (R^2 = .07 and .12, respectively). More recently, Harris *et al.* (1992) evaluated usefulness of Armour Tenderometer readings from 384 "A" maturity beef carcasses described in the study of Smith *et al.* (1984) and reported simple correlation coefficients of .10 ($P < .05$) and -.13 ($P < .01$) between AT readings and sensory panel tenderness ratings and WBS force values, respectively. Because of the low correlation to ultimate meat tenderness and palatability, and the apparent ineffectiveness of this technology, it has since been abandoned as a tenderness-predicting tool.

A second, moderately-invasive system was developed in Canada and is referred to as the "Connective Tissue Probe" (CT probe). This instrument uses an optical fiber probe and measures the reflectance of initially polarized light to predict the palatability of beef, predominantly by characterizing the connective tissue properties of the muscle (Swatland, 1991). Despite initial laboratory success, further improvements to the prototype system were needed to obtain more reliable results in commercial use. Later reports found that measurements (reflectance at 460 nm, fluorescence peak 3 and mean length disorder) collected using an optical-electrochemical probe accounted for 34% of the variation in perceived tenderness of 21 d aged *longissimus* steaks, but further work and improvements are needed to obtain more reliable predictions (Swatland *et al.,* 1998). Questions regarding durability of this particular instrument in the packing plant environment have been abundant, and it is clear that the instrument will require further development before it becomes commercially viable.

A third moderately-invasive system evaluated was the Tendertec Mark III Beef Grading Instrument, an Australian probe developed to measure the amount of connective tissue and other factors that contribute to the toughening of meat. In a study by George *et al.* (1997a), no statistical significance was found between the Tendertec outputs and Warner-Bratzler shear force values. Tendertec output variables were significantly correlated with sensory panel ratings for connective tissue amount and overall tenderness, but the coefficients were very low (George *et al.*, 1997a). These results were similar to previous findings by Belk *et al.* (1996) for the Tendertec instrument's ability to predict beef carcass palatability.

Working with Lester Jeremiah (Agriculture Canada, Lacombe), George *et al.* (1997b) compared efficacy of Tendertec and Swatland's CT probes (on carcasses) and the Meat Industry Research in New Zealand (MIRINZ) Tenderometer (on raw muscle tissue) as predictors of WBS force values for beef loin steaks. The MIRINZ Tenderometer requires that a muscle sample be positioned on two concentric rings of probes which, when rotated counter to each other, measure the force associated with connective tissue toughness of the sample. Correlation coefficients for Tendertec, CT probe and MIRINZ Tenderometer with WBS force values for samples from more than 400 carcasses and/or muscles were not statistically different from zero (.19, .17, .00 to -.36, respectively).

Use Of Color

Due to the limited success of probes and industry opposition to invasive systems, researchers also have investigated the use of color as a palatability predictor. Hodgson *et al.* (1992) and Hilton *et al.* (1997) found that lean and fat color scores for mature cow carcasses were related to subsequent cooked beef palatability. The lean and fat color scores used in the Hodgson *et al.* (1992) and Hilton *et al.* (1997) studies were determined by personnel trained to evaluate such carcass traits, and did not represent the use of instruments to sort beef carcasses into specific palatability classes.

Belk *et al.* (1999) reported that the lean and fat color of beef carcasses can be used to measure several traits that are related to beef carcass palatability, including: (1) presence/absence of marbling, (2) physiological maturity of the lean, (3) muscle pH, (4) production and feeding management history, and (5) ultrastructural status of sarcomeres and connective tissue within the muscle. In addition, lean color has been shown to be related to calpastatin activity of postmortem muscle (Tatum *et al.*, 1997).

Wulf *et al.* (1997) utilized a Minolta Colorimeter (a portable colorimeter) to measure the Commission Internationale de l'Eclairage (International Commission on Illumination; CIE) values for L* (lightness; dark = 0, white = 100), a* (red = + values, green = - values), and b* (yellow = + values, blue = - values). Wulf *et al.* (1997) found that L*, a*, and b* values measured on the exposed *longissimus* muscle of beef carcasses were related to beef carcass palatability. Similarly, Tatum *et al.* (1997), found that L*, a* and b* values, measured using the HunterLab MiniScan portable spectrophotometer, could be used to decrease the variation that occurs in beef carcass palatability. Both of these studies used color measurement instruments with small aperture sizes to measure the lean and fat color of *longissimus* muscle cross sections. Therefore, information concerning lean color was only generated for a small portion of the exposed *longissimus* muscle, and was not representative of the variation in muscle color that occurs across the cross-sectional face of the *longissimus* muscle surface at the 12^{th} rib.

Color To Augment Application Of Quality Grades

A Quality Grade Augmentation system was developed by Wulf and Page (2000) who supplemented current USDA Quality Grade Standards with Minolta colorimeter readings (L*, a* and b*), pH and hump height (maximum dorsal protrusion of the rhomboideus muscle; measured as the distance from the dorsal edge of the *ligamentum nuchae* to the dorsal edge of the rhomboideus, not counting subcutaneous fat). When evaluated under "carefully-controlled" bloom times, it was reported that this augmentation system could predict *longissimus* WBS force (R^2 = .36) measures and a carcass palatability (R^2 = .46) index (additive measure of *longissimus, gluteus medius* and *semimembranosus* WBS shear force values and sensory panel attributes) following

7 days of postmortem aging. From this research, two proposed augmentation schemes were outlined for USDA Choice and Select beef carcasses (Table 2.)

Effectiveness of the two proposed South Dakota State University systems to segregate cattle into palatability groups are demonstrated in Figures 1 and 2. Augmentation of the current USDA grade standards with the proposed systems could reduce the chance of an unpleasant eating experience from 14% to 1% and 36% to 7% for USDA Choice and Select carcasses, respectively. It is evident that augmentation systems can improve the accuracy and precision of sorting beef carcasses into palatability groups.

BeefCam™

Researchers at Colorado State University have focused efforts toward developing video image analysis (VIA) systems to make color measurements on the entire exposed surface of the *longissimus* muscle at the 12th rib. Early work using VIA technology to measure beef muscle color was marginally successful (Li *et al.*, 1997). The early VIA systems used the computer compatible RGB color measurements computed from the video images to determine the lean color of beef *longissimus* muscle. While RGB colors were correlated to tenderness, attempts to sort beef carcasses into differing palatability classes using these color measurements were unsuccessful (Li *et al.,* 1997). Early VIA research did prove that computer software could be written that would accurately segment a video image of a ribeye--via image processing techniques--into fat, lean and connective tissue components and conduct analysis of color and other attributes generated by color measurements on each of these components, independently.

In 1996, Colorado State University initiated pilot work with Hunter Associates Laboratory (manufacturers of the HunterLab MiniScan portable spectrophotometer) to develop a VIA system that could measure beef carcass lean and fat color using the L*, a*, and b* color scale. A bench-top VIA system first was used to obtain images of beef *longissimus* steaks for the purpose of objective color analysis. When the VIA-derived color measurements were used, in conjunction with expert quality grade factors, the probability of encountering a tough (WBS $\geq$ 4.5 kg) steak after 14 to 21 d of aging was reduced from .18 to .25 and .15 to .02 for USDA Choice and USDA Select steaks, respectively (Belk *et al.*, 1997). Furthermore, Belk *et al.* (1997) reported that the pilot study data confirmed that (1) color is related to subsequent cooked palatability of beef carcasses, independent of differences in marbling or carcass maturity, and, (2) VIA technology is capable of ascertaining color attributes of beef ribeyes, using the color information to augment USDA quality grades, and thereby improve the accuracy of quality grades in sorting carcasses based on expected eating palatability across narrow ranges of marbling scores.

Based on the results of the pilot study, Colorado State University and Hunter Associates Laboratory began development of a prototype portable video imaging system (BeefCam™) which contained hardware and software that were specifically designed for the analysis of beef carcass lean and fat color in a packing plant environment. Researchers at Colorado State University tested the BeefCam™ system for its ability to sort beef carcasses based on the expected eating quality of subsequent cooked product. A study conducted by Wyle *et al.* (1999) used the BeefCam™ system, either alone (Model I), or in conjunction with USDA Quality Grade (Model II) to certify carcasses as being tender (WBS < 4.5 kg) or tough (WBS $\geq$ 4.5 kg). Use of Model I resulted in 51.9% of the carcasses evaluated being characterized as tender, and 92.2% of those that were certified were actually tender. Using Model II, 53.4% of the carcasses evaluated (n = 500) were certified as being tender and 94.4% of those certified were actually tender (Table 3).

To validate the effectiveness of the BeefCam™, researches at Colorado State University selected 292 beef carcasses from a commercial Colorado packing plant (Cannell et al., 1999; unpublished data), a different plant from those sampled in Wyle et al. (1999). The sample population evaluated contained carcasses that were assigned USDA quality grades ranging from U.S. Standard to U.S. Prime, with the greatest proportion of carcasses falling into the U.S. Select and U.S. Choice grades (mimicking the U.S. beef population). Sample carcasses were assigned USDA yield grades ranging between 1 and 5, and all carcasses were selected to reflect the normal variability in composition, dressing defects and quality attributes encountered by the facility on a daily basis. Data from that validation trial are presented in Table 4. From this validation, when tested on a separate and unique beef carcass sample population, relative to WBS force and trained taste panel ratings, BeefCam™ performed similarly (if not better) in accuracy to its performance on the initial population from which the sorting algorithms and regression equations were developed.

Conclusions and Implications

Video imaging systems and Wulf's system have been shown to perform at current chain speeds (over 300 hd/h) and accurately (over 90%) segment the cattle population into tender versus not tender categories, while doing so in a non-invasive fashion. In an industry where consumers are becoming more demanding of the end product and are willing to purchase "branded" or "certified" products in search of a consistently good eating experience, instrument technologies will be an integral part of identifying potentially tender carcasses and more effectively sorting and marketing beef products; these technologies show overwhelming potential as the next phase in USDA Quality Grade Standard improvement.

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Table 1. Effectiveness of the Meat Animal Research Center (MARC) tenderness classification system as determined via Warner-Bratzler shear force (WBS) and trained sensory panel (SP) evaluation (N = 483).

Item	Tender	Intermediate	Tough
Carcasses sorted into each category, %	47	48	5
Carcasses actually tender, % by WBS	100	89	36
Carcasses actually tender, % by SP	100	91	28
Mean WBS at 14 d, kg	3.5^{z}	4.2^{y}	5.7^{x}
Mean OT rating	7.3^{x}	6.4^{y}	4.4^{z}
Mean EOF rating	7.3^{x}	6.3^{y}	4.2^{z}
Mean CT rating	7.7^{x}	7.4^{y}	6.7^{z}
Mean FI rating	5.0^{x}	5.0^{x}	4.8^{x}

$^{x, y, z}$Means in the same row bearing differing superscript letters differ ($P < .05$).
Source: Shackelford et al. (1999).

Table 2. Proposed South Dakota State University beef carcass classification (color augmentation) system.

System #1	System #2
Minimum requirement for Choice:	**Minimum requirement for Choice:**
1. Must be "A" or "B" overall maturity	1. Must be "A" or "B" overall maturity
2. Must have a minimum marbling score of Small^{00}.	2. If L* is from 36.0 to 40.0 then must have a minimum marbling score of Small^{50}
3. Must have a minimum L* value of 36.0.	3. If L* is > 40.0, then must have a minimum marbling score of Slight^{50}
4. Must have a hump height < 8.9 cm	4. Must have a hump height < 8.9 cm
Minimum requirement for Select:	**Minimum requirement for Select:**
1. Must be "A" or "B" overall maturity.	1. Must be "A" or "B" overall maturity.
2. Must have a minimum marbling score of Slight^{00}.	2. Must have a minimum marbling score of Slight^{00}.
3. Must have a minimum L* value of 38.0.	3. Must have a minimum L* value of 36.0.
4. Must have a hump height < 8.9 cm.	4. Must have a hump height < 8.9 cm.

Source: Wulf and Page (2000).

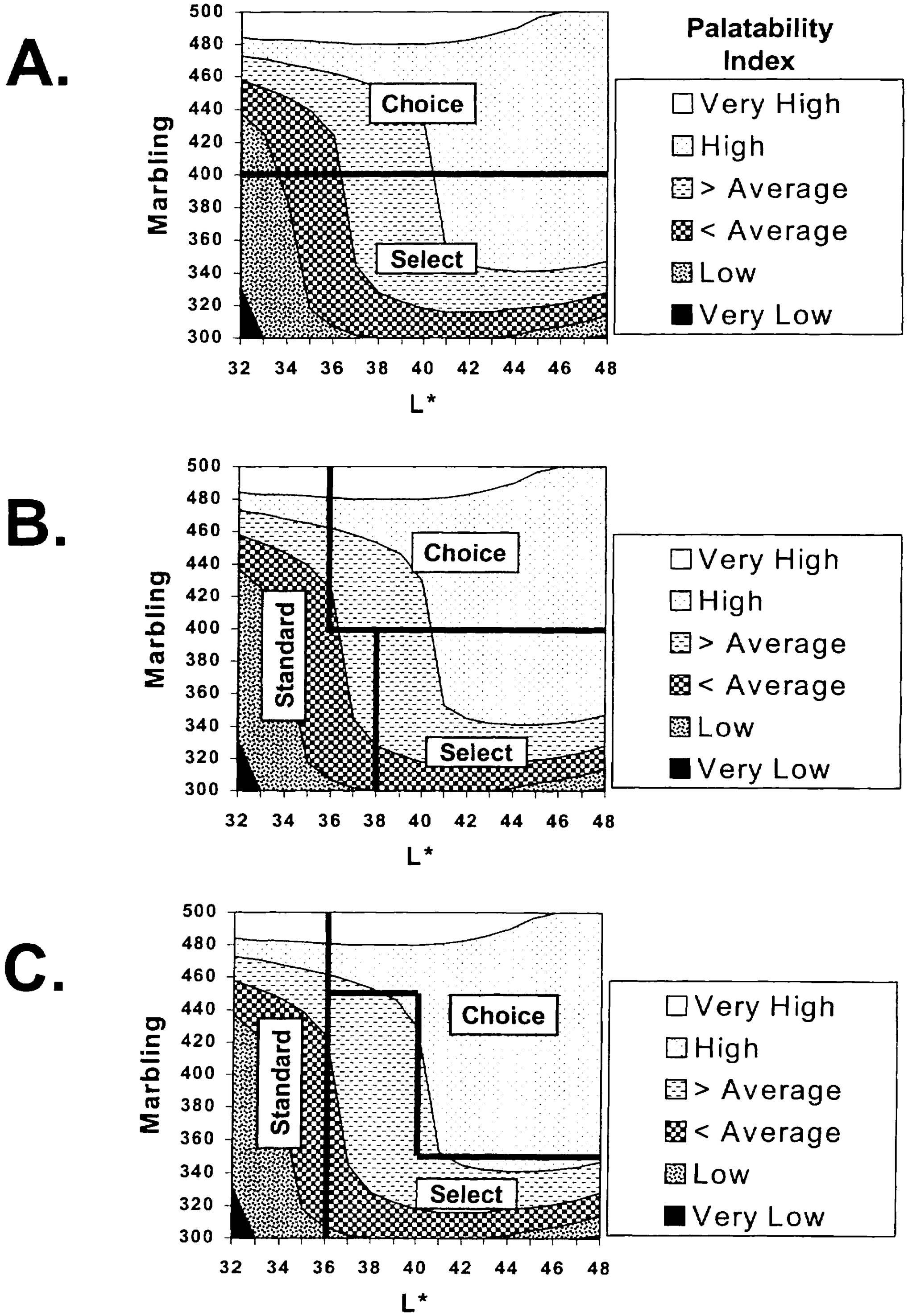

Figure 1. Surface response function for marbling score x lean color L* values and carcass segmentations using the current USDA Quality Grade Standards (A), and the SDSU proposed system No. 1 (B) or system No. 2 (C). Source: Wulf and Page (2000).

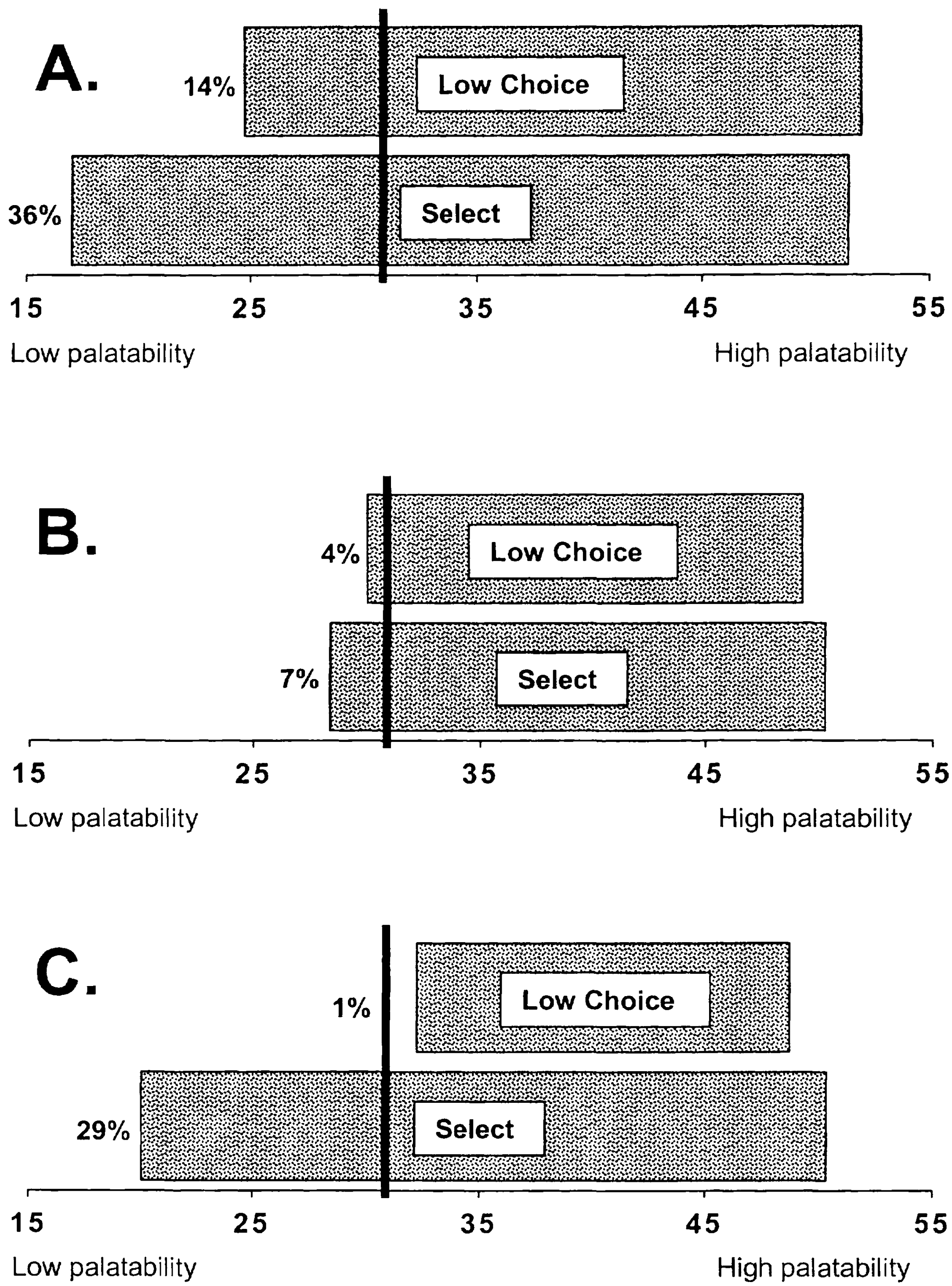

Figure 2. Beef carcass sorting effectiveness of the current USDA Quality Grade Standards (A), and the SDSU proposed system No. 1 (B) or system No. 2 (C). Percentages to the left of each bar reflect the number of unacceptable carcasses within each grade. Source: Wulf and Page (2000).

Table 3. Use of BeefCam™ alone (Model I), or to augment application of USDA Quality Grades (Model II), based on Warner-Bratzler shear force of cooked *longissimus* steaks (N = 769).

Model/Grade	% Carcasses Certified	Unacceptable Carcasses, %[a]		
		Total Sample Population	Certified	Rejected
<u>Model I:</u>				
All Carcasses	51.9	13.8[y]	7.8[x]	20.3[z]
Top Choice	57.3	7.9[xy]	4.3[x]	12.6[y]
Low Choice	58.5	10.3[x]	6.3[x]	16.0[y]
Select	37.5	24.7[y]	16.5[x]	29.6[z]
<u>Model II:</u>				
All Carcasses	53.4	13.8[y]	5.6[x]	23.2[z]
Top Choice	78.0	7.9[x]	4.8[x]	18.9[y]
Low Choice	59.1	10.3[xy]	6.7[x]	15.4[y]
Select	19.8	24.7[y]	4.4[x]	23.8[y]

[a] Percentage of carcasses in each classification group having *longissimus* steak Warner-Bratzler shear force values in excess of 4.5 kg after 10 d of postmortem aging.

[x, y, z] Percentages in the same row bearing different superscript letters differ ($P < .05$).

Source: Wyle et al. (1999).

Table 4. Validation of the BeefCam™ models developed by Wyle et al. (1999), based on Warner-Bratzler shear force of cooked *longissimus* steaks (N = 282) obtained from carcasses processed at a different packing plant.

Model/Grade	% Carcasses Certified	Unacceptable Carcasses, %[a]		
		Total Sample Population	Certified	Rejected
Model I:				
All Carcasses	45.7	7.1^{y}	1.6^{x}	11.8^{y}
Top Choice	48.6	6.8^{xy}	0.0^{x}	13.2^{y}
Low Choice	47.5	5.9^{xy}	0.0^{x}	11.3^{y}
Select	42.1	8.4^{x}	4.4^{x}	11.3^{x}
Model II:				
All Carcasses	42.6	7.1^{y}	1.7^{x}	11.1^{y}
Top Choice	60.8	6.8^{xy}	2.2^{x}	13.8^{y}
Low Choice	48.5	5.9^{xy}	0.0^{x}	11.5^{y}
Select	24.3	8.4^{x}	3.8^{x}	9.9^{x}

[a] Percentage of carcasses in each classification group having *longissimus* steak Warner-Bratzler shear force values in excess of 4.5 kg after 14 d of postmortem aging.

[x, y, z] Percentages in the same row bearing different superscript letters differ ($P < .05$)

IDENTIFICATION AND TRACKING

Bill Bowman, American Angus Association

Identification becomes a major part of the vision that we are not just ranchers, but producers of food. Our industry has begun a new era with a mindset of being more than just cattle raisers, more than even beef producers, but being in the business to produce meals for the consuming public. With this new enthusiasm and responsibility, we have created a desire to know more about the cattle we are producing and ultimately how we can create a desirable eating experience. Conversely, consumers may want more and more information on the food that they intend to purchase.

Why do we need to track data?

We as an industry are entering a new realm, as we have technology breakthroughs that will allow us to better measure potential consumer satisfaction and the ultimate value differences related to the end product. The challenge to tie this information back to the ranch level and ultimately to the genetics that are responsible for that consumer experience—good or bad—is not a simple or inexpensive one.

The collection of carcass data in packing plants has been a very manual process, both time-consuming and costly. However, the results have been considered worthwhile as we make genetic selection and shift management decisions based on the accumulated information.

In a perfect world we would be able to put a tag in a calf at the ranch of origin, collect pertinent data throughout the lifetime of that calf, including the end product value on the animal. Once that information was gathered it would be fed back to the commercial producer who raised the calf, and to the seedstock producer who provided the genetics, creating an integrated system of efficient beef production.

The challenge—Who we are dealing with? --The following 1999 U.S. summary of beef cow numbers by herd size illustrates an industry hurdle. A fragmented beef industry made up of so many small producers, many of which do not make their livelihood from their beef herds, results in a challenge to create a practical, economical system that can be utilized by all sized producers.

1999 US Beef Cows
33,546,000 cows—843,230 operations

79.0%	Of cow herd owners have less than 50 cows and account for 29.9% of all beef cows.
12.0%	Of cow herd owners have 50-99 cows and account for 19.1% of all beef cows.
9.0%	Of cow herd owners have cows or more and account for 51.0% of all beef cows.

Identification is a crucial element for accurate information flow and for source verification programs. Historically, identification methods have relied on traditional visual identifications systems such as tags, brands or tattoos. These systems or techniques work well within the animal's original environment, but once ownership changes hands, these identification methods may not work as well.

What are the new technologies available?

New technologies being used for identification purposes in cattle include such several new tools.

- Biometric ID, such as retinal imaging and iris scanning, is a new approach that may be more applicable for use in humans than animals.
- DNA sequencing can provide unique identification for an animal, but it still does not allow for easy transfer of the ID from one industry segment to the next.
- Optical Character Recognition (OCR) uses the same concept as a document scanner to read information on an ear tag, but is limited by the scanner ability to read in typical livestock handling situations.
- Bar codes on tags have been tested and used in some systems. The use of bar codes and readers, like we may be accustomed to seeing in grocery stores for example, are cost effective means of ID, but again read range and keeping the bar codes clean cause problems when used in most livestock environments.
- Radio Frequency Identification (RFID) has become one of the more widely discussed and used methods of electronic identification today.

All of the aforementioned technologies can be lumped under electronic ID, but for our discussion purposes we will use the term EID to mean RFID. EID has been experimented around the world using various forms on the animal. Initial research several years ago used implants to administer the microchip. Boluses placed in the animal's stomach have also been used in some areas. Both these methods present problems in that unless it is known that the EID is in the animal, the EID may go undetected as it moves to the next segment of the industry. The microchips implanted in tags are the most widely used today and present the best alternative to employ the technology across the industry. Equipment currently reading EID tags in packing plants and feedlots will drive usage of EID tags at the ranch level in the near future.

Information flow—"Going beyond the pencil and pad"

Identification becomes crucial for two reasons:

1. Information flow—Handling of data and maintaining the integrity of that data becomes a crucial part of identification systems. From a purebred standpoint, breed associations have maintained ancestral records and performance information on the registered cattle in their registries. Strides are being taken to follow these genetics into the commercial industry where progressive producers will use individual data management. Management of these data electronically, both at the seedstock and commercial levels, is continuing to grow. At the American Angus Association the number of registrations and performance data sent in by breeders via electronic methods is at the following levels:

American Angus Association Electronic Statistical Report

	August 1999	June 2000
Registrations	5.6%	18.88%
Weaning Weights	3.1%	27.13%
Yearling Weights	7.1%	34.25%

By eliminating a point of data entry with the electronic transfer of the data, accuracy increases. The future of EID and the possible further automation of data collection that may eliminate another data transfer point are exciting for producers.

2. Source verification--Identification is crucial for improved quality management and source verification programs that are of interest to the industry. EID is utilized in feedlot management systems and to identify and provide genetic information from the producer to the feedlot and packing segments. The continued growth in the number of branded beef programs and the volume of product sold in this manner will drive the identification process. Value-based marketing will also drive the use of identification systems to allow producers to capture the value of the genetic inputs into his program. Additionally, source verification may be an important key to enhance current and open new export markets for U.S. beef. Countries around the world are aggressively working on source-verified production, many being far ahead of efforts here in our country.

Talk of source-verification programs brings about the discussion of a possible "National ID System". In looking at National ID versus Electronic ID, there are key differences to consider. A very important distinction is that the national ID system and electronic ID are two entirely separate issues: (1) We can have national identification without electronic ID, and (2) using electronic ID does not imply and/or necessitate a national identification system. A national identification number can be a unique number (much like our social security number), staying with that animal throughout its lifetime. The dairy industry has assigned these unique numbers for several years, from an internationally recognized system referred to as the American ID system (AID). This system uses a three-character country code prefix (USA) followed by a 12-digit number.

As we look to the future and consider the impact that identification and tracking may have on the beef cattle industry, there are some key questions to ask. Are the costs at an acceptable level? Who pays for a system? How do we make it functional? How do we get it in producer's hands? What is the proprietary nature of the data and information and who has access to it?

Concern exists on the potential of a national identification system. Will trace back to the ranch level become a reality? Will a national ID system be a voluntary or a mandatory program? We must look at the use of an identification system and EID as an opportunity to improve the beef industry. Improving information flow to assist in better production decisions and building consumer confidence will be keys to unlocking the future of our industry.

BIF
32ND ANNUAL RESEARCH SYMPOSIUM AND ANNUAL MEETING

GENRERAL SESSION #2

WHO IS THE KEEPER OF THE TECHNOLOGY?

BREEDING OBJECTIVES – CONVENIENCE TRAITS

Larry Leonhardt, Shoshone Angus

When I was asked to give a presentation on "convenience traits", I wasn't just sure what this term all entailed. The unmeasured qualities that make cow-calf production easier and reduce human stress are actually more than a convenience; they are essential to producer profitability. Basic maternal characteristics such as disposition, mothering ability, functional conformation, longevity, etc. are often compromised or overlooked during our efforts to produce more pounds of the preferred product of the day in a shorter period of time. Ultimately these compromises tend to get us in trouble. So today, I want to focus more on functional conformation and/or type.

About 20 years ago I rearranged my own selection priorities with a portion of the herd. The objective was to develop and stabilize a more specific type with primary emphasis exclusively on maternal function. A working cow's job never really changes. Yet, the bulk of the industry is continually changing types. Each new type that becomes more popular is thought to be better, it seems like the "grass always looks greener on the other side of the fence". Consequently, many of today's cow herds are basically a sorted by-product of many types.

Historically, the beef industry has been a good example of the "tail wagging the dog". The most preferred type of cattle for the end product always seems to have a negative economic impact on the production end. For example, as a youth during the birth of the baby beef era, I had a chance to participate in a tour of a famous ranch near Cheyenne, Wyoming. What I remember most, was seeing their highly prized imported "baby beef" bulls. The bulls were smaller than their cows but AI solved that breeding problem. During this 20-year baby beef era, the more popular purebred herds promoted imported pedigrees and nurse cows were common. Today, we have numerical pedigrees and recipient cows.

When the priorities changed from too short and fat to too tall and/or too lean, those types also had a serious negative impact on the production end. For the last 35 years the primary objective with any type has been to produce more pounds in a shorter period of time utilizing AI, frame scores, performance testing, EPD and embryo transfer. Cattle became larger, however, when compounding cow-calf problems and a loss of quality grade reached the point where the problems offset the benefits, the industry began to downsize the big cattle. Today the most treasured types are those in a more moderate framed, thicker package – termed the "spread" cattle with more "natural thickness" (whatever that is). I am reminded of the more extreme thick types of the baby beef era when we had three C-sections out of eleven heifers with 50-55# birth weights from a 270 day gestation periods.

In a direction towards selecting superior individual animals that seem to do more things better and faster, the more ambitious breeders have evolved to across-breed composite selection maximizing heterosis. All-purpose composites, whether straight-bred or crossbred, seem to work well, at least in the short term, since nature tends to "balance" the diversity.

But despite all these genuine efforts to increase production, a growing complaint often heard today from the cow-calf producer to the consumer is the overall lack of consistency. Yet, how can a cow herd produce consistency when they are the consequence of continual change.....a sorted by-product of different types. We seem to be so wrapped up measuring EPD, turning the generations so rapidly to get a higher set of numbers, that we cannot possibly know what profound effects these cattle being produced in mass may have down the road on the basic unmeasured maternal traits and environmental adaptability.

We have become accustomed to the mind-set that we can cull away our problems – but the more we want each animal to do, the more we sort. Ultimately, a cow-calf producer's economic loss from the sorted culls has to be deducted from the increased value produced by the keepers. The purebred breeder gets enough premium from his keepers to afford the sort, not so for the commercial producer. so I believe at some point in time, some breeders will have to establish and stick with a type for where it all begins.....the cow, others will breed complimentary male lines in a coordinated effort to reduce the sort.

The Purpose of Purebreds

The purpose of a purebred is to offer more predictability or continuity generation after generation. If the objective is to improve product consistency and do it more efficiently without sacrifice to production end, the industry must look at what the rest of agriculture is doing and forego the persistent habits of the past trying to cram all the beneficial traits into one super parent. The dairy people traded beefiness for milk. The pork people finally accepted the genetic reality that the mother pig could not do her best job and also be the meatiest. And we can't successfully plant a 120 day corn in an 80 day environment.

I remain more convinced than ever that the industry will ultimately stabilize, not mongrelize, male and female parent lines designed for hybrid production. Selection for a more suitable beef cow that will reduce production problems and also enhance product consistency has got to be one of the most difficult, time consuming and challenging jobs in all of agriculture. The limiting factors are the constraints of her environment and negative trait correlations. Most beef cows are maintained on terrain unsuitable for cropping. They seldom enjoy the optimum environment that is provided for the poultry, pork and dairy production units. So a "one size fits all" approach is unlikely to happen. But ultimately there is a type that will predominate all others, simply because if she can do her job in a less than optimum environment, she is also likely to be efficient in a better environment.

The type of cow that will most likely prevail shows up by chance in almost everyone's pasture. They are the old reliable "stayers" with longevity (fewer problems), not the "sprinters" who wear out to quickly. To find or describe an ideal is easy; the difficulty is in figuring out how to replicate them more often. We are witnessing the growing popularity of the Angus cow in the commercial arena, gradually replacing the crossbred cow. This did not come about because of commercial production problems. It is a tribute to those Angus breeders who have paid more attention to the basic maternal "convenience traits" and preserved the breed's inherent qualities. While the crossbred cow was the salvation to the commercial producer from years of neglect by purebred breeders, I do not believe we have to rely on the effects of heterosis to uphold adequate maternal values.

Selection for a Maternal Type

I have spent about 30 years of trial and error inbreeding and outbreeding. In my efforts to identify and establish a more consistent preferred type, selective close breeding is a tool I use to reduce variation quicker. Within a production level, my selection favors an attentive mother with a sensible disposition, who has an overall moderate and symmetrical conformation with strong sexual distinction. When I select the bulls I use, I visualize their five or ten generation pedigrees as a pen of cattle. In an ideal "pen", the cows in the pen would be more similar to the preferred type. Of course, the same cow appears in the "pen" several times among the more inbred stock. Since the bulls are simply the progenitors for the maternal characteristics, their individual performance is secondary. While I have flirted with a few of the more extreme bulls within the population, *I have finally learned to avoid them altogether.*

In general, I have not observed the expected decline in fertility from close breeding, even though some animals carry inbreeding coefficients as high as 40%. Initially, I was concerned that the males might become more feminine or "steery". To the contrary, today the bulls are more virile or masculine, have stronger libido with dispositions friendly to man. I believe this can be attributed to the balanced selection criteria since I did have more production problems close breeding extremes. The cow herd had become more similar in type and it appears that the production level or EPD of the measured traits in the more preferable portion of the herd is stabilizing around breed average.

The basic role or breeding objective for this maternal line is for more efficient and consistent commercial hybrid production systems. I would be happy to discuss any specific questions you may have.

Thank You!

SWINE INDUSTRY SYSTEM PERSPECTIVES AND BREEDING OBJECTIVES GOING INTO THE 21st CENTURY

Russell A. Nugent III, the Pork Group, Inc., Rogers, AR

Introduction

The swine industry has experienced dramatic changes in the twentieth century. The total number of hog farms fell from around 2 million in the late 1940's to near one hundred thousand in 1999. The number of hog operations has dropped more than six-fold just since 1977 alone. The breeding herd has fallen from around 9.5 million in 1980 to just over 6 million in 1999. Yet pounds of hog (carcass basis) output per breeding female per year have gone from 1400 in 1978 to over 3000 in 1999! Huge advances in genetic improvement techniques, access to a world-wide gene pool, and tremendous improvement in production techniques have provided not only increased genetic potential, but a realization of much of that potential. Economically important traits such as litter size, feed efficiency, and carcass leanness have all made quantum leaps forward in the past decades. Behind these advances has been the breeding stock industry, composed of both "traditional" pure-breeders and the breeding companies.

Have the Rules Changed?

The swine industry experienced unprecedented low cash prices for live hogs during 1998 and 1999. Though the industry has always been cyclical like many other agricultural commodities, few were prepared for the intensity of the price dip. Equity was greatly reduced and many production systems were most likely forever changed. Animal flows were disrupted as belts were tightened and the best production systems limped through eight-cent hogs. Many producers did not survive. Breeding stock suppliers found themselves stuck with unsold product. No segment of the industry was unaffected.

As the swine industry emerges from this latest down cycle, the 21st century brings a new era of potential biotechnology, consumer awareness, environmental responsibility, and risk management. Producers already have an eye on the next down cycle like never before. Geneticists and breeding stock suppliers no longer find themselves able to focus on just genetic improvement. A wide potential customer base is no longer a given. Vertical integration, virtual integration, branded product, quality conscious retailers and consumers, a shrinking customer base and tighter profit margins have pressured and focused the breeding stock suppliers like never before. The four biggest hog packers killed 34% of the federally inspected slaughter in 1980. Today it is close to 60%. Smithfield, the nation's largest hog packer, is also the largest producer with four times as many sows in production as the next largest entity. And by the way, Smithfield also owns its own breeding stock company and several further processing entities and branded products. The rules have changed.

Breeding Objectives and the Production System

Today's breeding stock suppliers are as focused on risk management as they are on profitability. They can no longer leave the genetic improvement program to just the Geneticist. While genetic improvement is still paramount, the system that produces the genetic improvement must be focused on the customers beyond the packer, focused on food safety, focused on a system that produces the healthiest possible breeding stock, and focused on the balance between low (optimal) cost, and funding research and development. Marketing strategies cannot be ignored or mis-managed in this era of consumer awareness and customer (producer) consolidation. System byproducts must be profitable or at least not a drain on the profitability of the system. Long-term arrangements between packers and producers with a specific end product in mind are being forged with alarming frequency. All taken, a genetics program no longer has the luxury of being able to focus on just long term improvement. The system must be able to survive until tomorrow as well as five years from now.

Even as the Geneticist now finds him or herself more part of a production system than ever before, the basics are still the backbone of the genetic improvement process: economically important traits such as litter size, farrowing interval, weaning weight, feed efficiency, growth rate, and carcass quality must still be measured with precision and accuracy and evaluated with the latest biometric strategies. Bioinformatics, major genes, cloning, transgenics, outside gene pools, and other "new" tools beckon consideration for entry into the breeding scheme every day. Cost of investment versus potential economic return must be continually evaluated for these tools. The risk of use in terms of possible gain in genetic potential versus possible increase of consumer scrutiny (e.g., cloning) must also be continually debated within the breeding entity. Semen sexing, embryo cloning and transfer, repartitioning agents and other advances will challenge accepted genetic evaluation procedures. Thus, while the basics of the genetic improvement process will be nearly the same and execution of the program still paramount, the complexity of the process will increase.

Crystal Ball

The swine industry will continue to consolidate, both vertically and virtually. The export and domestic markets will be focused on consistency, meat eating quality, convenience, and food safety. The consumer will pay more for a brand they recognize and like. The retailer and packer will work in concert with the producer to assure the consumer is presented the product for which they will pay a premium. Over time, the domestic consumer will be treated with the same "respect" as the export customer. The breeding stock suppliers will have no choice but to embrace and participate in this system. The successful breeders will coordinate up the food chain and focus their efforts on the integrated team's agenda. All players in the integrated (virtual or vertical) chain will mediate risk together and smooth the cash flows over time for all entities in the chain. It's the only way to survive long term. Every one remembers eight-cent hogs...

TECHNOLOGY AND PUBLIC PERCEPTION

J.C. Swanson, Kansas State University

Introduction

The end of the last Ice Age is estimated at 13,000 years ago. Since that time migrating humans have left a trail littered with bones, tools and other artifacts documenting human development and technological genius. From the famous Clovis sites found in the Americas to our current rendezvous with genetic manipulation, humans have sought to gain advantage, control, and mastery of nature. However, not all human populations have taken advantage of their technological skills and have remained in a state reminiscent of our early ancestors. Environmental variables of where people live, resources, climate, etc. have played a significant role in their technological advance. The development of technology greatly depends upon the resources to which one has access. For example, populations migrating to lands rich with resources were able to develop intensive farming methods that produced food surpluses, allowed them to settle in one place, develop written language and communications, and freed people to develop crafts and skills outside of agriculture (Diamond, 1999). Civilizations that developed technologies sooner gained advantage and often conquered those who did not. Technology brings consequences both good and bad.

Today technological advances are forwarded by nations of wealth and resources. Much of the current controversy about the application of new technology centers on concerns regarding human safety, unnatural processes, and the general fear of beginning a long slide down a slippery slope that leads to unknown risk.

What is Technology

Technology in the purest sense is neutral (Stricklin and Swanson, 1993). It can be the production of a tool for human use, a manipulation of nature, or as the Oxford American Dictionary (1998) describes, "the practical application of applied sciences and mechanical arts." Moral deliberations begin when the technology takes on an application. Technologies may be perceived as "good" when applied in one venue but "bad" in another. For example, explosive devices can be used for fire work displays is designed for entertainment or for intentional killing humans during warfare. Perception of technology can change as its application acquires different consequences.

Public Perception

Fraser (1997) has described the changing public perception of animal agriculture. The traditional view of agricultural is characterized as a life driven by caring for animals, land and people, an independent lifestyle, and contributions to good health. In contrast the new perception is one of animal exploitation, unhealthy products, corporate control, and negative environmental effects. Fraser likens this to a similar transformation of the munitions industry. World War I and II popularized the role of the industry through personalities like "Rosie the Riveter" happily working within the weapons industry. A short time later the U.S. engagement of North Vietnam changed the perception of the munitions industry to corporate "merchants of death and destruction". Media focused on the effects of weapons on children and innocent civilians. Less than thirty years later the Gulf War arrives. Our public is fascinated by new air strike technology. They tune in for the next CNN report. Although the industry may never regain the popularity prior to the North Vietnam War, a perceptual shift to a more neutral position may have occurred due to the emphasis placed on developing technology that minimizes civilian death. The application and the consequences of a technology are central to public perception. In this example, the death of innocents is one of the most onerous consequences of wartime weapon deployment and carries deep moral sentiments among the public.

Weber et al. (1995) summarized U.S. public attitudes toward biotechnology based on a study conducted by Hoban and Kendall in 1993. During that time genetic engineering of plants and animals was beginning to skyrocket. Control issues concerning patenting of crop seed and animal genetics were of concern to farmers and ranchers, and the implications of using Bst were on the mind of Congress. Although consumers felt science and technology would raise their standard of living (86%) they also felt that citizens should have a greater role in decisions concerning technology (85%). Likewise they recognized the need for experts (63%) in making those decisions. Also, the public was undecided about the level of risk with 58% agreeing that science and technology have made the world riskier; they have little control (48%); that government agencies protect citizens from environmental risks (52%); and that people would be better off living a simple life style (44%). More revealing were their agreement with the following ethical statements: Humans were created to rule over nature (50%); Plants and animals exist primarily to be used by humans (45%) and; Animals have rights that people should not violate (82%). Although this survey (Hoban and Kendall, 1993) can be considered as dated, the respondents characterized attitudes that are still with us as each new technological development has been introduced. This study was the bellwether of what was to come in public concern.

Public attitude surveys about biotechnology in the U.S. (Priest, 2000), Canada (Einsiedel, 2000), Japan (Macer and Ng, 2000), and Europe (Gaskell et al., 2000) were recently reported in the journal *Nature Biotechnology*. In Europe consumers show erosion of optimism about biotechnology with only 46% agreeing that biotechnology will improve their way of life during the next 20 years. In the U.S. slightly more than half (52.8%) of the respondents gave an affirmative answer to this question and was lower than previously reported U.S. surveys. The Canadian survey indicated that citizen attitudes toward biotechnology were strongly linked to their attitudes about cloning. Only 44% felt that cloning animals will bring benefits to people. In Japan 66% of the respondents agreed that biotechnology would improve their quality of life but had a much higher agreement concerning the positive contributions of computers and information technology (82%) and telecommunications (77%). Genetic engineering was not viewed as favorably (59%) and considered much riskier (65%). The risk of genetic engineering was linked to genetic discrimination and insurance premiums. The U.S. showed strikingly similar trends.

Europeans were neutral about agricultural biotechnology (crops) but were strongly opposed to GM foods and the cloning of animals. Interestingly, the cloning of human cells for medical purposes was supported. The concern for GM foods centered on food safety issues rather than issues concerning the genetic engineering of crops. Europeans also felt they were insufficiently informed about biotechnology (80%). Similar to the Europeans, 69.9% of U.S. respondents considered themselves as not very well informed. Nearly all the surveys showed that the public can make distinctions between types of technology and their application. The U.S. survey strongly indicates that public resistance to biotechnology is not due to the lack of scientific literacy or education. Although better-educated individuals scored higher when given questions relating to the life sciences, the relative level of encouragement of the use of biotechnology remained unchanged. Only persons taking six or more college level courses in science tended to be more positive. Trends of opposition tended increase in persons possessing bachelor degrees and higher.

Cloning was by far the most prominent news item recalled by U.S. respondents with 40% of those remembering a specific biotech news story about cloning. Also 66.7% stated that "they had heard of the idea that animals... could be cloned to produce milk that can be used to make drugs and vaccines." The average moral acceptability score by all U.S. respondents was lowest for animal cloning. On a scale of 1 (definitely disagree) to 4 (definitely agree) cloning scored 2.5. This also concurred with the level of encouragement for the activity. Faring better than cloning were bacterial engineering (nearly 3.5) and genetic testing (3.0). Overall the U.S. public tended to be more distrustful of government regulators (only 39.5% approval) and more trusting of scientists (77.7%) and farmers (72.8%). Good news. Moral acceptability played a significant role in explaining attitudes for the European and Canadian public as well.

General Concerns

The public concerns about the use of science and technology have different bases. Theological concerns centered on "unnatural processes", such as genetic engineering or cloning, may drive some to reject specific types of biotechnology. Many U.S. states have still not resolved the debate concerning evolution and creationism. The foundation of the scientific discipline of genetics rests squarely upon the principles of evolutionary biology. The fear that science may be abused is based in historical events and science fiction. Human eugenics is considered an immoral practice. For example, the Nazis preoccupation with Aryan characteristics (and other factors) led to the killing of Jews and even persons thought to resemble Nazi defined Jewish characteristics. One only need to tour the holocaust museum in our nation's capitol to absorb the full meaning of hair swatches, nose calipers, and records of familial descent.

The dialog manifested by Jeff Goldblum's character in Jurassic Park strongly questioned whether scientists take the time to fully evaluate the potential consequences of their achievements. While largely entertaining, the movie also sets fire to discussion regarding the ethical consequences of our human genius. Technological failures may thwart public confidence in new innovations. Chernobyl, Three Mile Island, etc. are often cited as the catalyst for the anti-nuclear power movement. Recent failures of missile interception systems, under development by the U.S. military, bring bad tidings for taxpayer confidence and funding. Scientific controversy over technological applications, such as Bt corn and the effects on the Monarch butterfly, put citizens ill at ease with unknown long-term risks.

Finally, the socio-economic implications of creating "gene monopolies" and the concentration of world food supply in the hands of few corporate entities are worrisome. A related but less prevalent fear that emerges on occasion, is the development of a technocratic form of government where science and technology largely determine what is just and right. All of these factors can create resistance to the acceptance of new technologies.

Technology and Animals

As indicated in the public perception section, cloning was one of the most identified and less accepted technology by survey respondents. Why do people object more to animal manipulation then the genetic testing procedures used in human medicine? First the idea that most people believe that animals have rights that should not be violated (see Weber et al. 1995; Mench, 1999) may include the right to genetic integrity. Although simple cloning practices do not disturb genes per se, it represents the violation of natural development and the loss of uniqueness of the individual. We share commonality with farm animals in that we are mammals and may fear that this technology could potentially impact us. Rollin (1996) makes the point that "..genetic engineering is probably the most powerful technology ever devised by humans." Thus the manipulation of DNA presents the concern of sliding down the slippery slope of potential abuse of humans.

Genetic technology is often viewed as a tool of the powerful and wealthy. It is not an inexpensive technology and may put smaller producers at a disadvantage. The public view of agriculture going "corporate", as pointed out by Fraser (1998), Mench (1999) and Cheeke (1999), paints a corresponding picture of decreased individual care, forced levels of greater or unnatural growth, loss of space and mobility, and limited social behavior for animals. Some even worry about the potential alteration of pathogens caused by the genetic engineering of animals. Concurrently emerging medical technologies like xenotransplantation (concerns about specie jumping pathogens) and the fear of use of animals (as pathogen carriers) for bio-warfare against humans is enough to scare the wits out of the average citizen.

A final concern is the perception of the increasingly mechanistic view science and industry emits regarding the use of other life forms. Animals become "things" to manipulate rather than treated with the respect a living creature deserves. There is one item that squarely separates animal agriculture from the rest of the manufacturing world, the raw material we work with is alive and possesses a central nervous system. No matter how we attempt to "neutralize" the impact of what we do, the fact that we are working with animals will always place us under the microscope. The quality of life provided to these animals will reflect our attitudes toward responsible management and use.

Closing Thoughts

Gifford (1999) evaluated numerous public concerns about biotechnology. He asserts that technology is often rejected because the following moral criteria are not satisfied:

1. Utility or welfare is maximized for the whole, (this may include animals)
2. Goods are distributed fairly, and
3. People have some say over technologies that impact their well being.

The idea here is that we should fully consider the ultimate good of what we are doing. A popular news magazine recently examined the disparity of living conditions around Austin, TX. Austin had a technology boom over the past decade that has created instant millionaires out of young persons who were lucky enough to get in on the ground floor of fledgling companies. On one side of Austin's beltway massive homes, excellent schools, and many amenities abound. On the other side is a very poor community, poor schools, and the replacement of a computer in the classroom comes slowly. The perception here is that technology benefits only those who create it. Although sound examples can be produced to defeat this argument, it's the perception of this soci-economic chasm that is difficult to overcome.

Technologies involving the production of food must be carefully evaluated, presented to the public, and developed considering the criteria outlined by Gifford. Excuses and complaints of a scientifically illiterate public are unfounded. The two unifying concepts expressed in public surveys reported above are the public's wish to be "consulted" and more informed and, that the moral acceptability of what we achieve through scientific innovation be considered.

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EMERGING TECHNOLOGY COMMITTEE

CHAIRMAN: RONNIE GREEN

MINUTES

Beef Improvement Federation
Emerging Technologies Committee
AGENDA
July 13, 2000
Wichita, Kansas
2-5 PM
Ronnie D. Green, Chair
Future Beef Operations, Parker, CO

Minutes of Meeting

The Emerging Technologies Committee meeting was called to order by chairman Ronnie Green with approximately 100 in attendance. The committee agenda was based upon input from the previous meeting in Virginia. Attendees had requested a program that would address base level understanding of evolving DNA technology and genomics tools. The program (shown below) was excellent and well received by attendees. Papers are attached from Harris Lewin, Jay Hetzel, and Gary Sherman. Dan Pomp's comments were further elaborated in his general session paper from Thursday morning. The meeting adjourned at 5:45 pm.

The Fundamentals of DNA-Based Genetic Evaluation Tools

2:00-2:30 pm "Setting the Stage: The EPD vs. The QTL Approach"
Ronnie D. Green, Future Beef Operations, LLC

2:30-3:10 pm "Gene Mapping, DNA Markers, the Cow and Man"
Harris Lewin, University of Illinois and AniGenics

3:10-3:50 pm "Searching for QTL from Gene Maps and Other Information"
Dan Pomp, University of Nebraska-Lincoln

3:50-4:00 pm "Genestar: A New DNA Test for Marbling"
Don Nicol and Jay Hetzel, Genetic Solutions, Brisbane, Australia

4:00-4:30 pm "Marker-Identified QTL vs. Actual Gene: The Carcass Merit Example"
Scott Davis and Jerry Taylor, GenomicsFx

4:30-5:00 pm "New Paternity Testing DNA Technology"
Gary Sherman, Great Plains Veterinary Educational Center, University of Nebraska, Clay Center, NE

An Ordered Comparative Map of the Cattle and Human Genomes: A Guide to the Future of Beef Cattle Genetics

Harris A. Lewin, Ph.D.
The University of Illinois at Urbana-Champaign

Introduction

Beef cattle genetics is entering a critical new phase in which recent knowledge gained from genome research can be utilized to reduce producer costs and increase the quality of retail product. For maximum returns to the industry, genomic technologies will have to be cost effective, with the payoff to producers, integrators and retailers readily quantified. However, the full potential of these new technologies will be realized only when we acquire a deeper understanding of the location and function of genes that are responsible for producing the most desirable phenotypes.

In less than 15 years, research on the bovine genome has led to the discovery of genes and genetic markers that are important to the beef industry. Beginning with our study in 1987 (Beever et al., 1989; by coincidence with this meeting, conducted at the Gardiner Angus Ranch, Ashland KS) up until the recent completion of large-scale studies to identify quantitative trait loci (QTL) in beef cattle conducted at Texas A & M University and the USDA-Meat Animal Research Center, marker relationships have been described for just about every trait of economic value that has been measured on the farm or at the slaughterhouse (e.g., Stone et al., 1999). These markers are just beginning to make their way into commercial use through a variety of commercial sources in the U.S., such as AniGenics, GenomicFX and Celera AgGen. However, a major limitation of the present technology is the "low resolution" of the QTL maps, i.e., there is considerable uncertainty regarding the map location of nearly all QTL that have been identified in beef cattle. More importantly, there has not yet been a single confirmed example of an actual gene being identified for a QTL (excluding major genes, such as *myostatin*). Selecting directly on the allele(s) of a gene producing the effect, rather than a linked genetic marker, will vastly improve the utility and accuracy of marker assisted selection. Thus, it will be critical to the future application of marker assisted breeding of beef cattle for QTL to be identified at the gene level. The following presentation describes a summary of nearly three years of work by the author's laboratory that enables the rapid identification of candidate genes for traits of economic importance to the beef industry.

Comparative Mapping and Comparative Mapping Strategies

A fundamental strategy used to map genes in the cattle genome is comparative genomics. This strategy takes advantage of two important genetic attributes; *i*) the sequences of genes of closely related species tend to be highly conserved at the nucleotide level (generally greater than 70%), and *ii*) genes located on one chromosome in one species tend to be located on the same chromosome in another closely related species (conserved synteny). The relatively small evolutionary distance separating most mammals, approximately 80 million years, means that huge blocks of synteny will be conserved among any two mammalian species. For cattle genomics, this represents an unparalleled opportunity to exploit the spectacular achievements of the Human Genome Project.

There are many different ways of producing a map of genes. The "early days" of cattle genomics utilized two basic non-complementary technologies. Somatic cell genetics, pioneered by Jim Womack at Texas A & M University (TAMU), produced the first comparative maps of cattle chromosomes. Womack and coworkers mapped more than 500 genes using this approach (Womack and Kata, 1995). However, this method does not reveal the order of genes on the chromosome, only which genes are on what chromosome. Linkage analysis in families, another method for gene mapping, was used to produce the first detailed chromosome maps of genetic markers (e.g., Ma et al., 1996; Kappes et al., 1997). However, the ~2500 microsatellite markers used to build the primary linkage maps generally provide no comparative information because the markers represent "anonymous" DNA segments. Other methods, such as "chromosome painting" helped to fill in the outlines of the comparative map, but in total only 200 or so actual genes have been ordered on the cattle gene map using linkage analysis in families. In general the process of adding genes to the ordered linkage map is very slow because of the need to first identify polymorphism in the gene one wants to map.

Our effort to rapidly expand the number of genes on the cattle gene map was made possible by three significant technological advances: *i*) the development of a radiation hybrid (RH) cell panel by Jim Womack at TAMU (Womack et al, 1997), *ii*) low cost, high throughput DNA sequencing established at the University of Illinois W. M. Keck Center for Comparative and Functional Genomics, and *iii*) the COMPASS approach for comparative gene mapping (discussed below). Radiation hybrid gene mapping is a variant of somatic cell mapping that employs radiation to break up the cattle chromosomes within interspecies hybrid cell lines. The closer two genes are together, the more likely they will occur on the same fragment in one of the cell lines. A panel of about 90 RH cell lines permits accurate mapping and ordering of genes using the polymerase chain reaction (PCR) and standardized computer software. The method is rapid and has the important advantage of not requiring polymorphism for mapping. However, DNA sequence information is required, and that is where DNA sequencing technology has played a critical role in the rapid advancement of gene mapping in many species.

Several years ago we proposed a novel strategy for comparative mapping, termed *comparative mapping by annotation and sequence similarity* (COMPASS; Ma et al., 1998). The method uses high throughput sequencing of short pieces of genes known as "expressed sequence tags" (ESTs), a powerful algorithm for finding the same gene in other species, and previous knowledge of comparative genome organization, to predict the map location of ESTs *in silico*. We first used COMPASS for prioritization of ESTs for mapping on the cattle-hamster RH panel (Ozawa et al., 2000; Band et al., 2000). Prioritization was based on identification of genes that filled "gaps" in the comparative map. A software tool was developed to permit high throughput, batch processing of thousands of ESTs simultaneously (Rebeiz and Lewin, 2000). The method has been shown to be > 95% accurate (Band et al., 2000). The newest version of the COMPASS tool predicts not only which chromosome the gene is on, but also the location of the gene on the chromosome (Rebeiz and Lewin, unpublished). With the cost of mapping a gene on the RH panel currently at $300, *in silico* mapping using COMPASS provides an enormously powerful tool for "electronic binning" of markers in regions where important genes may reside. Furthermore, the newest version of COMPASS, based on the whole-genome RH map (described below), can be used for filling in sparse regions of the RH map, as well as precise closure of all gaps in the comparative map.

An Ordered Comparative Map of the Cattle and Human Genomes

We used a combination of RH mapping, EST sequencing and COMPASS to produce a whole-genome RH map of the cattle genome and a whole genome cattle-human comparative gene map (Band et al., 2000). A total of 1314 marker loci were genotyped on the RH panel, of which 995 are genes and 319 are microsatellites. Of these, 768 genes were placed on the RH map in addition to the 319 framework microsatellites. Map coverage is 9330 cR (approx. 92% of the cattle genome) with 13 chromosomes having contiguous coverage. Among the 768 genes mapped, 570 have mapped human orthologs, thus permitted the construction of detailed comparative maps of each chromosome. Fifteen cattle chromosomes were found to contain genes from just one human chromosome. Four cattle chromosomes were completely conserved with four corresponding human homologs although each had multiple internal rearrangements producing changes in gene order. We estimate a minimum of 50 percent comparative genome-wide coverage on our map. At least 105 evolutionarily conserved chromosome segments (2 or more genes) were identified between the two genomes, apparently resulting from 41 translocation events and a minimum of 54 internal rearrangements. Only four new conserved segments were identified, thus indicating that the present cattle-human comparative map includes a high percentage of the actual number of conserved segments. All centromeres were found to be repositioned with one possible exception. Two chromosomes, BTA18 and BTA19, were found to have significantly greater number of genes than expected on the basis of their size. It is interesting to note that the human homologs of these chromosomes, HSA10 and HSA17, respectively, also have a higher gene density than expected. These new whole-genome RH and comparative maps will be cornerstones for the identification of genes important to the beef and dairy industries.

COMPASS of 47,787 Cattle ESTs

The development of the whole-genome cattle-human comparative map enables prediction of chromosome location of any DNA sequence using the COMPASS strategy. On the basis of 333 COMPASS predictions confirmed by RH mapping, the method of chromosome assignment was shown to be 94.7% accurate (Band et al., 2000). This is a critically important tool, as it enables researchers to overlay QTL maps with gene maps, thus allowing the identification of candidate genes for any trait of interest. As a first demonstration of this tool we analyzed 47,787 cattle ESTs deposited in GenBank (the public repository of DNA sequences; Rebiez and Lewin, 2000). A total of 30,097 had significant similarity to human genes in UniGene (a database containing human genes and their map location, if known). These sequences represent approximately 9,956 unique sequence clusters (66.9% redundancy). Among these, 6,295 UniGene clusters (represented by 21,311 EST entries) contained human mapping data from the GB4 RH panel. Cattle chromosome assignments were predicted for these 21,311 ESTs (Rebeiz and Lewin, 2000), thus providing an invaluable resource for the research community.

Summary

As the beef industry moves into the new millennium, genomics and derivative biotechnologies will provide a direct means to increase production efficiency and expand markets through improvement in product quality and uniformity. The application of genomics to beef production will be facilitated by direct identification of genes controlling production and carcass traits. The development of a comparative map of genes, as opposed to a map of anonymous DNA markers, provides an essential tool for identification of genes that will be useful to the beef industry.

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LIVE ANIMAL, CARCASS AND ENDPOINT COMMITTEE

CHAIRMAN: ROBERT WILLIAMS

MINUTES

LIVE ANIMAL, CARCASS AND ENDPOINT COMMITTEE MEETING

2000 BIF MEETING

Wichita, Kansas
July 13, 2000

The meeting was called to order by Chairman Robert Williams at 2:00 p.m. on July 13, 2000.

Chairman Williams welcomed everyone to the committee meeting and updated attendees on the committee purpose and briefly went through the agenda.

Dale Kelly, Canadian Charolais Association, gave a brief overview of Canada's Four-Breed Alliance. The alliance members are the Canadian Charolais Association, Canadian Limousin Association, Canadian Simmental Association and the Canadian Hereford Association. Kelly then introduced Susan Joyal of BeefNet Canada. Joyal reported on the current status and direction of BeefNet Canada, which was formed by the Canadian Four-Breed Alliance.

Dr. William Herring, University of Missouri, gave an informative report on research funding opportunities for beef cattle and the importance of cooperation within the industry to fund research. He closed his presentation by presenting his work on selection indexes for profitability.

John Breathour, Kansas State University, provided an interesting report on the current status for sorting cattle into outcome groups using current scientific knowledge.

Dr. David Johnston, University of New England, Armidale, NSW, Australia, wrapped up the presentations with some new research results in Australia as it relates to industry endpoints and genetic improvement.

There was good discussion after each presentation and general questions of the presenters at the end of the session.

After all discussion and with no other business from the floor to be discussed, Chairman Williams closed the meeting at 4:30 p.m.

Respectfully submitted,

Robert E. Williams
Chairman

BeefNet Canada – An Evolving Concept

Susan Joyal, BeefNet Canada
Alberta, Canada

INTRODUCTION

BeefNet Canada is a recent initiative of the 4-Breed Partnership comprised of the Canadian Charolais, Canadian Hereford, Canadian Limousin and Canadian Simmental Associations. From the outset, BeefNet Canada's goal was to look for new and valuable ways for the 4-Breed Partnership to participate in the beef industry. It was first proposed they do so by creating a program aimed at improving the efficiency and competitive edge of beef industry participants by allying industry sectors through a system of vertical cooperation. At the program's core would be an efficient and high-speed system of electronic data capture and information sharing, as well as an offering of value-added services. BeefNet Canada was formally established on March 1st, 2000.

The following three months were devoted to researching various alliances and agricultural technology and service companies with a view to recommending an operational structure that would best serve the 4-Breed Partnership's goal and the Canadian beef industry. A three-step approach was taken:

1) Identify industry needs
2) Identify industry solutions
3) Recommend a strategy for BeefNet Canada

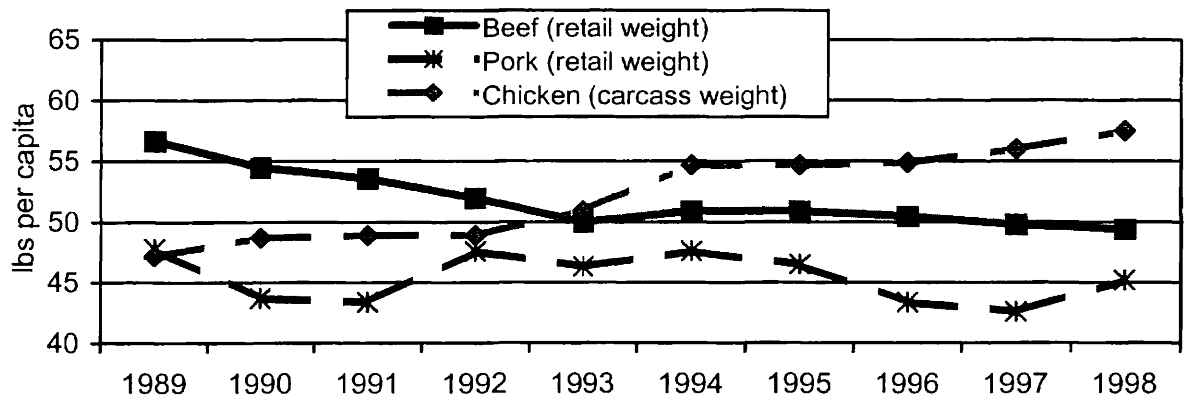
The final recommendation differed from the one first proposed. Research findings and the subsequent evolution in thought and reasoning that led to recommendation of a different operational structure have been summarized in this paper.

IDENTIFY INDUSTRY NEEDS

The Canadian beef industry can be characterized as follows: In 1999, there were 4.15 million beef cows in Canada. The majority, 79%, were located in the prairie provinces of Alberta, Saskatchewan and Manitoba. An annual total of 3.82 million cattle were produced and slaughtered at an average warm carcass weight of 758 lbs. Three major packers, located in Alberta and Saskatchewan, slaughtered 60% of those 3.82 million cattle.

In attempting to identify industry needs, an obvious and first question comes to mind: Are consumers dissatisfied with beef and why? Ten-year trends in meat consumption in Canada for the year ending 1998 are presented in Graph 1 (CanFax).

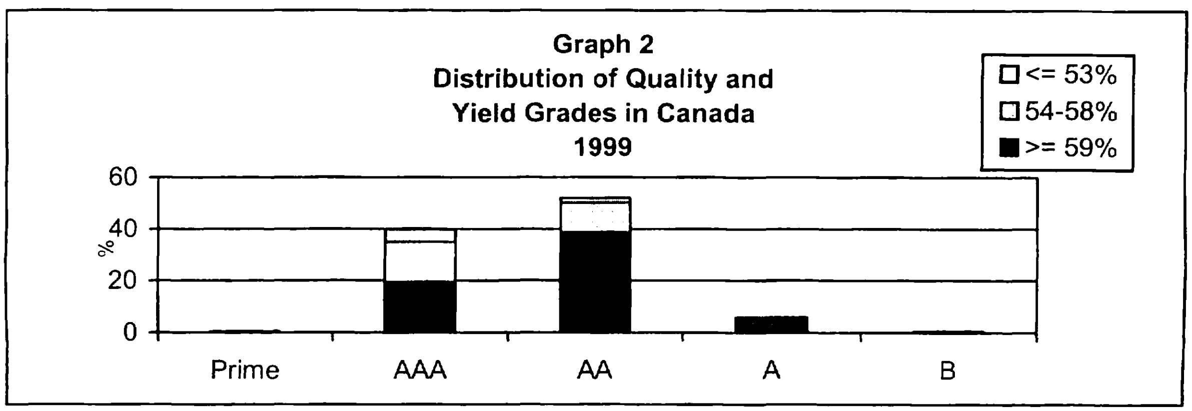
Graph 1
TRENDS IN MEAT CONSUMPTION IN CANADA



Declines in beef consumption were evident. Articles in Food in Canada magazine reported that one in four beef carcasses were unacceptably tough (Dorrell March 1999) and that "national consumer research indicates that 52 percent of respondents would purchase more beef 'if it was consistently tender'" (Menzies March 1997).

The Canadian Beef Quality Audit (1995-1996) (Donkersgoed, Jewison et al. 1997) was conducted to determine the prevalence of quality defects in Canadian cattle. Researchers cited a $70.52 per head loss due to quality nonconformities including brands, horns, tag, bruising, injection site lesions, condemnations, off-weight carcasses and grade losses. The audit was repeated and results from the 1998-1999 Beef Quality Audit (Donkersgoed 1999) indicated that, while slight improvements were noted in some areas, overall there was an increase in the loss per head to $73.77.

As part of the first audit, the authors suggested quality and yield grades targets for the industry. The distributions of quality and yield grades in Canada for cattle slaughtered in 1999 were plotted in the Graph 2 (CanFax 1999).



Ideally, they suggested that 60% of young carcasses would have a quality grade of AAA or prime and 80% of young carcasses would have a yield grade of ≥ 59%. Only 40.4%

of young carcasses had quality grades of AAA or prime, compared to the target of 60%. And only 63.8% of young carcasses had a yield grade of ≥ 59%, compared to the target of 80%.

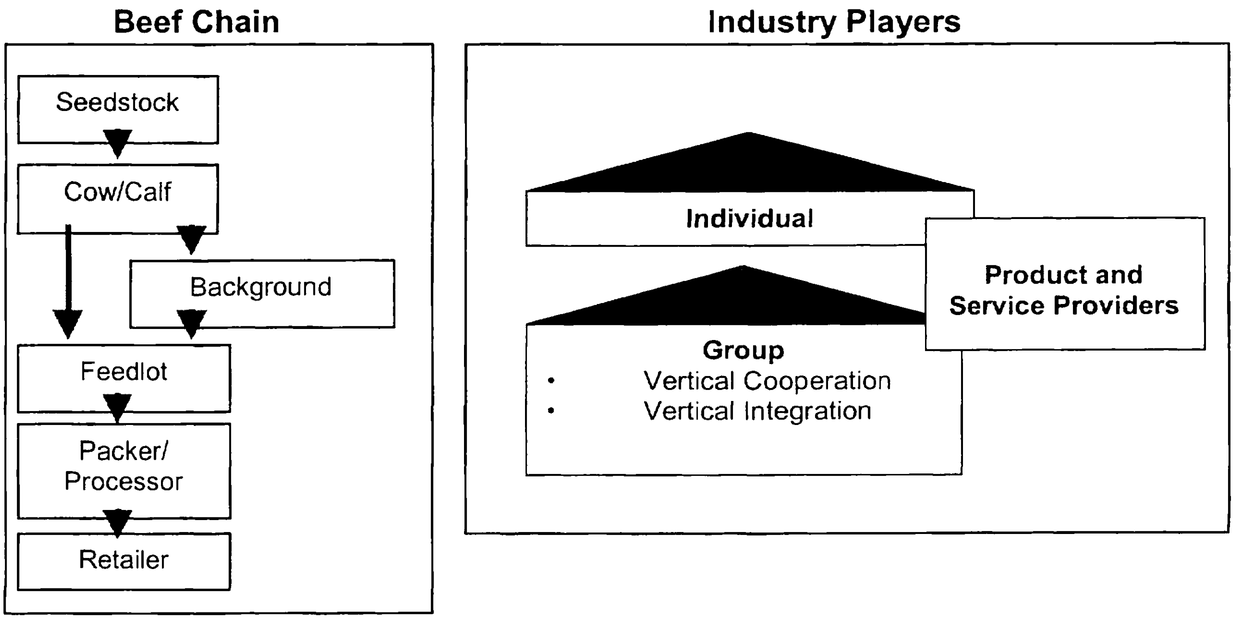
At its simplest, the audit message could be distilled to: "Improvements in beef quality, uniformity, consistency and pricing are needed to ensure the industry's future competitiveness." Audit authors suggested non-conformities could be reduced through industry adoption of the following recommendations:

1. Improvements in genetic and nutritional management
2. Development of carcass Expected Progeny Differences (EPD)
3. Electronic identification
4. Information relay systems
5. Timely marketing
6. Computer vision grading systems
7. Value based marketing

Over the last few years, challenges facing the industry have been tackled by a host of industry players, including purebred associations. New and innovative programs, products and services, all designed to capture more value, have been introduced. And, while many have failed, a few have excelled and still others hold great promise.

IDENTIFY INDUSTRY SOLUTIONS

The following schematic illustrates the beef chain and separates industry players into three broad categories.



Industry players may effect change either individually or in groups and both may use product and service providers to assist them.

INDIVIDUALS. Typically, individuals in a sector will choose to implement changes in their own operation with a view to enhancing the product and capturing more value. Unfortunately, the changes may not always be recognized or appropriately compensated for by other individuals or sectors in the beef chain.

GROUPS. A distinction was made between groups involved in vertical cooperation and those involved in vertical integration.

> ***Vertical Cooperation***. Examples of groups involved in vertical cooperation abound in today's industry and, for ease of reference, can be grouped into the following subcategories: (1) breed associations, (2) feed companies, (3) feedlots, (4) branded beef groups and programs and (5) cooperative groups. Participation is voluntary and extrication from the group is relatively easy.
>
> Typically, groups involved in vertical cooperation capture additional value by differentiating their product either on the basis of genetics, management practices, performance and/or product specifications.
>
> ***Vertical Integration***. In contrast to vertical cooperation, the term integration refers to individuals or business units within and between sectors with the same goals who have formed a business relationship. Extrication from the group takes time and can be complicated. And, although this model is common in the poultry and swine industries, it has only recently been introduced into the beef industry.
>
> In this type of closed system, additional value is often captured in two ways: (1) increased efficiencies within the system due to information sharing and adoption of 'best practices' and (2) enhanced ability to establish and dedicate streams of differentiated product to specific markets.

PRODUCT AND SERVICE PROVIDERS. Used by both individuals and groups, this is a very broad category that includes suppliers of beef industry related software and systems.

RECOMMEND A STRATEGY FOR BEEFNET CANADA

The three months devoted to researching options available to BeefNet Canada proved to be an educational and, with respect to the original proposal, evolutionary experience. Initially, all manner of allying sectors and identifying services to offer were considered. As part of the research, conversations were initiated with ranchers, feedlot operators and a number of industry officials. Two key points surfaced repeatedly.

Firstly, even if BeefNet Canada managed to successfully ally sectors of the beef chain through a high-speed system of electronic data capture and information sharing, the value of the information would be limited by the level of detail that could be reported. For most ranches, parentage of calves is unknown or incomplete and the information would be limited to whole-herd averages. Secondly, there were concerns expressed about who would be willing to pay for the information and exactly how much it was worth.

In an industry that is so highly segmented, where one segment's profitability is often had at the expense of the next segment's; and a buyer's competitive edge sometimes relies on a supplier's ignorance of their own product, it is difficult to conceive of an open, information and service based business that would be commercially viable in the long term. At this time, there doesn't appear to be sufficient incentive to encourage all segments of the beef chain to cooperate and progress towards the common goal of increasing beef quality and consumer demand.

However, that doesn't mean there wouldn't be individuals within each segment who would be willing to join forces and create such a system. And so, the final recommendation on the best operational structure for BeefNet Canada was to orchestrate, facilitate and participate in the development of a vertically integrated supply chain.

If adopted, this operational structure would encompass most, if not all, of the recommendations put forth by the Canadian Beef Quality Audit (1995-1996). It would satisfy the 4-Breed Partnership's goal of participating in the industry in new and valuable ways and such a program would likely lead to improvements in beef quality, uniformity, consistency and pricing, and ultimately to increased consumer satisfaction and demand.

The wisdom of purebred association involvement in helping to create and promote programs, products and services largely designed to improve commercial production and marketing has sometimes been questioned. And yet, many would argue that their involvement is critical to the entire process. Purebred producers should find information on commercial performance invaluable in helping to ascertain whether or not selection direction and rate and transfer of improved genetics has been effective. Certainly, the opportunity to capture more value by improving commercial production is considerable but it is limited by the potential of the animals in the system. And that potential is defined by genetics.

Failure of purebred associations to take an active role would likely prove a mistake; an unwillingness to participate in today's industry may well lead to exclusion in tomorrow's industry. That was certainly the experience of swine registries in the USA as vertical integration gained a stronghold in the 1990's - registrations fell by over 50%.

For BeefNet Canada, spearheading the development of a vertically integrated supply chain is a concept that continues to evolve. The near-term strategy is to research the concept more fully and develop a business plan with which to approach potential investors. Ideally, the core of business investors would include a retailer, packer/processor and feedlot operator.

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TECHNOLOGY AND INFORMATION FOR SORTING FEEDLOT CATTLE INTO THE MOST PROFITABLE OUTCOME GROUPS

John R. Brethour, KSU Agricultural Research Center – Hays

The cattle industry has asserted the need for value-based marketing for more than a decade. The present proliferations of carcass price grids and vertically integrated marketing programs indicate that value based marketing has, in fact, arrived. It now behooves producers to utilize available technology and management strategies that can exploit features of grade and yield marketing to increase profitability.

In a pen of feedlot cattle there is an ideal number of days to feed each individual animal that maximizes profit. That number ranges over a period of more than 120 days from the time that the first animal should be marketed until the last is ready. That reflects the diversity in weight, body composition and growth pattern unique to each animal. The optimal number of days is affected by the schedule of premiums and discounts in the pricing formula. One might market cattle early if using a "lean" beef formula with substantial rewards for yield grade #1 and #2 carcasses On the other hand, feeding would probably be extended for a "premium Choice" formula providing the cattle have the genetic potential to attain sufficient marbling to qualify for the higher quality grades. It is usually profitable to feed longer when feed costs are low.

Figure 1 shows how most cattle have a small window of peak profitability. When cattle are sold too soon, the producer sacrifices unrealized gain and potential quality grade. The slope of the left side of the curve in this chart indicates that there may be about $0.70 lost profit for each day that an animal is marketed too early. The chart also shows that after the hypothetical magic day is reached, profitability declines rapidly and quickly tumbles more than one dollar per day. That is because cattle fed past their time soon risk the penalties of over fat and over weight carcasses.

The batch marketing procedures that have been prevalent in the industry probably represent the most inefficient practice in the beef production process. Even though all cattle in a pen are sold on one day, our models show that there is a standard deviation of at least 25 days in the distribution of optimal days on feed for individual animals within a pen. Figure 2 shows that about 32% of the cattle are more than 25 days too early or too late. The batch process is more suited for harvesting wheat than cattle.

Figure 3 shows how a 3-way sort should create marketing groups that more nearly allow each animal to be harvested near its optimal day and results in only 3% being more than 25 days away from the optimal date. This is more like picking tomatoes as they become table ready and creates a precision marketing paradigm comparable to the precision farming methods used in crop production.

Acknowledgement: Figures 1 and 4 are taken from the thesis of Jodie (Walker) Tate, Economic returns to ultrasound technology in the timing and sorting of feedlot cattle: a study in value-based marketing. M. S. Thesis – Colorado State University, 1999.

Sorting feedlot cattle is, of course, neither new nor novel. Only in recent years have cattle not been visually selected for market as they appeared to be ready. But today's feeding operations tend to require clustering procedures that can be executed upstream in the process. One can list sorting procedures that range from the full use of available technology to those that merely require an experienced eye.

1. ACCU-TRAC (Micro-Beef)
2. KSU – CPEC (Cattle Performance Evaluation Co)
3. Biosort (Cattle Scanning System)
4. Sort by weight
5. Visual sort

ACCU-TRAC is a computerized Electronic Management sorting system developed by Micro-Beef Technologies, Inc of Amarillo, TX. It's stated purpose is to objectively measure and predict the optimal marketing date to maximize economic return for each individual animal. The system uses multiple technologies and scientifically developed equations, including equations developed at Cornell University by Danny Fox to estimate optimal market weight from frame score estimates obtained from video imaging and ultrasound technology created by Jim Stouffer to automatically measure and control backfat thickness.

The KSU system was developed at the Agricultural Research Center – Hays and is licensed to CPEC, Oakley, KS. It exploits automated measurement of backfat thickness and marbling with ultrasound and uses those estimates to predict future yield and quality grade. A proprietary feedlot profitability model determines the number of days to continue to feed each animal that maximizes profit. The system is dynamic in that it can adjust to any price formula and is portable. Also, unlike the ACCU-TRAC system, only a single evaluation is used, usually at reimplanting midway during the feeding period.

Biosort is the name of the company that acquired what was earlier known as Cattle Scanning Systems. This is video imaging technology that measures animal height and width and classifies individuals into "biological types". Animal weight is also used in the clustering procedure.

There is little information comparing the efficacy of the different sorting procedures. Also, it is difficult to develop and execute a protocol that adequately measures the additional profitability from sorting. That is because there is a constellation of economic factors that might be enhanced by sorting including:

1. Targeting more carcasses into the premium classifications of a price grid.
2. Avoiding outliers such as over fat and overweight carcasses that are heavily discounted.
3. Improving overall performance (gain and feed efficiency).
4. Obtaining more pounds gain on a pen of cattle.

Two studies conducted by Basarab, et al [Basarab, J. A., J. R. Brethour, D. R. ZoBell, and B. Graham. 1999. Sorting feeder cattle with a system that integrates ultrasound backfat and marbling estimates with a model that maximizes feedlot profitability in value-based marketing. Canadian Journal of Animal Science. 79:327-334] indicated $18 and $10 (US$) improvements in profitability with the KSU system. Another attempt to estimate the response to sorting was performed with data from over 7,000 carcasses. In this simulation carcass data were backed up 80 days and then the data were processed with the KSU sorting programs, which also mimicked the errors inherent in that procedure. Figure 4 shows net return after a charge for ultrasound evaluation and additional bookkeeping of $16.88 for a 3-way sort, similar to the results reported in the Canadian studies.

A problem in conducting studies measuring the response to evaluation and sorting is that information is obtained that enables correct timing for marketing the control (unsorted) group. Also, the technologies have immeasurable educational value and provide an understanding of the merit of the cattle, which should enable more judicious selection of marketing grids. In some instances, the evaluations provide confidence to exploit the benefits of grade and yield marketing. So the total additional profit from using sorting technologies may exceed $30 per head.

Inherent to using ultrasound upstream to predict future carcass merit is a knowledge of the development of backfat thickness and marbling as functions of days-on-feed. Figure 4 shows that backfat thickness increases at an exponential rate with a doubling time of about 70 days. This means that an animal with 0.1 inch backfat when it arrives at the feedlot would be expected to have about 0.2 inch after 70 days on feed and double again to 0.4 inch (Yield grade #2) after 140 days on feed. Another animal with initial backfat thickness of 0.2 inch initially would reach 0.8 inch (Yield grade #4) after the same days on feed (two doubling times). The rate coefficient (doubling time) is less for younger cattle and for large framed, later maturing breeds.

Marbling score increases in a different fashion; the equation is a power function, which is between the exponential and linear model. Serial scanning indicated that it takes an average of 114 days to progress from low Select to low Choice and 70 days to increase on to average Choice. It requires another 96 days to reach low Prime. The model explains why some cattle (those with very low levels of initial marbling) still grade low Select after as many as 200 days on feed while others will become Prime after 150 days on feed; the latter probably had enough marbling to grade Choice when they were started on feed.

Models that predict the optimal days on feed to maximize profit are more sensitive to backfat thickness than other variables because in most instances the optimal strategy is to feed to a backfat thickness target between 0.4 and 0.5 inch. This often precludes effective sorting at the beginning of the feeding period. Cattle often arrive at the feedlot in thin condition with very little measurable backfat. It often requires about 60 days on full feed for genetic differences in fattening to be expressed. On the other hand, ultrasound marbling estimates made at the beginning of the feeding period have been about 75% accurate in predicting whether individual animals will grade Choice or not. We have also experienced this level of accuracy in classifying future quality grade from using ultrasound to evaluate calves soon after weaning.

There is some advantage in commingling sorted cattle into uniform outcome groups. An intensive study by Micro-Beef indicates that commingling does not adversely affect performance (http://www.microbeef.com/aboutmicrochemical.htm). In addition, electronic identification allows individual animal tracking through the feedlot and the packing plant. Algorithms are available that correctly partition feed intake of commingled cattle among multiple owners.

These technologies enable cattle producers to adopt “just-in-time” production strategies that are comparable to the “precision agriculture” procedures available in crop production. They result in building quality control into the system that will enable the industry to better meet consumer expectations while increasing profitability to the cattle industry.

INDUSTRY ENDPOINTS AND GENETIC IMPROVEMENT – NEW RESULTS

David J. Johnston
Cooperative Research Centre for Cattle and Beef Quality
Animal Genetics and Breeding Unit, University of New England, Armidale, NSW, Australia*

This year (2000) sees the final slaughter of cattle generated for the Cooperative Research Centre for Cattle and Beef Quality (CRC) genetics program. This very exciting project has involved the breeding, feeding and slaughter of almost 10,000 pedigree recorded animals. The results from this project will benefit the Australian beef industry for many years to come. The genetics program has described the genetic variation in several meat quantity and quality traits between breeds and crossbreds and sires within breeds. The project has added significantly to the pool of knowledge in the field of molecular genetics and its role in the improvement of beef production and quality through marker-assisted selection.

The straight-breeding project consisted of 7800 progeny from seven breeds representing 400 sires, including both temperate and tropically adapted breeds. The temperate breeds included Angus, Hereford, Murray Grey and Shorthorn. The tropically adapted breeds included Brahman, Belmont Red and Santa Gertrudis. The cattle were purchased at weaning from cooperating breeders and backgrounded on pasture. When each group reached the required weight they were finished on either pasture or grain to three important market weight endpoints (domestic 400kg; Korean 520kg; and Japanese 600kg). All animals were measured for growth from weaning to slaughter. Ultrasound scans for carcass attributes were recorded at least at six monthly intervals between weaning and slaughter. Animals finished in the feedlot had individual feed intake measured for a period of the finishing. At slaughter complete carcass and meat quality measurements were recorded. As well, since July 1997, samples of striploin of every carcass generated in the project have been evaluated by consumer taste panel as part of Meat and Livestock Australia's Meat Standards Australia (MSA) program.

The design of the project enabled the amount of additive genetic variation and the heritability (and trait relationships) for each carcase and meat quality trait to be described. These parameters could also be estimated at each of the different finishing systems (pasture and grain) and at the three different market weights. As well, the genetic relationship between the different treatments could be estimated to determine if important genotype by production environment interactions were occurring.

One of the major outcomes of the genetic project has been the delivery to the Australian beef industry the knowledge and techniques to breed cattle whose offspring will meet market specifications and be profitable for all parts of the production chain. Some key genetics results, to date, from the straight-breeding

*AGBU is a joint unit of NSW Agriculture and the University of New England progeny test project are:

- Carcase weight, intramuscular fat % (chemical measure of marbling) and actual retail beef yield % are all moderate to highly heritable in both temperate and tropically adapted breeds.
- Objectively measured tenderness is moderately heritable in tropically adapted breeds but low in temperate breeds.
- Feed intake and residual feed intake are moderately heritable.
- A moderate genetic antagonism exists between retail beef yield % and intramuscular fat %.
- very high (positive) genetic correlations exist between traits measured on carcases finished on grain versus pasture.
- greater genetic expression (additive variances) were observed for many of the measures of fatness from grain finished animals compared to pasture finished.
- very high genetic correlations exist between traits measured on carcases at the different market weight endpoints.
- greater genetic expression (additive variances) were observed for many of the traits from the heavier market weight animals compared to the lighter market weight.
- high genetic correlations exist between ultrasound carcass measures in seedstock bulls and heifers with the same trait measured in the CRC slaughter progeny.
- CRC data and results have provided the basis for new marbling and beef yield % EBVs in BREEDPLAN.

All analyses will be completed by November 2000. For the latest estimates or further information contact David Johnston (djohnsto@metz.une.edu.au)

GENETIC PREDICTION COMMITTEE

CHAIRMAN: LARRY CUNDIFF

PRELIMINARY GUIDELINES FOR MARKER ASSISTED GENETIC PREDICTION

R. *Mark Thallman, U.S. Meat Animal Research Center*

Introduction

Genetic testing is beginning to impact many aspects of human society and will continue to do so at an increasing rate. This technology has already impacted crop production and is beginning to be used in livestock species. It is only a matter of time before it will impact cattle breeding. It seems unlikely that the beef industry will be able to maintain market share over the long term without taking advantage of genetic testing. However, there are more challenges in applying genetic testing to beef cattle than to many other food species. Consequently, the adoption of this technology is likely to be slower in beef cattle. Nonetheless, the time is right for the beef industry to begin developing the infrastructure necessary to implement this technology.

Genetic testing has a number of potential applications in cattle breeding, including parentage testing, tests for genetic diseases or defects, and tests for qualitatively inherited traits such as color or horns. However, most economically important production and end-product traits are influenced by several or many genes. The individual genes that influence such traits are known as quantitative trait loci (QTL). The identity of these genes may be known, but in many cases only the general location of the QTL on a chromosome is known. This presentation will focus on tests for QTL.

Genetic testing has the potential to increase the accuracy of selection, especially for traits that are expensive to measure, sex-limited, or measured postmortem. It can also make evaluations available at birth or even before. This is an important advantage for traits that are only measured after selection decisions are made.

Categories of genetic tests

Genetic tests can be classified into two main categories – direct tests and linked marker tests. The recommendations that follow depend heavily on the extent to which each type of test will be used in the beef industry. Therefore, each type of test will be explained in some detail.

Direct tests are based on the specific functional differences in the DNA that cause differences in the traits of interest. Linked marker tests are based on differences in DNA markers that are linked (in close proximity) to the genes that actually cause differences in the traits of interest. There are different opinions regarding the relative usefulness of linked marker tests as compared to direct tests.

Linked markers are the only option when a region of a chromosome is known to influence traits, but the gene or the specific mutation that causes the effect has not yet been discovered. This is the situation for most current genetic tests for production and end-product traits, including those being evaluated in the NCBA Carcass Merit Project. With linked markers, it is necessary to establish, within each family, the association between the markers and the QTL that effects the traits. For each individual, it is necessary to determine which alleles (forms) of the markers are associated with favorable effects on the traits and which marker alleles are associated with unfavorable effects. Some individuals have only one form of the gene affecting the traits. They are termed homozygous and possess two copies of the same allele of the gene. Homozygous individuals need to be distinguished from heterozygous individuals that possess two alternate alleles of the gene.

If the association between marker alleles and traits is known in a parent, then the linked markers can be used to predict whether each of its progeny inherited the favorable or the unfavorable allele of the QTL. One of the objectives of the Carcass Merit Project is to find these associations in influential sires in the beef industry. When marker data is collected on a large number of related individuals, this process can be quite efficient and accurate. However, linked markers can not be used to predict the genetic merit of individuals that do not have a substantial number of relatives with both marker data and phenotypes (trait data).

Direct tests have the potential to overcome some of the difficulties in using linked marker tests. Because the test detects the change in the DNA that directly causes the differences in traits, there is no need to determine which test allele has the favorable effect. Therefore, direct tests should be easier to use than linked markers and do not depend as heavily on information about relatives. Consequently, some experts believe that only direct tests will be useful in cattle breeding.

However, direct tests require much more knowledge to develop than linked marker tests. They require knowledge of which gene is responsible for the observed differences in traits. Finding the responsible gene can be expensive and time consuming. It can be very difficult to prove that a particular gene has the observed effects on traits. Consequently, very few direct tests are currently available for production and end-product traits in beef cattle. There is no doubt that the genes that effect important traits will eventually be identified, but the ones that will be identified first are likely to be those that have very large effects, possibly disrupting the normal physiology of the animal. The myostatin gene that causes double muscling when it is inactivated is an example. The more useful differences in genes will be more difficult to identify.

After the responsible gene has been identified, it is necessary to determine the mutations (differences in the DNA sequence) that are responsible for the effects on traits. Usually, one or more mutations are discovered in the process of finding the gene, but this by no means guarantees that all of the relevant mutations in industry populations have been discovered. In many cases, there will also be mutations at other positions within the gene that have similar effects on the traits, but that have not yet been identified. Animals that have these unidentified mutations will not be detected by the direct test. Screening enough individuals in each of the relevant breeds to detect all of the functional mutations (QTL alleles) would be an enormous task and is unlikely to be economically feasible.

As an example, assume that gene X, affecting marbling, is discovered in a cross between breeds A and B. Breed A has a fully functional allele of the gene (X^A), but breed B has a mutation at a specific position within the gene that causes the gene to be nonfunctional. A direct test is developed to distinguish between X^A and the nonfunctional allele of the gene that is present in breed B (x^B). In a composite of breeds A and B, this direct test could be used to efficiently select individuals with X^A.

However, assume that in breed C, QTL alleles X^A and x^B are both present along with an undiscovered nonfunctional allele of the gene (x^C) caused by a mutation at a different position in the gene. The effect of x^C on marbling would be the same as that of x^B, but the direct test would consider x^C to be the same as X^A because the direct test only looks at one specific position in the gene. Therefore, selection within breed C based on the direct test would increase the frequency of X^A and x^C, and would decrease the frequency of x^B. This would lead to an increase in marbling, but much more slowly than if the test was able to also distinguish between X^A and x^C.

Furthermore, the effect of a particular mutation may not be the same in all breeds. Continuing the example, assume that in breed D, X^A and x^B are present and that an alternative physiological pathway is active that partially circumvents the need for gene X to be active in order for marbling to be deposited. In breed D, the difference in marbling between X^A and x^B may be much smaller than it is in the composite of breeds A and B. Therefore, selection on the direct test for gene X would still increase marbling, but by less than was expected. In breed D, it would be appropriate to place less emphasis on gene X relative to other genes affecting marbling, if it was known that the effect of gene X was less in breed D. However, this would not be known unless it was actually investigated. This would require performing the test for gene X on a substantial number of progeny with marbling data in breed D and analyzing the data.

A third category of tests, association tests, may also develop. They share many features in common with direct tests, but would be less difficult and expensive to develop. However, they could also be less reliable than direct tests due to several technical problems.

Vision of the future

The appropriate course of action for the beef industry to take is highly dependent on the way in which genetic testing will be applied in the industry. However, there are numerous scenarios that could develop and there is not general agreement on which is the most likely or most beneficial. Therefore, several scenarios will be explored and their implications discussed before recommendations are made.

A popular utopian vision of the future is that direct tests performed on a DNA sample on an individual will be sufficient to accurately determine the genetic merit of the individual. This scenario, which assumes that EPDs, phenotypes and relatives' DNA will be unnecessary, is mentioned primarily because it is a widely held misperception. Most economically important traits in beef cattle are influenced by a large number of genes that interact with one another, the environment, and the management system in a multitude of ways. Unfortunately, attempts to provide "simplified explanations" of DNA technology have misled many non-geneticists to believe that genetic testing will be simple to apply to cattle breeding. This effect is exacerbated by the fact that there are some simply inherited traits such as color and recessive genetic defects for which direct tests without consideration of relatives are sufficient.

Nonetheless, for traits that are influenced by several or many genes, that have the greatest economic importance in cattle, and on which this presentation is focused, this scenario presents serious problems. It would encourage breeders to test only those animals that are candidates to become parents or that are offered for sale. There would be no incentive to perform genetic tests on progeny that are evaluated for carcass traits. In fact, because genetic testing is assumed to replace phenotypes, this scenario would discourage the collection of phenotypes. However, without an adequate system for collecting genetic test data on animals with relevant phenotypes in influential industry germplasm, many or most of the important functional mutations are likely to go undiscovered, and hence, undetected by direct testing. Likewise, without an adequate system for capturing phenotypic and genetic test data in industry populations, the effects of the mutations detected by direct tests will necessarily be estimated from relatively small research populations and extrapolated to industry populations that may be very different.

Most experts in the field of genetic testing recognize that genetic testing can enhance the accuracy of selection, but that it will not replace EPDs in the foreseeable future and that breeders will need to continue to collect phenotypes. Now that linked markers have become available for use, the challenges in applying them (primarily the association of marker alleles with traits) have become more obvious. Consequently, many experts have concluded that the linked marker tests must be converted to direct tests. However, there is generally a failure to recognize the limitations of direct tests, primarily because direct tests have not been used long enough for the problems to have been exposed.

The default scenario that is developing is derived from the utopian scenario described above. In it, direct tests and EPDs will both be used, but independently, with the EPDs eventually playing a lesser role. Currently, the emphasis is on developing the direct tests. Relatively little thought is given to how the results of the tests will be reported (in terms of effects on all relevant traits) or how they will be combined with the results of other tests. Presumably, the company performing the test would provide an estimate of the effect of each possible test result on the traits identified with the test. The test results could be used to "adjust" the EPDs, but the effects of genes included in the tests would be counted twice, once by the genetic test and once by the EPD. It appears likely that the direct tests would be applied to relatively few individuals and that they would have more influence on marketing than on breeding decisions. Under the default scenario, there would be no organized attempt to associate genetic test data with phenotypes. Consequently, there would be little discovery of new functional mutations or re-estimation of the effects of the different test outcomes in specific breeds or on additional traits.

Clearly, a system for capturing and analyzing phenotypic and genetic test data in industry populations would be beneficial to the beef industry. Fortunately, a national cattle evaluation system already exists for the phenotypic data. However, the beef industry, through BIF, will have to take deliberate action if it wants a unified system for handling genetic testing data. One scenario is that genetic test data would be submitted to centralized data bases through the breed associations and the genetic test data would be used to enhance the accuracy of EPDs instead of as an alternative or a supplement to EPDs. Under this scenario, both linked markers and direct tests could be used. The associations between marker alleles and traits would be determined (where sufficient data existed) automatically as part of the EPD analysis. Likewise, it would be possible to systematically discover new functional mutations to be included in direct tests and to estimate the effects of genes on a within-breed basis. Under this scenario, the information derived from genetic testing would be packaged in the form of EPDs, which would make it much easier for breeders to use than would be the case under the previously discussed scenarios.

This scenario does depend on marker data on a larger number of animals than the other scenarios. Therefore it would require a substantial decrease in the cost of large-scale genetic testing. It also presents considerable statistical and computational challenges, but these can probably be met. Furthermore, it would require a substantial infrastructure for acquiring and handling genetic testing data.

Substantial numbers of individuals (preferably unselected) with both phenotypes and genetic test data are required to obtain the best information from either linked markers or direct tests under this scenario. Fortunately, one of the objectives of the NCBA Carcass Merit Project is to associate alleles of linked markers with effects on traits in a number of sires that are influential in the beef industry. This project is a good start, but will need to be followed up in order to be relevant to future generations. A population addressing this need is also under development at the U.S. Meat Animal Research Center.

There is another scenario that could develop, especially if genetic test data is not incorporated into national cattle evaluation. Breeding companies could develop nucleus herds with extensive genetic testing and collection of phenotypes, compute in-house genetic evaluations taking the genetic tests into account, and use advanced reproductive technologies to maximize response to selection. Multiplier herds would then be used to produce seedstock for sale to commercial cattlemen. This scenario is similar to the current situation in the swine industry. Large breeding companies have not fared well in the beef industry in the past, but genetic testing technology may give them enough competitive advantage to succeed if traditional cattle breeders do not use genetic testing effectively.

Genetic testing is almost certain to be used in the beef industry. It definitely will be used in the production of competing products. It is not clear how or when genetic testing will come into widespread use in the beef industry, as it is just now becoming commercially available. It would take several years to develop the infrastructure necessary to incorporate genetic testing into national cattle evaluation. However, it may take longer to develop a sufficient number of direct tests under the default scenario. The development cost of the direct tests will certainly be much higher than for linked markers. If beef cattle breeders want to have an organized system for implementing genetic testing, then it is time to start developing it. However, another option is to do nothing and wait to see whether large breeding companies move into the beef industry.

In order to propose coherent guidelines, BIF should first develop a vision for how genetic testing is likely to be used in beef cattle breeding and production. Therefore, it would probably be beneficial for the issues discussed above to be debated by people with divergent points of view at the next Genetic Prediction Workshop.

Assumptions

Because there is currently not a consensus as to how genetic testing will be used, I will proceed by making a set of assumptions that I believe to be reasonable:

- The number of genetic tests that are commercially available will increase greatly in the next few years.
- The cost of genetic testing will decrease dramatically in the next few years. This will become possible due to technology developed for human genetic testing, but its effect will not be realized until the volume of genetic testing in livestock increases substantially.
- When the number of available tests becomes greater, it will not cost much more to run a battery of many tests per animal than to run only one test per animal. It is likely that there will be discounts for submitting samples on large numbers of animals simultaneously, provided the same set of tests is requested on all of the animals.

- Several companies will offer genetic testing services to cattle breeders. These companies will be referred to as "DNA service labs." It is likely that some genetic tests will be offered by several different DNA service labs, but others will be proprietary and only available from one DNA service lab. Therefore, breeders that wish to evaluate their cattle as thoroughly as possible will probably need to send samples to multiple DNA service labs.

- New tests will continue to be developed for the foreseeable future. Consequently, some important animals will need to be tested at several points in time, perhaps many years apart.

- Some of the available tests will be direct tests. Some of the direct tests will not detect all of the functionally different alleles that are present in commercially relevant populations.

- At least for the next few years, many of the available tests will be linked marker tests.

Some of the issues that should be considered under these assumptions will be addressed next.

DNA collection and storage

Genetic tests are performed on DNA, which is present in almost all cells of the body. Traditionally, DNA has been extracted (purified) from a tissue source before the actual genetic test is performed. Extraction of the DNA can be a substantial fraction of the laboratory cost of performing a single genetic test. However, a sufficient quantity of DNA is usually extracted from the tissue to perform many genetic tests. DNA can usually be stored in aqueous solution for several years, but not indefinitely. The tissues from which DNA is most commonly extracted are: blood, semen, hair follicles, ear notches and muscle. Each of these tissues can be stored in frozen form for many years. Some types of genetic tests can be performed directly on tissue samples without DNA extraction.

Under the default scenario described above, there is no need for breeders to archive tissue or DNA samples for future use. However, if genetic testing is to be incorporated into national cattle evaluation, then it will be very beneficial to have DNA on ancestors and on progeny with expensive phenotypes archived for use whenever appropriate genetic tests are developed and included in the national cattle evaluation. If this is the course breeders wish to take, then the time to begin archiving samples is now.

Therefore, it seems appropriate for some beef cattle breeders to begin collecting and storing samples from some of the influential animals in their herds. This recommendation is contingent on an inexpensive means for breeders to collect and store samples for genetic testing to be done in the future. Consequently, guidelines for tissue collection and storage would be useful and some of the points that need to be addressed are:

- What tissue(s) should be collected?
    - Some of the options are:
        - Frozen semen – when available, it is an excellent source of DNA. One straw is sufficient to perform hundreds of tests. It can be stored in liquid nitrogen, or for DNA extraction, in a deep freeze.
        - Blood spotted on FTA paper – a few drops of whole blood can be spotted and dried on a special card and stored at room temperature, presumably for at least ten years. Each card costs a bit over a dollar and is sufficient for roughly a hundred tests.
        - Hair follicles – several service labs are accepting tail hairs (pulled with the follicle intact) as DNA sources. They can be stored at room temperature (at least short term). Roughly three to five hair follicles are required to perform one test or group of tests. Kits for storing tail hairs on cards are available.
        - Fresh blood – has long been the standard tissue for DNA testing in cattle. However, the usual procedure is to isolate and freeze the white cells prior to DNA extraction. Isolation of white cells requires some laboratory equipment and skills that make it unattractive for on-the-ranch tissue storage.
        - Frozen blood – recently developed methods for extracting DNA from frozen whole blood seem very promising. Blood could be stored either in syringes or inexpensive plastic vials and stored indefinitely in a deep freeze. A few cc's would be sufficient to perform hundreds of tests. This may be the least expensive method (excluding surplus semen).
    - Should BIF recommend particular types of tissue and storage protocols?
        - This should involve dialog with service labs and a commitment that they would accept the recommended tissue types. Although DNA can be extracted from a wide variety of tissues, the extraction methods also vary widely. It would be discouraging to collect and store samples, only to find out later that the service labs either would not accept the samples or that they added a substantial surcharge for a nonstandard extraction method.

- Where and how should the samples be stored?
    - It would be beneficial for breeders to be able to store tissues on their ranch.
        - Several tissue types could be stored at room temperature or in a deep freeze and so could be stored on the ranch for little or no expense.
        - This would allow collection now without major expense or commitment.
        - It would also facilitate distribution of tissue to several different service labs if necessary.

- Several DNA service labs offer or plan to offer tissue and/or DNA storage as a service for a fee.
  - They should be able to offer benefits in sample identification, inventory, and an preservation.
  - Once extracted, DNA could be stored in a format that facilitates low-cost genotyping of groups of animals.
- Tissue or DNA should be stored long term so that it is not necessary to collect a new sample from the same animal each time a new DNA test becomes available.
- Labeling, inventory, and keeping track of storage locations of samples is not trivial.

- Which animals should tissue samples be collected from? The following list is not applicable to all herds, but may be considered as a starting point:
  - Sires
  - Dams of AI sires
  - Common ancestors that tie together the sires in the Carcass Merit Project
  - Descendants and collateral relatives of sires in the Carcass Merit Project or other QTL projects
  - Any progeny groups on which expensive or extensive phenotypes are collected
  - In some elite herds, it may be beneficial to collect tissue from all animals in the herd, provided the cost of doing so is minimal.

Additional issues to be addressed

There are a number of questions that could be addressed by BIF guidelines for genetic testing. Instead of treating each of these in detail, I will try to raise some of the questions and make a few comments.

- Who owns the DNA and tissue samples? Who has access to the results of the genetic tests?
  - It seems by default that the entity that pays for collection, storage, and testing would be the owner.
  - In many cases, this would be the owner, or a past owner, of the animal.
  - However, anyone that owns semen could submit a sample for testing.
  - Under special circumstances, breed associations, NCBA, or services labs may claim ownership of samples or information that they arranged to have collected and/or paid for.
  - Submission of results of genetic tests for national cattle evaluation would be beneficial to the industry, but can not be assumed. Selective reporting of test results could be a problem.

  - There may be cases in which several entities independently submit samples on the same sire. This could result in unnecessary cost to the industry, caused by insufficient sharing of information.

- Information acquisition and storage
  - The efficient acquisition and storage of genetic testing results will require substantial database development. The need to distribute the information only to those that are authorized will complicate the problem.
  - It is not clear what organization will be best equipped to perform this role. Perhaps it is one or more of the organizations that perform national cattle evaluation. Perhaps a new organization needs to form to fill this role. Perhaps one breed association could do it and contract out services to the others. It is almost certainly too large and expensive a task for every breed association to attempt to do it themselves. It would be best to avoid redundancy in this role.
  - Data should be transferred electronically and directly from the service lab to the central database. This should be authorized at the time the genetic tests are ordered as a standard part of the order form. It would require that the sample be identified such that it could be recognized by the central database (registration number or equivalent).
  - The nomenclature of markers and genes tends to evolve over time, so this will have to be accounted for.
  - The genetic location and identity of some of the genetic tests will probably not be disclosed. For others, they will be known and should be recorded.
  - The possibility of data errors should be accounted for and a system to identify them should be developed.
  - Information handling for QTLs should be integrated with parentage verification and parentage determination data
    - It might be desirable to recommend or require that parent verification be performed on animals with QTL/disease marker data.
  - Information handling for QTLs should be integrated with that for disease and other single-gene tests.

- What should the role of breed associations be in genetic testing?
  - Education
  - Oversee incorporation into national cattle evaluation
  - They may consider organizing projects to follow up on the Carcass Merit Project.
  - They may also consider collecting sets of ancestral DNA that tie the most heavily used sires in the breed together and funding marker data on those ancestors.

- It might be beneficial to have a standard "label" for each genetic test that is available, so that breeders have the information they need to decide among the tests? The label would answer each of the following questions that breeders should ask about a DNA test:

- Is it a direct test or a linked marker test?
- How large is the effect on each trait of interest?
  - Should include the standard error of the estimate.
  - How much of the variation in the trait is explained by the QTL?
- What is its effect on other traits?
  - Have all relevant traits been evaluated in the validation population?
- How many alleles have been characterized?
- What are the allele frequencies?
- What is the degree and direction of dominance?
- How many breeds has it been characterized in?
- What populations have been used to characterize the test?
  - How many "informative" individuals (individuals with at least one parent that is heterozygous for the test and for the QTL)?
  - How many informative individuals of each genotype?
    - If the frequency of a particular genotype is low, the estimate of the effect of that genotype may be imprecise.
- If public information, what is the location in the genome of the test?
  - If a direct test, what gene is involved?
    - What type of mutation: inactive gene, altered activity of gene product, altered expression, etc.
    - Brief description of what is known about the function of the gene.
  - If flanking markers, which ones?
    - How far apart are the flanking markers and what is the confidence interval for the location of the QTL?

- Should there be some standard resource populations on which DNA tests could be verified prior to commercialization?
  - This section is based on a suggestion by William Herring.
  - These populations should represent diverse germplasm representative of the US cattle population. They should also have as many different phenotypes as possible recorded. Possibilities include:
    - NCBA Carcass Merit Project
    - MARC resource families
    - MARC GPE Cycle VII and other cycles
    - Texas A&M Angleton families
    - Univ. of Missouri Angus alliance families
    - Breed association progeny testing programs
  - The system could work as follows:

- The institution with the resource population would provide DNA (but not pedigrees or phenotypes) to the company that wishes to commercialize tests.
- The company would run the tests on the DNA and send the results to institution.
- The institution or some independent organization would analyze the effect of the DNA test on all available phenotypes.
- The institution would generate a report of the results in a standard format. This report would contain most of the information discussed above. The company would agree not to selectively report the results.

- How important will trait phenotypes be when genetic testing becomes widespread?
  - Phenotypes will continue to be very important, although genetic tests can reduce the number of phenotypes needed and increase the value of each phenotype recorded.
  - It has been proposed that direct tests will eliminate the need for phenotypes. This is highly unlikely although direct tests may extend phenotypes farther than anonymous markers can.

ACROSS-BREED EPD TABLES FOR 2000 ADJUSTED TO A 1998 BASE

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Introduction

This report is the 2000 update of estimates of sire breed means from data of the Germplasm Evaluation project at the U.S. Meat Animal Research Center (MARC) adjusted to a 1998 base using EPDs from the most recent national cattle evaluations. Then the factors to adjust EPD of 14 breeds to a common base were calculated and are reported in Tables 1-4.

Changes from the 1999 update (Van Vleck and Cundiff, 1999) are as follows:

1) Included for the first time were 105 progeny of 16 Red Angus bulls with birth, weaning and yearling weights. The average BIF accuracy values were about .75 and the regression coefficients of progeny performance on sire EPD were low for birth weight (.47) and high for yearling weight (1.48) but with large standard errors.
2) The most new information in several years was available mostly from bulls first used in 1998, Hereford (8), Angus (14), Simmental (13), Limousin (16), Charolais (14) and Gelbvieh (15). Three new "old" Maine-Anjou bulls were included with 44 progeny. Angus did not report EPD for 7 low accuracy bulls previously reported with 131 progeny at MARC. Similarly, the Charolais data did not include 11 low accuracy bulls previously reported with 118 progeny in direct comparisons at MARC.
3) Changes in bases for the national Maine-Anjou genetic evaluations are reflected in this report as are some changes continuing with Simmental and Gelbvieh evaluations.

Methods

The calculations are as outlined in the 1996 BIF Guidelines. The basic steps were given by Notter and Cundiff (1991) with refinements by Núñez-Dominguez et al. (1993), Cundiff (1993, 1994), Barkhouse et al. (1994, 1995), and Van Vleck and Cundiff (1997, 1998, 1999). All calculations were done with programs written in Fortran language with estimates of variance components, regression coefficients, and breed effects obtained with the MTDFREML package (Boldman et al., 1995). All breed solutions are reported as differences from Angus. The table values to add to within-breed EPDs are relative to Angus.

For completeness, the basic steps in the calculations will be repeated.

Models for Analysis of MARC Records

Fixed effects in the models for birth weight, weaning weight (205-d) and yearling weight (365-d) were: breed of sire (14), dam line (Hereford, Angus, MARC III Composite) by sex (female, male) by age of dam (2, 3, 4, 5-9, ≥10 yr) combination (27), year of birth (70-76, 86-90, 92-94 and 97-99) and a separate covariate for day of year at birth of calf for each of the three breeds of dam. Dam of calf was included as a random effect to account for correlated maternal effects for cows with more than one calf (3778 dams for BWT, 3534 for WWT, 3417 for YWT). For estimation of variance components and to estimate breed of sire effects, sire of calf was also used as a random effect (528).

Variance components were estimated with a derivative-free REML algorithm. At convergence, the breed of sire solutions were obtained as were the sampling variances of the estimates to use in constructing prediction error variance for pairs of bulls of different breeds.

For estimation of coefficients of regression of progeny performance on EPD of sire, the random sire effect was dropped from the model. Pooled regression coefficients, regressions by sire breed, by dam line, and by sex of calf were obtained. These regression coefficients are monitored as accuracy checks and for possible genetic by environment interactions. The pooled regression coefficients were used as described later to adjust for genetic trend and bulls used at MARC.

The fixed effects for the analyses of maternal effects included breed of maternal grandsire (13), maternal grand dam line (Hereford, Angus, MARC III), breed of natural service mating sire (16), sex of calf (2), birth year-GPU cycle-age of dam subclass (66), and mating sire breed by GPU cycle by age of dam subclass (35) with covariate for day of year of birth. The subclasses are used to account for confounding of years, mating sire breeds, and ages of dams. Ages of dams were (2, 3, 4, 5-9, ≥10 yr). For estimation of variance components and estimation of breed of maternal grandsire effects, random effects were maternal grandsire (390) and dam (1930 daughters of maternal grandsires). For estimation of regression coefficients of grand progeny weaning weight on maternal grandsire EPD for weaning weight and milk, random effects of both maternal grandsire and dam (daughter of MGS) were dropped from the model.

Adjustment of MARC Solutions

The calculations of across-breed adjustment factors rely on solutions for breed of sire or maternal grandsire from records at MARC and on within-breed EPDs. The records from MARC are not included in within-breed EPD calculations.

The basic calculations for BWT, WWT, and YWT are as follows:

MARC breed of sire solution adjusted for genetic trend:

$$M_i = MARC(i) + b[EPD(i)_{1998} - EPD(i)_{MARC}]$$

Breed table factor to add to EPD for bull of breed i:

$A_i = (M_i - M_x) - (EPD(i)_{1998} - EPD(x)_{1998})$

where,

MARC(i) is solution from mixed model equations with MARC data for sire breed i,

$EPD(i)_{1998}$ is the average within-breed EPD for breed i for animals born in the base year (1998),

$EPD(i)_{MARC}$ is the weighted (by number of progeny at MARC)

average of EPD of bulls of breed i having progeny with records at MARC,

b is the pooled coefficient of regression of progeny performance at MARC on EPD of sire (for 2000: 1.05, .83, and 1.17 for BWT, WWT, YWT),

i denotes breed i, and

x denotes the base breed x, which is Angus in this report.

The calculations to arrive at the Breed Table Factor for milk are more complicated because of the need to separate the direct effect of the maternal grandsire breed from the maternal (milk) effect of the breed.

MARC breed of maternal grandsire solution for WWT adjusted for genetic trend:

$$MWWT(i) = MARC(i)_{MGS} + b_{wwt}[EPD(i)_{98WWT} - EPD(i)_{MARCWWT}] + b_{MLK}[EPD(i)_{98MLK} - EPD(i)_{MARCMLK}]$$

MARC breed of maternal grandsire solution adjusted for genetic trend and direct genetic effect:

$$MILK(i) = [MWWT(i) - .5\ M(i)] - [\overline{MWWT} - .5\ \overline{M}]$$

Breed table factor to add to EPD for MILK for bull of breed i:

$$A_i = [MILK(i) - MILK(x)] - [EPD(i)_{98MLK} - EPD(i)_{MARCMLK}]$$

where,

$MARC(i)_{MGS}$ is solution from mixed model equations with MARC data for MGS breed i for WWT,

$EPD(i)_{98WWT}$ is the average within-breed EPD for WWT for breed i for animals born in 1998,

$EPD(i)_{MARCWWT}$ is the weighted (by number of grand progeny at MARC) average of EPD for WWT of MGS of breed i having grand progeny with records at MARC,

$EPD(i)_{98MLK}$ is the average within-breed EPD for MILK for breed i for animals born in 1998,

$EPD(i)_{MARCMLK}$ is the weighted (by number of grand progeny at MARC) average of EPD for MILK of MGS of breed i having grand progeny with records at MARC,

b_{WWT}, b_{MLK} are the coefficients of regression of performance of MARC grand progeny on MGS EPD for WWT and MILK (for 2000: .52 and 1.07),

$M(i) = M_i$ is the MARC breed of sire solution from the first analysis for WWT direct breed effect of sire adjusted for genetic trend,

$\overline{MWWT}$ and $\overline{M}$ are unneeded constants corresponding to unweighted averages of MWWT(i) and M(i) for i = 1,..., n, the number of sire (maternal grandsire) breeds included in the analysis.

Results

Tables 1, 2, and 3 (for BWT, WWT and YWT) summarize the data from, and results of, MARC analyses to estimate breed of sire differences and the adjustments to the breed of sire effects to a 1998 base. The last column of each table corresponds to the "breed table" factor for that trait. The number of MARC bulls and number of progeny were unchanged for only 6 of the 14 breeds. The most new information in many years was available for the 2000 analyses mostly from progeny of Hereford (8), Angus (14), Simmental (13), Limousin (16), Charolais (4) and Gelbvieh (15), bulls first used in 1998. Three new (used in 1972) Maine-Anjou bulls were also included with 44 progeny. Angus did not report EPD for 7 low accuracy bulls previously reported with 131 progeny at MARC. Similarly, the Charolais data did not include 11 low accuracy bulls previously used in direct comparison with other breeds at MARC.

Results for birth weight (Table 1) reflect only direct breed effects, as opposed to weaning weight which includes direct breed effects (Table 2) and maternal (MILK) breed effects (Table 4). Maternal breed effects can have a significant influence on birth weight. The most notable instances involve birth weight of Bos indicus (e.g., Brahman) or Bos indicus influenced breeds. For example, calves with Bos taurus breed dams (e.g., Angus or Hereford) by Brahman sires are about 11 lb heavier at birth (i.e., Table 1, column [6]) than calves by Angus and Hereford sires. However, as a breed of dam, progeny of F1 cross females by Brahman sires were 10.3 lb lighter than progeny of reciprocal cross Angus X Hereford females. Thus, in rotational crossing systems or composite populations involving Bos indicus and Bos taurus breeds, increased birth weight due to direct Brahman breed effects are virtually offset by maternal breed effects reducing birth weight This offsetting effect of Brahman cross dams can not be considered in the across breed adjustment in Table 1 because maternal effects are not considered in genetic evaluations for birth weight. Consideration of maternal genetic effects on birth weight may not be as important for estimation of within breed EPDs as for across breed EPDs, but their estimation would help to more accurately estimate across breed EPDs involving Bos indicus and Bos taurus breeds and crosses.

Breed differences adjusted to a common base year depend primarily on three factors. Thus, any change in table values from year to year will depend on changes in those factors: 1) base year average EPD for each breed, 2) corresponding weighted EPD for bulls used at MARC, and 3) the head-to-head comparison of progeny at MARC of those bulls (breed of sire differences). For the table factor used to adjust to a common breed basis, the base year mean EPD for the base breed is used (average EPD for Angus born in 1998).

For birth weight, most of the changes in adjusted breed differences (column 7) were generally less than .5 lb except for Maine-Anjou (1.1 lb). The difference between the adjusted Angus and Red Angus means was less than the difference between Angus and any other breeds, 1.7 lb. The factors (column 8) which allow adjustment of EPD to an Angus base were mostly similar to 1999 except for Maine-Anjou which added progeny of three 1972 bulls and for Limousin which added 16 bulls and 111 progeny.

For weaning weight, differences in adjusted breed means were generally similar in 2000 to those from last year. The largest changes were for South Devon (from –1.1 to 8.5 lb), Simmental (from 26.0 to 32.1) and Maine-Anjou (from 13.3 in 1999 to 8.6 in 2000). The South Devon change was due primarily to an increase in difference between the base year breed EPD and weighted EPD of bulls used at MARC (7.5 to -.3 in 1999 and 13.1 to .0 lb in 2000). The MARC EPDs changed little but the yearly breed EPD increased from 7.5 to 13.1 lb. The Maine-Anjou change was largely due to a change in difference between breed mean EPD and weighted EPD for MARC bulls (2.3 – 1.5 lb in 1999 and 5.7 – 10.2 lb in 2000). The Simmental change was not due to the difference between base year mean EPD and EPD of MARC bulls (37.3 – 20.2 lb in 1999 and 36.7 – 19.9 in 2000) but seems due to the head to head difference at MARC increasing by 4.1 lb from 1999 to 2000. Both Angus and Simmental had more than a dozen new bulls represented in 2000. The table factors changed most from 1999 for those 3 breeds of sire. Other changes were 2 to 4 lb or less.

For yearling weight, the adjusted breed means changed more than for BWT and WWT. South Devon had the largest change due mostly to an increase in the difference between base year mean EPD and mean EPD of the South Devon bulls at MARC (18.2 vs .0 in 2000 and 10.4 vs -.1 in 1999). The Maine-Anjou difference between base year mean and MARC EPD decreased considerably (3.7 vs 2.8 lb in 1999 and 20.9 vs 32.2 lb in 2000). The Gelbvieh change from 14.9 in 1999 to 4.3 in 2000 seems due to the change in head to head difference from Angus from 17.4 in 1999 to 23.2 in 2000 and the change in difference between mean breed EPD for 1998 and the weighted mean of MARC bulls (58.0 vs 42.3 in 1999 and 62.0 vs 48.3 in 2000). The Salers change from 2.7 lb in 1999 to 12.3 lb in 2000 seems due to both of these factors (head to head of 24.1 in 1999 and 18.5 in 2000) and change in difference of mean base year EPD and MARC EPD of 10.9 vs 11.3 lb in 1999 and 18.9 vs 11.7 lb in 2000. Changes in table factor were substantial for only three breeds vs South Devon, Simmental, and Maine-Anjou. For many of the other breeds, the table factor relative to Angus tended to increase, continuing a trend of several years: 1997 to 1998, 1998 to 1999, and 1999 to 2000. That appears due to the weighted average EPD of Angus bulls at MARC becoming more similar to the base year mean EPD (50.9 vs 27.3 lb in 1998, 53.3 vs 35.4 in 1999 and 55.0 vs 42.4 in the 2000 analyses).

Table 4 summarizes the calculations for the table adjustment for MILK EPDs. Because daughters of the MGS are still producing calves and some bulls were reported for the first time, some new grand progeny had records; 120 more Hereford, 35 fewer Angus, 103 more Brahman, and 209 fewer Charolais grand progeny (due to loss of 11 low accuracy bulls) and 130 grand progeny of the 3 newly reported Maine-Anjou bulls used in 1972. Changes in 2000 compared to 1999 were less than 4 lb with most from 0 to 2 lb except for Gelbvieh which had a major change in the base.

Table 5 summarizes the average BIF accuracy for bulls with progeny at MARC weighted appropriately by number of progeny or grand progeny. South Devon bulls had relatively small accuracy for all traits as did Brahman and Maine-Anjou bulls. Table 6 reports the estimates of variance components from the records that were used in the mixed model equations to obtain breed of sire and breed of MGS solutions. Neither Table 5 nor Table 6 changed much from the 1999 report.

Table 7 updates the coefficients of regression of records of MARC progeny on sire EPD for BWT, WWT and YWT which have theoretical expected values of 1.00. The standard errors of the specific breed regression coefficients are large relative to the regression coefficients. Large differences from the theoretical regressions, however, may indicate problems with genetic evaluations, identification, or sampling.

The regressions by sex for YWT EPD changed in 1998 so that the female regression (1.13) was smaller than the male regression (1.23) whereas in 1997 the reverse was found (1.29 and 1.19). For YWT in 1999, the female regression decreased to 1.02 and the male regression increased to 1.32 which are similar to the .98 and 1.35 in the year 2000 analysis. This pattern of the regression coefficients by sex changing over years has not yet been explained. The change in 1998 was thought to be due to joint adjustment of records for sex, age of dam and dam breed.

The coefficients of regression of records of grand progeny on MGS EPD for WWT and MILK are shown in Table 8. Several sire (MGS) breeds have regression coefficients considerably different from the theoretical expected values of .50 for WWT and 1.00 for MILK. The standard errors for the regression coefficients by breed are large except for Angus and Hereford. The standard errors for regression coefficients associated with heifers and steers overlap for milk EPD.

Prediction Error Variances of Across-Breed EPD

The standard errors of differences in the solutions for breed of sire and breed of MGS differences from the MARC records can be adjusted by theoretical approximations to obtain variances of adjusted breed differences (Van Vleck, 1994: Van Vleck and Cundiff, 1994). These variances of estimated breed differences can be added to prediction error variances of within-breed EPDs to obtain prediction error variances

(PEV) or equivalently standard errors of prediction (SEP) for across-breed EPDs (Van Vleck and Cundiff 1994, 1995). The variances of adjusted breed differences are given in the upper triangular part of Table 9 for BWT, lower triangular part of Table 9 for YWT, upper triangular part of Table 10 for direct WWT, and lower triangular part of Table 10 for MILK. How to use these to calculate standard errors of prediction for expected progeny differences of pairs of bulls of the same or different breeds was discussed in the 1995 BIF proceedings (Van Vleck and Cundiff, 1995).

Even though the variances of estimates of adjusted breed differences look large, especially for YWT and MILK, they generally contribute a relatively small amount to standard errors of predicted differences. For example, suppose for WWT a Salers bull has an EPD of 15.0 with prediction error variance of 75 and a Hereford bull has an EPD of 30.0 with PEV of 50. The difference in predicted progeny performance is (Salers adjustment + Salers bull's EPD) - (Hereford adjustment + Hereford bull's EPD):

$$(33.0 + 15.0) - (3.6 + 30.0) = 48.0 - 33.6 = 14.4.$$

The prediction error variance for this difference is (use the 21.3 in the upper part of Table 10 at intersection of row for HE and column for SA):

V(Salers breed - Hereford breed) + PEV(Salers bull) + PEV(Hereford bull):

$$21.3 + 75 + 50 = 146.3$$

with

standard error of prediction $\sqrt{146.3} = 12.1$.

If the difference between the Salers and Hereford breeds in 1998 could be estimated perfectly, the variance of the estimate of the breed difference would be 0 and the standard error of prediction between the two bulls would be:

$\sqrt{0 + 75 + 50} = 11.2$ which is only slightly smaller than 12.1.

Implications

Bulls of different breeds can be compared on a common EPD scale by adding the appropriate table factor to expected progeny differences (EPDs) produced in the most recent genetic evaluations for each of the 14 breeds. The AB-EPDs are most useful to commercial producers purchasing bulls of two or more breeds to use in systematic crossbreeding programs. Uniformity in AB-EPDs should be emphasized for rotational crossing. Divergence in AB-EPDs for direct weaning weight and yearling weight should be emphasized in selection of bulls for terminal crossing. Divergence favoring lighter birth weight may be helpful in selection of bulls for use on first calf heifers. Accuracy of AB-EPDs depend primarily upon the accuracy of the within-breed EPDs of individual bulls being compared.

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Table 1. Breed of sire solutions from MARC, mean breed and MARC EPDs used to adjust for genetic trend to 1998 base and factors to adjust within breed EPDs to Angus equivalent - BIRTH WEIGHT (lb)

	Number		Raw MARC Mean	Ave. Base EPD		Breed Soln at MARC		Adjust to 1998 Base		Factor to adjust EPD to Angus
				Breed 1998	MARC Bulls	+ Ang	vs Ang	+ Ang	vs Ang	
Breed	Sires	Progeny	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Hereford	91	1197	87	3.7	2.7	91	4.8	92	5.7	4.6
Angus	86	857	86	2.6	2.5	86	.0	86	.0	.0
Shorthorn	25	181	87	1.8	.9	93	7.1	94	7.9	8.7
South Devon	15	153	80	.1	-.2	92	5.6	92	5.7	8.2
Brahman	40	589	98	1.7	.7	99	12.7	100	13.6	14.5
Simmental	41	517	86	3.2	2.8	94	8.1	95	8.4	7.8
Limousin	36	498	82	1.4	-.5	90	4.1	92	6.0	7.2
Charolais	67	563	89	1.8	.8	96	10.3	97	11.2	12.0
Maine-Anjou	18	218	94	2.2	4.7	98	11.5	95	8.7	9.1
Gelbvieh	41	489	89	1.7	.7	92	5.9	93	6.9	7.8
Pinzgauer	16	435	84	-.1	-.4	92	6.1	92	6.3	9.0
Tarentaise	7	199	80	2.4	1.8	90	4.4	91	4.9	5.1
Salers	27	189	85	1.2	1.4	92	5.6	91	5.3	6.7
Red Angus	16	105	84	.6	-1.2	86	.0	88	1.7	3.7

Calculations:
(4) = (5) + (1, Angus)
(6) = (4) + b[(2) - (3)] with b = 1.05
(7) = (6) - (6, Angus)
(8) = (7) - (7, Angus) - [(2) - (2, Angus)]

Table 2. Breed of sire solutions from MARC, mean breed and MARC EPDs used to adjust for genetic trend to 1998 base and factors to adjust within breed EPDs to Angus equivalent - WEANING WEIGHT (lb)

Breed	Number Sires	Number Progeny	Raw MARC Mean (1)	Ave. Base EPD Breed 1998 (2)	Ave. Base EPD MARC Bulls (3)	Breed Soln at MARC + Ang (4)	Breed Soln at MARC vs Ang (5)	Adjust to 1998 Base + Ang (6)	Adjust to 1998 Base vs Ang (7)	Factor to adjust EPD to Angus (8)
Hereford	90	1092	513	31.9	20.2	498	1.9	508	5.5	3.6
Angus	87	776	496	30.0	22.7	496	.0	502	.0	.0
Shorthorn	25	170	521	11.9	7.0	511	15.4	515	13.4	31.5
South Devon	15	134	443	13.1	.0	500	3.7	511	8.5	25.4
Brahman	40	509	532	12.4	4.8	517	20.9	523	21.2	38.8
Simmental	40	460	485	36.7	19.9	520	24.2	534	32.1	25.4
Limousin	36	444	461	10.1	-2.8	501	5.1	512	9.8	29.7
Charolais	66	490	500	13.2	4.2	523	26.6	530	28.0	44.8
Maine-Anjou	18	197	459	5.7	10.2	514	18.4	511	8.6	32.9
Gelbvieh	41	456	494	34.0	27.1	517	20.9	523	20.6	16.6
Pinzgauer	16	415	478	.6	-4.1	500	4.0	504	1.8	31.2
Tarentaise	7	191	476	11.3	-4.8	503	7.2	517	14.5	33.2
Salers	27	176	525	11.5	7.1	513	16.9	517	14.5	33.0
Red Angus	16	100	523	24.5	24.6	503	7.4	503	1.2	6.7

Calculations:

(4) = (5) + (1, Angus)

(6) = (4) + b[(2) - (3)] with b = .83

(7) = (6) - (6, Angus)

(8) = (7) - (7, Angus) - [(2) - (2, Angus)]

Table 3. Breed of sire solutions from MARC, mean breed and MARC EPDs used to adjust for genetic trend to 1998 base and factors to adjust within breed EPDs to Angus equivalent - YEARLING WEIGHT (lb)

Breed	Number Sires	Number Progeny	Raw MARC Mean (1)	Mean EPD Breed 1997 (2)	Mean EPD MARC Bulls (3)	Breed Soln at MARC + Ang (4)	Breed Soln at MARC vs Ang (5)	Adjust to 1998 Base + Ang (6)	Adjust to 1998 Base vs Ang (7)	Factor to adjust EPD to Angus (8)
Hereford	90	1016	865	53.6	34.4	857	-6.9	879	.8	2.2
Angus	87	728	864	55.0	42.4	864	.0	879	.0	.0
Shorthorn	25	168	918	18.1	13.9	887	22.7	892	13.0	49.9
South Devon	15	134	744	18.2	.0	872	8.1	893	14.7	51.5
Brahman	40	438	838	20.9	8.3	834	-29.7	849	-29.6	4.5
Simmental	40	424	829	59.5	32.2	891	27.5	923	44.7	40.2
Limousin	36	439	783	18.9	-2.2	852	-11.5	877	-1.5	34.6
Charolais	66	457	873	22.8	8.0	903	38.6	920	41.2	73.4
Maine-Anjou	18	196	787	20.9	32.2	887	23.2	874	-4.7	29.4
Gelbvieh	41	454	838	62.0	48.3	867	3.0	883	4.3	-2.7
Pinzgauer	16	347	838	.7	-8.0	849	-15.0	859	-19.5	34.8
Tarentaise	7	189	807	20.7	-4.1	841	-23.0	870	-8.7	25.6
Salers	27	173	899	18.9	11.7	882	18.5	891	12.3	48.4
Red Angus	16	100	943	40.3	42.1	879	15.1	877	-1.7	13.0

Calculations:
(4) = (5) + (1, Angus)
(6) = (4) + b[(2) - (3)] with b = 1.17
(7) = (6) - (6, Angus)
(8) = (7) - (7, Angus) - [(2) - (2, Angus)]

Table 4. Breed of maternal grandsire solutions from MARC, mean breed and MARC EPDs used to adjust for genetic trend to 1998 base and factors to adjust within-breed EPDs to Angus equivalent - MILK (lb)

					Mean EPD				Breed Soln		Adjust to 1998 Base			Factor to adjust MILK EPD to Angus
				Raw MARC Mean	Breed		MARC		at MARC MWWT		MWWT		MILK	
Breed	Sr	Number Gpr	Daughters	(1)	WWT (2)	MILK (3)	WWT (4)	MILK (5)	+ Ang (6)	vs Ang (7)	+ Ang (8)	vs Ang (9)	(10)	(11)
Hereford	66	1555	372	475	31.9	10.5	14.8	1.3	475	-14.8	494	-10.7	-17.7	-10.0
Angus	65	915	226	490	30.0	14.0	16.9	6.7	490	.0	505	.0	-4.2	.0
Shorthorn	22	251	69	527	11.9	2.6	6.9	7.2	517	26.7	514	9.8	-1.1	14.5
South Devon	14	347	69	488	13.1	.1	-.1	.4	502	12.2	509	4.2	-4.3	13.8
Brahman	40	880	216	522	12.4	6.2	4.9	2.8	528	37.9	535	30.9	16.0	28.0
Simmental	27	796	152	513	36.7	9.8	14.6	11.0	526	36.0	536	31.5	11.3	19.7
Limousin	20	764	150	477	10.1	3.1	-10.1	-.5	488	-2.0	502	-2.3	-11.4	3.7
Charolais	46	708	149	502	13.2	7.5	.4	2.3	509	18.6	521	16.3	-1.9	8.8
Maine-Anjou	17	485	86	533	5.7	8.8	10.1	8.9	518	28.2	516	11.3	2.8	12.2
Gelbvieh	25	653	143	537	34.0	18.0	24.8	15.8	525	35.3	532	27.9	13.4	13.6
Pinzgauer	15	545	133	504	.6	-1.0	-1.7	6.4	507	17.1	500	-4.2	-9.3	9.9
Tarentaise	6	341	78	513	11.3	2.0	-6.0	4.8	515	24.5	520	15.9	4.4	20.6
Salers	25	351	87	534	11.5	7.6	5.8	9.0	517	26.5	518	13.4	2.0	12.6

Calculations:

(6) = (7) + (1, Angus)

(8) = (6) + b_{WWT} [(2) - (4)] + b_{MLK} [(3) - (5)] with b_{WWT} = .52 and b_{MLK} = 1.07

(9) = (8) - (8, Angus)

(10) = [(9) - Average (9)] - .5[(7, Table 2) - Average (7, Table 2)]

(11) = [(10) - (10, Angus)] - [(3) - (3, Angus)]

Table 5. Mean weighted[a] accuracies for birth weight (BWT), weaning weight (WWT), yearling weight (YWT), maternal weaning weight (MWWT) and milk (MILK) for bulls used at MARC

Breed	BWT	WWT	YWT	MWWT	MILK
Hereford	.66	.65	.55	.63	.52
Angus	.89	.87	.83	.82	.80
Shorthorn	.81	.79	.66	.81	.77
South Devon	.37	.39	.37	.41	.42
Braham	.49	.54	.35	.54	.40
Simmental	.93	.91	.90	.97	.96
Limousin	.94	.91	.86	.95	.92
Charolais	.78	.76	.64	.76	.67
Maine-Anjou	.70	.69	.69	.69	.69
Gelbvieh	.71	.64	.58	.68	.63
Pinzgauer	.85	.68	.62	.70	.64
Tarentaise	.95	.95	.94	.95	.95
Salers	.85	.83	.74	.83	.80
Red Angus	.78	.73	.71	--	--

[a]Weighted by number of progeny at MARC for BWT, WWT, and YWT and by number of grand progeny for MWWT and MILK.

Table 6. REML estimates of variance components (lb^2) for birth weight (BWT), weaning weight (WWT), yearling weight (YWT), and maternal weaning weight (MWWT) from mixed model analyses

	Direct			Maternal
Analysis[a]	BWT	WWT	YWT	MWWT
Direct				
Sires (528) within breed (14)	12.2	150	661	
Dams (3534) within breed (3)	29.6	1004	1370	
Residual	67.4	1520	4179	
Maternal				
MGS (390) within MGS breed (13)				196
Daughters within MGS (1930)				882
Residual				1240

[a](Numbers) for weaning weight.

Table 7. Pooled regression coefficients (lb/lb) for weights at birth (BWT), 205 days (WWT), and 365 days (YWT) of F_1 progeny on sire expected progeny difference and by sire breed, dam breed, and sex of calf

	BWT	WWT	YWT
Pooled	1.05 ± .05	.83 ± .06	1.17 ± .06
Sire breed			
Hereford	1.10 ± .09	.81 ± .09	1.14 ± .08
Angus	.88 ± .14	.61 ± .13	1.14 ± .11
Shorthorn	.83 ± .48	.75 ± .43	1.07 ± .34
South Devon	1.04 ± .55	-.31 ± .38	-.18 ± .44
Brahman	1.79 ± .26	1.13 ± .27	.77 ± .25
Simmental	1.26 ± .28	1.00 ± .18	1.16 ± .18
Limousin	.78 ± .20	.58 ± .18	1.19 ± .17
Charolais	1.01 ± .16	.94 ± .19	1.18 ± .17
Maine-Anjou	.71 ± .40	.52 ± .44	.50 ± .48
Gelbvieh	1.03 ± .19	.95 ± .32	.94 ± .25
Pinzgauer	1.26 ± .17	1.50 ± .21	1.66 ± .17
Tarentaise	.83 ± .90	.69 ± .53	1.30 ± .60
Salers	1.16 ± .39	.93 ± .52	1.05 ± .51
Red Angus	.47 ± .29	1.13 ± .49	1.48 ± .45
Dam breed			
Hereford	1.04 ± .10	.76 ± .10	1.08 ± .09
Angus	1.14 ± .07	.87 ± .08	1.19 ± .07
MARC III	.90 ± .10	.81 ± .12	1.22 ± .11
Sex of calf			
Female	1.08 ± .07	.97 ± .08	.98 ± .07
Male	1.02 ± .07	.68 ± .08	1.35 ±. 07

Table 8. Pooled regression coefficients (lb/lb) for progeny performance on maternal grandsire EPD for weaning weight (MWWT) and milk (MILK) and by breed of maternal grandsire, breed of maternal grandam, and sex of calf

Type of regression	MWWT	MILK
Pooled	.52 ± .05	1.07 ± .08
Breed of maternal grandsire		
Hereford	.56 ± .08	.86 ± .12
Angus	.64 ± .12	.99 ± .18
Shorthorn	.32 ± .35	.64 ± .44
South Devon	.27 ± .26	-1.08 ± .87
Brahman	.47 ± .21	.69 ± .37
Simmental	.61 ± .24	1.10 ± .62
Limousin	.66 ± .35	2.52 ± .35
Charolais	.26 ± .17	1.52 ± .27
Maine-Anjou	-.02 ± .30	.11 ± .33
Gelbvieh	.49 ± .30	1.27 ± .36
Pinzgauer	.69 ± .19	.42 ± .58
Tarentaise	.19 ± .58	.82 ± .75
Salers	1.00 ± .35	2.71 ± .39
Breed of maternal grandma		
Hereford	.41 ± .08	1.41 ± .13
Angus	.63 ± .06	.94 ± .10
MARC III	.39 ± .11	.84 ± .17
Sex of calf		
Female	.54 ± .06	1.08 ± .10
Male	.50 ± .06	1.06 ± .10

Table 9. Variances (lb^2) of adjusted breed differences to add to sum of within breed prediction error variances to obtain variance of differences of across breed EPDs for bulls of two different breeds[a]. Birth weight above diagonal and yearling weight below diagonal

Breed	HE	AN	SH	SD	BR	SI	LI	CH	MA	GE	PI	TA	SA	RA
HE	.0	.3	1.0	1.6	.5	.8	.8	.6	1.3	.7	.9	2.7	.9	1.6
AN	23.	.0	1.0	1.6	.6	.8	.8	.6	1.4	.7	1.0	2.8	1.0	1.7
SH	64.	67.	.0	2.2	1.3	1.4	1.5	1.1	1.9	1.2	1.4	3.4	1.1	2.3
SD	99.	101.	141.	.0	2.0	1.5	1.5	1.5	2.5	1.9	2.2	4.0	2.2	2.7
BR	40.	41.	90.	127.	.0	1.1	1.2	.9	1.6	1.0	1.0	2.8	1.3	2.0
SI	47.	50.	91.	89.	75.	.0	.8	.7	1.7	1.0	1.4	3.2	1.4	1.8
LI	49.	52.	93.	94.	77.	45.	.0	.7	1.7	1.0	1.4	3.3	1.4	1.7
CH	37.	40.	71.	91.	64.	42.	45.	.0	1.5	.8	1.1	3.0	1.0	1.7
MA	83.	87.	121.	158.	106.	107.	109.	97.	.0	1.2	1.7	3.6	1.8	2.6
GE	43.	47.	76.	117.	68.	62.	63.	51.	76.	.0	1.2	3.1	1.1	1.8
PI	59.	64.	94.	139.	70.	88.	90.	74.	113.	75.	.0	2.8	1.4	2.3
TA	162.	167.	205.	242.	168.	192.	194.	181.	216.	182.	165.	.0	3.3	4.1
SA	60.	64.	74.	137.	87.	87.	90.	68.	117.	73.	91.	201.	.0	2.3
RA	100.	103.	144.	166.	129.	105.	104.	102.	161.	108.	143.	248.	141.	.0

[a]For example, a Hereford bull has within breed PEV of 300 for YWT and that for a Shorthorn bull is 200. Then the PEV for the difference in EPDs for the two bulls is 64 + 300 + 200 = 564 with SEP = 23.7.

Table 10. Variances (lb^2) of adjusted breed differences to add to sum of within breed prediction error variances to obtain variance of difference of across breed EPDs for bulls of two different breeds. Weaning weight direct above diagonal and MILK below the diagonal

Breed	HE	AN	SH	SD	BR	SI	LI	CH	MA	GE	PI	TA	SA	RA
HE	.0	8.0	22.3	32.7	11.7	15.6	16.0	12.2	28.6	14.1	16.9	43.1	21.3	38.2
AN	24.1	.0	24.0	33.9	12.8	17.1	17.5	13.7	30.6	16.0	19.0	45.4	23.2	39.9
SH	55.5	59.2	.0	48.2	30.3	31.5	32.2	25.2	43.2	26.6	30.6	59.2	27.1	54.4
SD	70.7	73.3	105.9	.0	41.0	29.3	30.6	29.8	54.4	39.2	44.4	70.6	47.2	60.0
BR	27.5	29.6	67.9	84.0	.0	23.7	24.1	20.3	35.5	21.3	19.1	43.7	29.2	46.8
SI	51.0	53.7	86.4	66.3	64.3	.0	14.3	13.4	37.4	21.0	26.9	53.7	30.6	39.8
LI	55.1	58.0	90.6	70.7	68.4	51.2	0	14.3	37.6	20.9	27.5	54.4	31.4	39.5
CH	36.9	39.8	67.1	65.0	49.7	45.5	49.8	.0	34.0	17.4	22.9	50.1	24.4	38.7
MA	65.4	70.2	99.0	117.2	77.4	97.5	101.6	82.3	.0	25.6	37.3	63.9	42.2	59.7
GE	41.7	45.7	69.0	92.4	53.7	72.4	76.5	55.4	59.0	.0	22.9	50.8	25.8	41.2
PI	52.9	57.5	84.7	105.8	57.6	86.0	90.2	69.8	93.9	66.2	.0	42.4	30.0	50.4
TA	124.7	129.5	161.5	178.6	126.2	159.0	163.2	144.1	162.4	139.6	128.3	.0	58.3	77.2
SA	46.8	51.2	67.5	97.6	59.5	78.1	82.3	58.8	96.1	67.2	79.9	138.6	.0	53.5
RA	--	--	--	--	--	--	--	--	--	--	--	--	--	.0

METHODS FOR INTERNATIONAL COMPARISON OF SIRE EVALUATIONS

Ignacy Misztal and J. Keith Bertrand
University of Georgia

Introduction

There is a considerable interest in international evaluation of sires in beef cattle. Such a comparison would simplify the identification of best genetic material globally. While the international genetic evaluation in beef cattle is currently being conducted across at most 2 countries (Canada-USA, Australia-New Zealand), such an evaluation has become very successful on a large scale in dairy cattle. Interbull (see www.interbull.org), located in Sweden, is an international evaluation agency that currently provides dairy sire evaluations for almost 30 countries. The purpose of this paper is to review methods used in dairy cattle for international comparison of sires, and to discuss possible application of these methods in beef cattle.

International Evaluations in Dairy

Historically, the first method for international comparison was linear conversion of EPDs from exporting country to importing county based on historical data of sires evaluated in both countries. It was followed by MACE (multiple-across country evaluation), a method that evaluates sires for all countries simultaneously while considering all sire relationships. A method under study is joint data analysis for multiple environments.

Conversion

In the conversion method (Goddard, 1985; Wilmink et al., 1986), the EPD of sire i in importing country j is assumed to be a linear functions of EPD of the same sire in exporting country k:

$$EPD_{ij} = a_{ij}\, EPD_{ik} + b_{ij}$$

where coefficients a_{ij} and b_{ij} need to be estimated for each importing country i and each exporting country j.

This method assumes a genetic correlation between countries of 1.0, which is the same as assuming sires will rank identically in both countries. To apply this method, coefficients a and b need to be estimated for any two countries from EPDs of sires evaluated in both countries. However, the number of such sires may be low, and their daughters may have received preferential treatment in importing countries. Also, as such sires are likely to be be old, it may be that conversions based on older sires may not be optimal for younger sires. Also, if a sire has evaluations in many countries, only information from two countries is utilized for any pair of countries. For example, if there are strong connections between countries A and B, equally strong connections between countries B and C, and no connections between countries A and C, the conversion method cannot be utilized.

MACE

MACE (Schaeffer, 1994) involves a multi-trait model, where EPDs of each country are treated as correlated traits:

$$\mathbf{y}_{ij} = \mathbf{c}_i + \mathbf{q}_{ij}\mathbf{g}_i + \mathbf{s}_{ij} + \mathbf{e}_{ij},$$

where $\mathbf{y}_{ij}$ is the vector of de-regressed EPDs of sire j in country i, $\mathbf{c}_i$ is the vector of mean effects of country i, $\mathbf{g}_i$ is the vector of genetic merit of animals originating from country i, $\mathbf{q}_{ij}$ is the matrix that relates fractions of genes from country i in sire j, and $\mathbf{s}_{ij}$ is the vector of MACE EPD of sire j for country i.

All relationship among sires are used and genetic correlations < 1 are allowed, resulting in the following variances:

$$\text{var}(\mathbf{s}) = \mathbf{G}_0\mathbf{A}$$

where $\mathbf{G}_0$ is a variance-covariance matrix among countries, and $\mathbf{A}$ is the relationship matrix among sires.

MACE approach simultaneously utilizes all proofs from all countries. Country differences are, at least partially, accounted for, resulting in possibly different rankings of sires in each country. Also, EPDs are computed for countries that may not share any common sires provided that animals in these countries are connected through relationships.

While MACE is superior to the conversion method, it is not perfect. First it relies on EPDs and accuracies calculated separately in each country, where different evaluation methodologies are being used. Therefore, It is possible that low genetic correlations between any two countries may not be the result of true genotype by environment interactions, but they could be due to differences in evaluation methodologies used to calculate EPDs within each country. Second, the method poorly accounts for different production systems because each country is treated as a different environment regardless of size and regional differences. For example, very similar environments of Belgium and the Netherlands are treated as separate, and very different environments in the U.S. are treated as identical. In practical terms, this results in difficulties of estimating the matrix of genetic correlations, which is close to being non-positive definite for the 30 countries presently participating in Interbull. Finally, Interbull ignores female relationships, which could provide additional links, especially with increased embryo exports.

Combined Evaluation

Weigel and Rekaya (2000) proposed a combined evaluation system that would combine advantages of a standardized evaluation while allowing for differences in production systems. In their methodology, data from each herd is classified as belonging to one of several production systems based on size, production, climatological, type of pasture and other factors. Subsequently, data from each production system is regarded as a separate trait. The evaluation model is a standard model used for evaluation in dairy, upgraded to multiple traits. In the combined evaluation, each animal has multiple evaluations corresponding to each production system. It is up to the appropriate groups or agencies within each country to determine which evaluation is the most suitable one for their given conditions.

The advantage of this approach is standardization of models and a limited number of traits regardless of the number of countries participating in the international evaluation program. However, the implementation of this approach also faces a few problems. In order for the combined evaluation to succeed, national evaluation agencies must release raw data and give up control over their national evaluations. This is hard to accomplish in countries with high national pride. Because the combined evaluation will result in a much larger model than the one used in any country, most sophisticated models that are feasible computationally only in smaller countries, cannot be used. Also, the standardized model may not account for local differences as well as models used in within country national evaluation programs.

Challenges in Beef cattle

There several differences between dairy and beef cattle with regard to international evaluation. First, the number of breeds in beef cattle is much higher, and none of the breeds is dominant internationally. Also, AI is less prevalent in the beef cattle industry compared to the dairy industry. As a result, international connections are weaker for beef cattle than for dairy cattle, and methods best exploiting existing connections have to be used. Because beef traits are less standardized across countries than dairy traits, a larger number of traits may need to be defined across a larger number of production systems.

Because milk components in dairy cattle are recorded at the same time, single-trait evaluation of these components is satisfactory. Due to sequential data recording, multiple trait evaluation in beef cattle is considered mandatory. Thus, the number of traits in a combined evaluation in beef cattle can be fairly large. An additional complication in international evaluation would be inclusion of upgrading populations, which would require the use of multi-breed models (Klei et al., 1996; Sullivan et al., 1999)

Combined analysis in Beef cattle

While a multi-environment international evaluation system for beef cattle may be too complicated at present, production environments in different countries can be treated as identical if differences among them are not too large. Recently, Donoghue (2000) reviewed studies in genetic correlation within and between North and South America, and between Australia and New Zealand. While genetic correlations for weaning weight between several countries were below 1.0, they were above .80 and similar in magnitude to genetic correlations within various regions of the U.S., which currently are treated as homogeneous.

Conclusions

The methodology used in international dairy evaluation is evolving and is moving towards a combined analysis of data from all interested parties with evaluations available for several distinct production systems. In beef cattle, a combined evaluation assuming few or even one production system is likely to be the method of choice. Challenges in any evaluation system that combines data from several countries are likely to be political in nature as well as technical.

Acknowledgements

Discussions with Kent Weigel, Bert Klei and Georgios Banos are gratefully acknowledged

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PRODUCER APPLICATION COMMITTEE

CHAIRMAN: SALLY DOLEZAL

MINUTES

Producer Application Committee
BIF 2000 MEETING

The Producer Applications Committee was called to order on July 14th at 2:00 pm with 135 in attendance.

The first speaker was Kansas rancher Joe Thielen who described his ranching operation. He discussed the concern for data overload. He also said that the primary concern of the commercial cow calf man is pounds of beef sold. He said his cattle breeding and selection program was organized around 3 principles: 1) Can it be measured? 2) Is it important? and 3. Can it be influenced? He discussed that herd goals should include the cost of setting as well as achieving them. He related that he had reduced feed cost and calving difficulty by paying attention to the little things. He also related that he had raised conception rates of 2nd calf cows from 50% to 92%, and ADG in the feedyard from 2.76 to 4.0 lb/d.

The second speaker, Tom Woodward from Texas, spoke on his breeding program that uses Brahman influence cows bred to Red Angus, Braunvieh, and Simbrah bulls. He emphasized the need for retaining heterosis in the cowherd and utilizing breed effects and trying to utilize complementarily. His primary measurements are pounds of calf produced per acre and cost of pounds of calf produced. He said, "I was never a scientist but I had been through the program". He emphasized that Brahman cows will contribute longevity to a cow calf operation. The ranching operation is participating in Rancher's Renaissance and is focusing on EPDs, carcass merit, and consumer acceptability.

The third speaker was Ronnie Silcox who discussed the origin and the offerings of BIF as an organization. He described the Guidelines, factsheets, committees (standing and other), and asked for input as to where BIF needs to move in future. He passed out a survey for future topics and ideas. A total of 25 were returned.

Afterwards a general discussion was held as to the future of data collection and sources of unbiased information. Extension was cited by several as the main source of unbiased information. There was concern over university researchers taking their findings to private industry, especially when paid for by tax dollars or by grants supported by tax or Beef Checkoff dollars. Many hoped that Extension would continue to work with industry to be a conduit for information, acting as a filter one person said, to provide useful information to beef producers.

Meeting adjourned at 4:45 pm.

Respectfully
Joe Pashcal

TECHNOLOGY TRANSFER – THE ROLE OF BIF

Ronnie Silcox, The University of Georgia

Introduction

The 2000 meeting of BIF is the 32nd annual Research Symposium and Convention of the Beef Improvement Federation. In 1964, a national committee composed of people from beef breed associations, extension services, performance associations and research institutions met to develop uniform procedures for beef cattle. At a time when breed association programs were developing and state BCIAs were using a variety of different methods of reporting data, this was badly needed. Just getting everyone to agree to use 205 days for weaning weight adjustments was a difficult and controversial decision. The work of this group lead to the formation of the Beef Improvement Federation in 1968 and laid the groundwork for the publication of BIF's *Guidelines for Uniform Beef Improvement Programs* in 1970.

In the early years, BIF meetings were small, informal affairs. Over 600 people are in attendance at the 2000 meeting. Many of these are attending for the first time. The purpose of this presentation is to explain how BIF functions and what it has to offer.

Purpose of BIF

BIF has the following purposes:

To work for establishment of accurate and uniform procedures for measuring recording and assessing data concerning the performance of beef cattle which may be used by participant organizations.

To assist member organizations and/or their affiliates in developing their individual beef improvement and quality management programs consistent with the needs of their members.

To develop cooperation among all segments of the beef industry in the compilation and utilization of performance records to improve efficiency, profitability and sustainability of beef production.

To encourage the Federation's membership organizations to develop educational programs emphasizing the use and interpretation of performance data and quality management programs.

To develop the increased confidence of the beef industry in the economic potential available from performance measurement and assessment.

How BIF Works

BIF is a federation composed of member organizations. Since BIF is a federation it works differently from the associations that people are more accustomed to. Individuals are not members of BIF, but attend as representatives of member organizations. All guidelines developed by BIF are recommendations. Member organizations are under no obligation to use all or any part of BIF guidelines. Member organizations are divided as follows:

> Regular (voting) members are state, provincial, national or international organizations that are either actively conducting performance programs in beef cattle or are the certified organization designated to represent a given area. For many states and provinces these are the state BCIA or the performance committee of the state cattleman's association. Breed Associations are also regular members.
>
> Associate (non-voting) members consist of those national organizations not actively conducting performance programs as well as those public agencies that have a direct interest in beef cattle. Examples of associate members are AI organizations and other companies.
>
> Sustaining (non-voting) members include anyone who makes a contribution of $50 or more in a given year.

A board of directors directs the activities of BIF. Voting members of the board are elected by member organizations with each member organization having one vote. Six members of the board come from member breed associations. Eight producers are elected from state or provincial performance organizations with two each from East, Central and West regions and two at-large. NCBA and NAAB each appoint one voting member to the board. Non-voting, appointed members of the board including USDA, Canadian Breeds Council, regional secretaries and the Executive Director.

To address issues BIF uses working committees. These committees meet at the annual convention and anyone in attendance can participate in committee discussions. Committees change over time as new issues arise. Current committees include:

> Genetic Prediction
> Producer Applications
> Emerging Technology
> Multiple Trait Selection
> Live Animal, Carcass and Endpoint
> Whole Herd Analysis

These committees work to develop uniform procedures and guidelines for performance programs. Once a committee has developed a recommendation it is submitted for approval by the board of directors. If approved by the board, it becomes a BIF recommendation.

BIF Publications

Guidelines for Uniform Beef Improvement Programs ("BIF *Guidelines*") since it was first published in 1970 has gone through seven revisions. It is the standard reference used in North America for beef performance programs. The 7th edition of *Guidelines* was revised in 1996. Committees are beginning work on revisions for the 8th edition. Copies of *Guidelines* are available from Ronnie Silcox, Beef Improvement Federation, Animal and Dairy Science Department, Athens, GA 30602 at a cost of $15 per copy.

BIF's web page is located at www.beefimprovement.org. The Beef Improvement Federation has developed several fact sheets for producers. These fact sheets have been reproduced by several member organizations for use in local publications. The following fact sheets can be found on the web page:

Calving Difficulty in Beef Cattle
Utilizing Performance Information in Beef Judging Events
Commercial Beef Sire Selection
Understanding Performance Pedigrees
Beef Performance Glossary
Understanding and Using Sire Summaries

More fact sheets are in the process of development and will be added as they are completed.

GENETIC MANAGEMENT/ CARCASS TRAITS

Tom Woodward, Broseco Ranches

Introduction

Over the last twenty years, Broseco Ranches has made an effort to measure and improve the carcass value of retained ownership cattle. A significant change was made in the breeding program in 1983 with some modification in 1998. The initial long-range plan was designed to optimize heterosis and breed complimentarity. A demanding reproductive goal was established. It is an ongoing process to improve end product while at the same time improving production at all phases of production.

Background

Broseco Ranch is located in Northeast Texas at an elevation of 310 feet, forty-five (45) inches of rainfall and a hydrophilic soil. Winters are wet and cold and summers are hot and humid. The ranch occupies about 20,000 acres and is stocked at approximately an animal unit per 2.8 acres. Management is designed around a unit system with four cattle units and one maintenance unit. An intensive grazing system is used on about one half of the ranch and the remaining under a continuous graze system. Approximately fifteen 100+ acre traps are used for winter pasture and haying.

The mature cows are bred for sixty days (60) during June and July. The heifers are bred for forty-five days (45) from mid May until the end of June. Heifers are bred to calve at twenty-four months (24) of age and must rebreed each year to stay in the herd. Mature cows also must rebreed each year and if they fail to raise a calf after being palpated pregnant in the Fall, they are marked for culling if they fail to raise another calf.

Heifers are bred to light birth weight Red Angus Bulls. The bulls must have a birth weight EPD of –2.0 or lower and an actual birth weight of less than 80 pounds to be selected for use on heifers. An effort is also made to avoid those yearling bulls who's numbers result from a "fire and ice" mating.

All caves are weaned and preconditioned at the ranch and moved to cool season pasture or the feedlot. Most calves are retained and payment received based on carcass value. Broseco is aligned with Ranchers Renaissance, an alliance of ranchers, feeders and a packer. It is a value based system and is focused on end product value.

Genetic management

The genetic base at the beginning of 1981 was composed of cows that were two and three generation backcross to Braford bulls. Prior to infusion of the Braford, the cattle were Hereford and Angus crosses. The genetic makeup of the Braford Bulls was no more than one-fourth Brahman influence. Starting in 1980 the cows were mated to Brahman Bulls. In

1983 a three breed rotation was developed using Red Angus, Simbrah and Beefmaster. The females resulting from the Brahman cross were then mated to Red Angus, the Red Angus mated to Beefmaster, the Beefmaster mated to Simbrah and the Simbrah mated to Red Angus. The Brahman sired cows have continued to be bred to Red Angus or Braunvieh X Red Angus Bulls. The Beefmaster Bulls were eliminated from the rotation and replaced with Braunvieh Bulls for the 1999 breeding season.

Results

The following chart illustrates the results based on the trend line beginning in 1989 for a ten-year period:

	1989	1999
Out weight	1110	1140
ADG	2.6	3.0
DOF	150	160
Dry conversion	6.8	6.4
Vet costs	8.00	11.00
Hot yield	64%	64%
Choice	18%	61%
Select	80%	31%
Yg 1-2	54%	61%
Yg 4	3%	2%

The above data is based on approximately 20,000 head of cattle fed over the ten-year period.

Carcass weight calculated at 730 pounds is on target with industry demands. The ADG varies of course based on in weight, month of entry, sex, and other variables. Yearling steers will gain near 4 pounds per day when fed during optimum times. Dry conversion is a major factor in cost of gain and that has improved slightly as the growth rate of the cattle has increased. Vet costs have increased and that is primarily due to the use of more expensive implants. Dressing percent or hot yield has stayed constant. It varies with each pen of cattle and is impacted most often by management factors.

One of the objectives was to improve carcass performance while maintaining performance at the ranch, as a stocker and as a feeder. We have been successful in that effort, as our conception rates have stayed relatively stable even though the breeding season has been shortened from six months during the early 1980's to only sixty days currently.
The percentage of choice cattle has tripled during the ten-year period with a corresponding decrease in the percentage of select cattle. The next question is what has happened to yield grades and that is the "good news". There has actually been an

increase in the percentage of yield grade 1&2 and a slight decrease in the percentage of yield grade 4 cattle.

WHOLEHERD ANALYSIS COMMITTEE

CHAIRMAN: ROBERT HOUGH

MINUTES

Whole Herd Analysis Committee

BIF 2000 MEETING

2:00 p.m. Friday, July 14th

Moderator: Bob Hough

The Whole Herd Analysis Committee meeting was called to order at 2:00 p.m. during the BIF Annual meeting in Wichita, KS. After presenting an overview of Whole Herd Reporting programs for various breed associations, Bob Hough introduced the speakers and described the format of the meeting which was as follows:

Update – Whole Herd Reporting Status – An overview of the status of WHR programs with the various breed associations – Bob Hough, Red Angus Association of America

Update – Whole Herd Analysis: Reproduction – An update on the development of a heifer pregnancy rate EPD – Bruce Golden, Colorado State University

AAACUP – A non-cow inventory based model for collecting complete, unbiased contemporary group performance records – John Crouch, American Angus Association

Whole Herd Reporting and Marketing Programs – Integration of Red Angus' THR and Commercial Marketing Programs – Bilynn Schutte, Red Angus Association of America

Reshaping Breed Associations – WHR and inventory based fee structures are examples of how some breed associations have changed the way they are structured. How might we expect them to continue to evolve? – Dave Daley, California State University, Chico and Harlan Ritchie, Michigan State University

Question & Answer – John Crouch, Bilynn Schutte, Dave Daley and Harlan Ritchie

A discussion session including a speaker panel that included Russ Nugent followed the presentations. Bob Hough, Bruce Golden, Harlan Ritchie, John Crouch, and Bilynn Schutte submitted proceedings papers. After an active afternoon, Hough adjourned the committee meeting at 5:00 p.m.

Respectfully submitted,

Robert L. Hough, Chair

UPDATE – WHR Status for the Various Breed Associations

Robert L. Hough, Red Angus Association of America

A survey was conducted regarding the policies regarding Whole Herd Reporting of the 21 beef breeds, which belong to National Pedigreed Livestock Council. The 16 breed associations that responded were: Angus (AN), Beefmaster (BM), Blonde d'Aquitaine (BD), Brahman (BR), Brangus (BN), Charolais (CH), Gelbvieh (GV), Hereford (HH), Limousin (LM), Maine-Anjou (MA), Red Angus (AR), Salers (SA), Santa Gertrudis (SG), Shorthorn (SS), Simmental (SM), and Tarentaise (TA).

Breeds were grouped into one or more of the following categories with regards to their association's policy on Whole Herd Reporting:

1. Not Considering
2. Considered and Rejected
3. Considering
4. Implemented Voluntary Program
5. Implemented Program Requiring Reproductive Status Only
6. Implemented Complete System

1. Not Considering – Angus

   Comments:
   a. Encourage Complete reporting with their Angus Information Management Software (AIMS).

2. Considered and Rejected – Salers, Maine-Anjou, Santa Gertrudis, Brahman, Limousin

   Comments:
   a. Price; Cost per cow too expensive (SA, BR).
   b. Negative response from membership (MA, SA).
   c. Educational process beyond the resources of the Association (SG).
   d. Does not reward herds with high reproductive rates (SG).
   e. Confidentiality issues (LM).
   f. Administrative expense, primarily computer programming costs (LM).
   g. Two associations (SA, MA) do maintain inventory systems with no reporting requirement.

3. Considering – Limousin, Beefmaster, Blonde d'Aquitaine

   Comments:
   a. Discontinued inventory based system; return currently under review (LM)
   b. Designing system, which track heifers entering herd (LM).
   c. Will be discussed at fall Board meeting (BD).
   d. Voted to establish WHR within 3-5 years (BM).

4. Implemented Voluntary Program – Simmental, Shorthorn, Hereford

   Comments:
   a. Implemented to enhance performance record database and position database for reproductive EPDs (SI).
   b. Assessment per cow is discounted ($10 vs $13) for electronic records (SI).
   c. Discouraged that program did not grow the second year (SI).
   d. Assessment is $15.00 and requires birth, weaning, disposal or reason code (SH).
   e. Hereford is implementing WHR January 1, 2001.
   f. Breeders not participating in WHR will not receive EPDs (HH).

5. Implemented Program Requiring Reproductive Status Only - Charolais, Gelbvieh, Brangus

   Comments:
   a. Brangus does not have inventory based fee structure. Membership was significantly opposed to such a system.
   b. Gelbvieh is implementing WHR this year with a two-tiered inventory based fee.
   c. Performance data requirements are not mandatory, but encouraged (BR, CH).

6. Implemented WHR with inventory based fee structure, and mandatory reporting of production and performance data – Tarentaise, Red Angus

   Comments:
   a. Tarentaise are requiring BW and WW, while Red Angus requires birth date and WW. In absence of calf records, disposal or reason codes are required.
   b. Fee includes a free transfer of one calf (TA, AR).
   c. Include costly re-activation fee (RA), or stair-step late penalty (TA).
   d. Implemented a series of "data filters" that removes questionable data prior to genetic predictions (AR).
   e. Generated heifer exposure inventories (AR).

HEIFER PREGNANCY EPD: AN ECONOMICALLY RELAVANT TRAIT FOR IMPROVING HEIFER FERTILITY

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In the late 1970's and early 1980's researchers concluded that selecting bulls with larger scrotal circumference measurements would improve fertility in daughters of these bulls when bred to calve at two years of age. This inference was based on compelling research that showed a very strong relationship between the age when these daughters reached puberty and the scrotal circumference of their sires. Obviously, if puberty is not reached prior to or during a heifer's first breeding season she will not conceive.

Scrotal circumference is called an indicator trait because it indicates the potential genetic merit for a completely different trait that the breeder wants to improve: pregnancy in heifers. Measuring indicator traits to make improvement in other traits is a common breeding technique. For example, we use birth weight to improve calving difficulty, mature weight to decrease maintenance feed consumption of cows, and rib-eye area to improve carcass yield.

The trait that we are trying to improve by measuring an indicator trait is called an economically relevant trait. Heifer pregnancy is the trait that directly affects profitability and is the economically relevant trait that scrotal circumference indicates.

When using phenotypic selection, the selection decisions are often made based on the value of indicator traits. This has been especially true in the case of scrotal circumference and heifer fertility for several reasons. Because most selection progress occurs by selecting bulls, scrotal circumference is something that can be phenotypically measured on young bulls. Also, observed heifer pregnancy rate tends to have a low heritability. This makes it very difficult to accurately select among older bulls by looking at the pregnancy rates of their daughters. The biggest problem with using phenotypic selection on an indicator trait such as scrotal circumference is that the indicator trait's measurement will always be a very low accuracy prediction of the genetic merit of the economically relevant trait.

EPDs were developed as a method to increase the accuracy of predicting genetic merit. Using EPDs instead of phenotypic selection will always be higher accuracy. However, it turns out that using the EPD for an indicator trait in a selection decision can actually reduce the accuracy of a selection decision for improving an economically relevant trait. This is especially true if the EPD for the economically relevant trait is available. EPDs for economically relevant traits are the most accurate selection tool for improving those traits.

The stayability EPD is an example of the implementation of this principle. Stayability EPDs are mostly a prediction of the ability of the daughters of a sire to conceive and produce calves as mature females. This is an economically relevant trait. Stayability is directly associated with costs and returns in a cow calf operation.

Research conducted at Colorado State University shows that female fertility can be thought of as two different traits: fertility in mature females and fertility in first calf heifers. This is because many of the genes for female fertility that are described by stayability are very different then the genes that affect fertility in first calf heifers that are bred to calve as two-year-olds. Because of this, and because a scrotal circumference EPD would violate the principle of using economically relevant traits, in 1995 the Colorado State University Center for Genetic Evaluation of Livestock began a project to develop an EPD for heifer pregnancy. After the initial prototypes were developed, in 1998 a collaborative effort between the Red Angus Association of America (RAAA) and the Colorado State University Center for Genetic Evaluation of Livestock was initiated to develop heifer pregnancy EPDs for Red Angus cattle as part of the RAAA's program to institute economically relevant trait EPDs.

This article describes the results of the first prototype RAAA heifer pregnancy EPD. Here we explain the meaning of the EPD, the procedures we used to develop them, and the relationships we discovered between scrotal circumference, yearling weight and heifer pregnancy in the RAAA data.

Because the RAAA uses a Total Herd Reporting (THR) performance recording system we had a unique opportunity to generate a large amount of data very quickly to develop the heifer pregnancy EPDs. THR is a very powerful tool that gives a breed association a substantial advantage over other breed associations, where selective reporting occurs. One of these advantages is the ability to produce female fertility EPDs because breeders provided information about the disposition of all breeding females and calves.

The THR data was supplemented with historical heifer exposure data (pre THR), which was solicited from breeders' personal databases. A total of 10,310 records on pregnancy status of heifers exposed to breeding were provided to the RAAA for this analysis. To first determine the relationship between heifer pregnancy, scrotal circumference, and yearling weight, only data that came from breeding seasons shorter than ninety-days and bred to calve as two-year-olds were used. Ninety days was identified as the typical maximum optimal breeding season for most commercial cow-calf production situations. The vast majority of the data with identified start and end dates for breeding season was less than ninety days. The data came from heifers born in 1989 through 1998. The average conception rate in these data was 83 percent.

Besides the fact that a THR performance records system is required to produce female fertility EPDs, pregnancy data presents unique analytical problems. This is because it is observed in categories (i.e., pregnant or open) unlike traditional traits for which we have EPDs such as birth weight or yearling weight. To account for this we used special analytical techniques called threshold models.

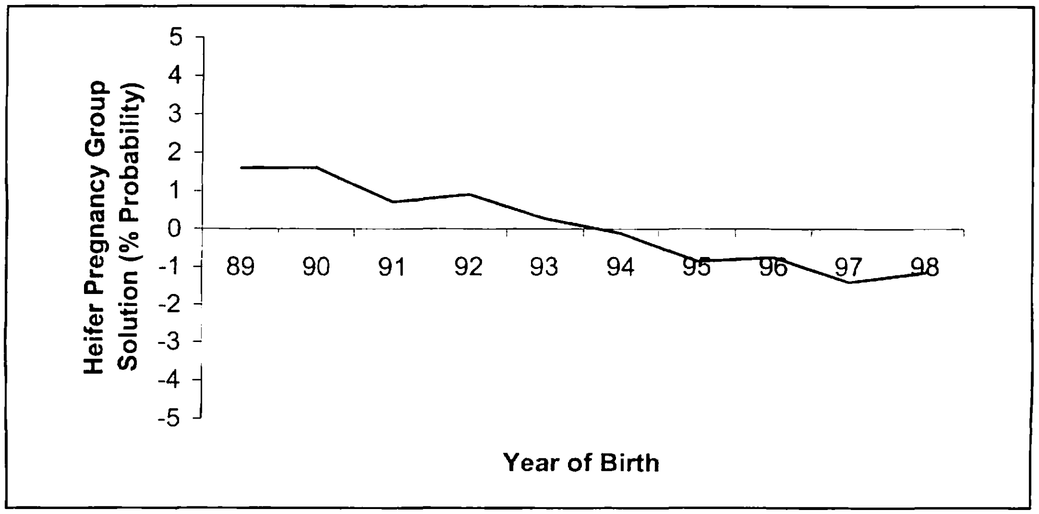
In the past, researchers used traditional analytical methods for analyzing pregnancy data. But these traditional methods did not adequately account for the unique properties of categorical information. Using these inappropriate methods led to the belief that female fertility is a lowly heritable trait. However, results from this study and three other studies of heifer pregnancy data have shown us that when more appropriate analytical techniques are used, the heritability of heifer pregnancy is higher than previously thought. The potential for pregnancy in heifers is as heritable as most growth traits such as weaning weight and yearling weight.

The heritability value for heifer pregnancy we obtained from the RAAA data was 27 percent. This means that 27 percent of the differences in ability to conceive were due to genetic potential for fertility. This is a moderately heritable trait and is in the same range of heritability as weaning weight in Red Angus, which is 23 percent heritable and yearling weight, which is 28 percent heritable.

After we obtained the heritability estimate, we produced the first prototype EPDs. Like the stayability EPD, the heifer pregnancy EPD is on the percent probability scale. For example, the daughters from a bull with a +10 heifer pregnancy EPD will have a 10 percent higher probability of conceiving as a first calf heifer calving for the first time at two-years of age, than the daughters from a bull with a zero EPD.

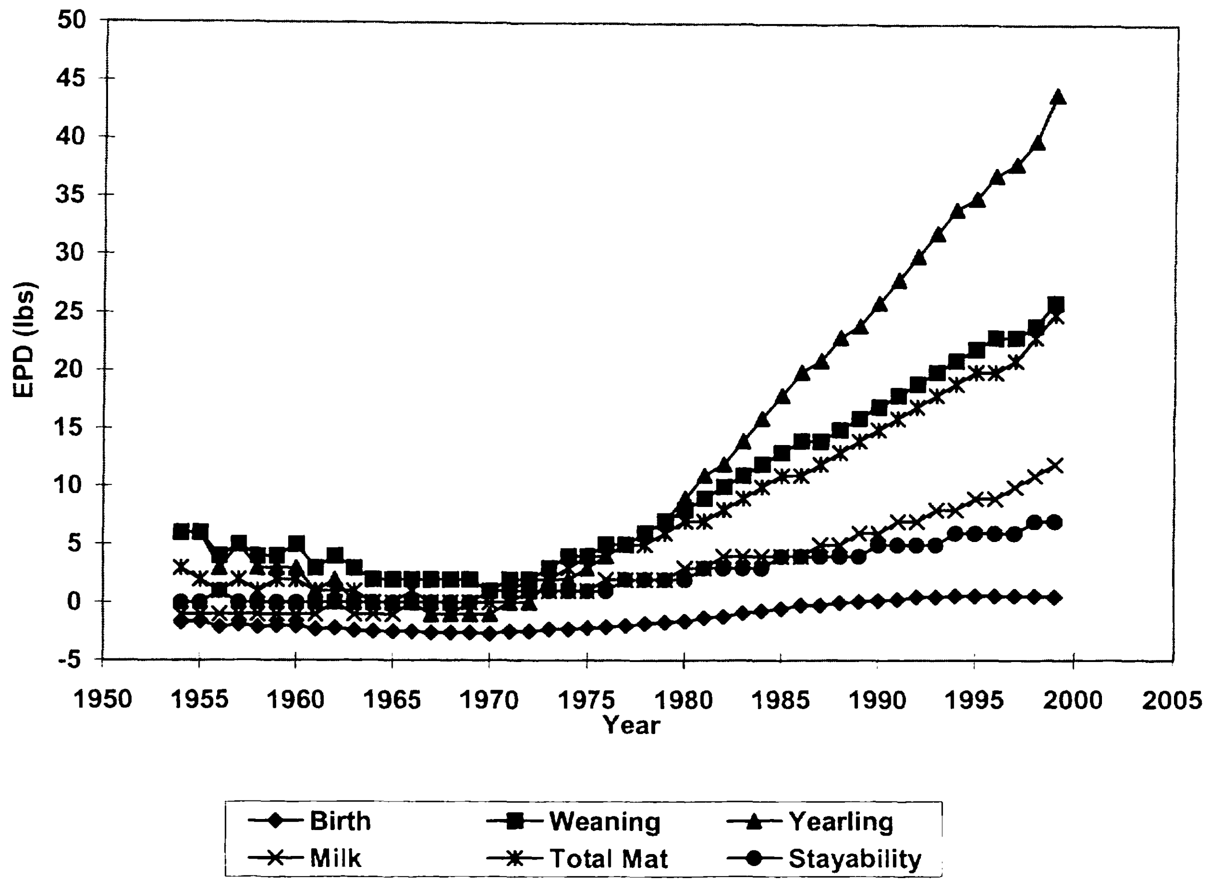
From these prototypes we plotted the genetic trend for heifer pregnancy. As you can see from Figure 1, the genetic trend indicates that RAAA may have a decrease in the genetic potential for females to become pregnant as first calf heifers. This decreasing trend indicates that heifers born in 1998 had 3% less genetic potential to conceive to calve as two-year-olds than heifers born in 1989. In order for breeders to maintain high conception rates they would have had to feed the 1998 born heifers more than the 1989 born heifers.

Figure 1. Genetic Trend of Heifer Pregnancy



To find an explanation for this decreasing genetic potential for heifer pregnancy we first looked at the relationship between heifer pregnancy and yearling weight. Figure 2 shows the EPD trends in the growth traits published in the RAAA sire summary. As you can see from the yearling weight EPD trend Red Angus breeders have made very large increases in yearling weight by selection.

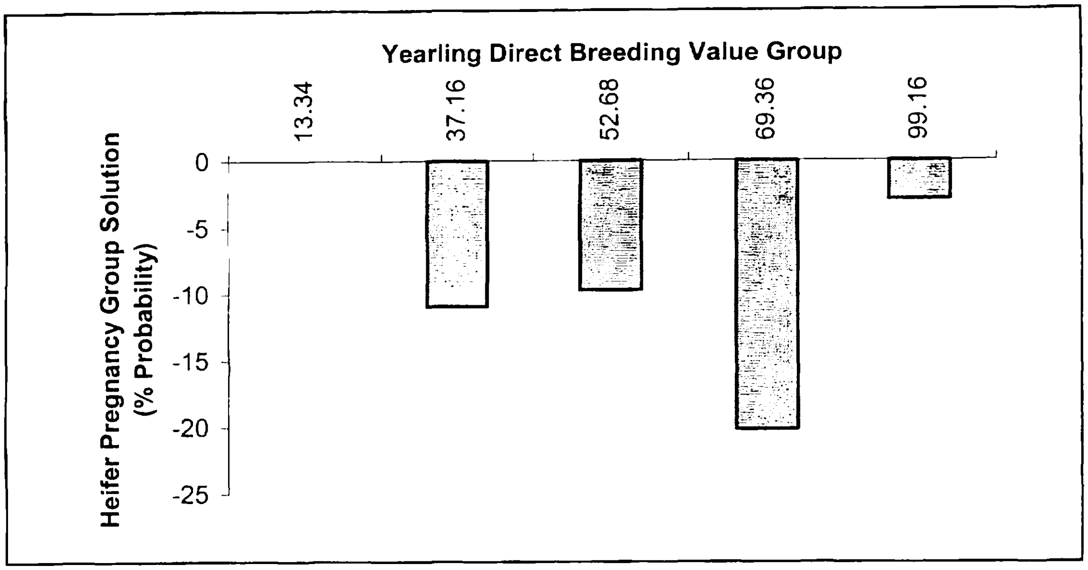
Figure 2. Historical Genetic Trends



To understand the relationship between heifer pregnancy and growth (yearling weight), we analyzed the heifer pregnancy data again, this time including additive genetic groups for yearling weight EPD. We looked at heifer pregnancy in five different progressively higher yearling weight EPD groups. Figure 3 shows the value of the heifer pregnancy for each yearling weight EPD group.

Figure 3 indicates that generally there is an unfavorable relationship between yearling weight genetic merit and genetic merit for heifer pregnancy. This result agrees with between breed differences seen in research studies. It is generally believed that larger breeds tend to be more slow to mature and more difficult to breed as two-year-olds.

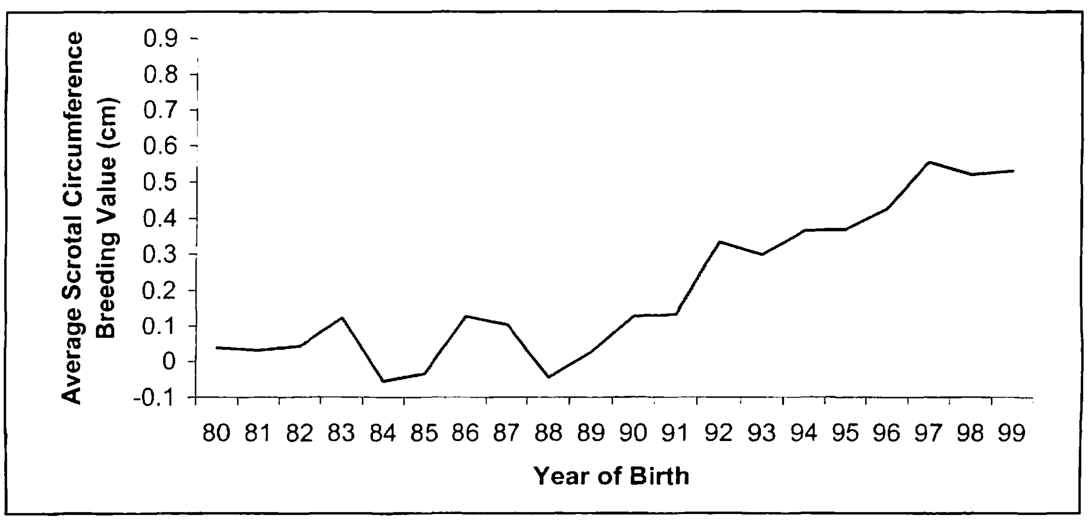
Figure 3. Heifer Pregnancy EPD by Yearling Weight Breeding Value Group



However, the highest yearling weight EPD group in the RAAA data was nearly equal to the lowest yearling weight EPD group in genetic potential for heifer fertility. This may indicate that the relationship is inconsistent, at least in this group of animals.

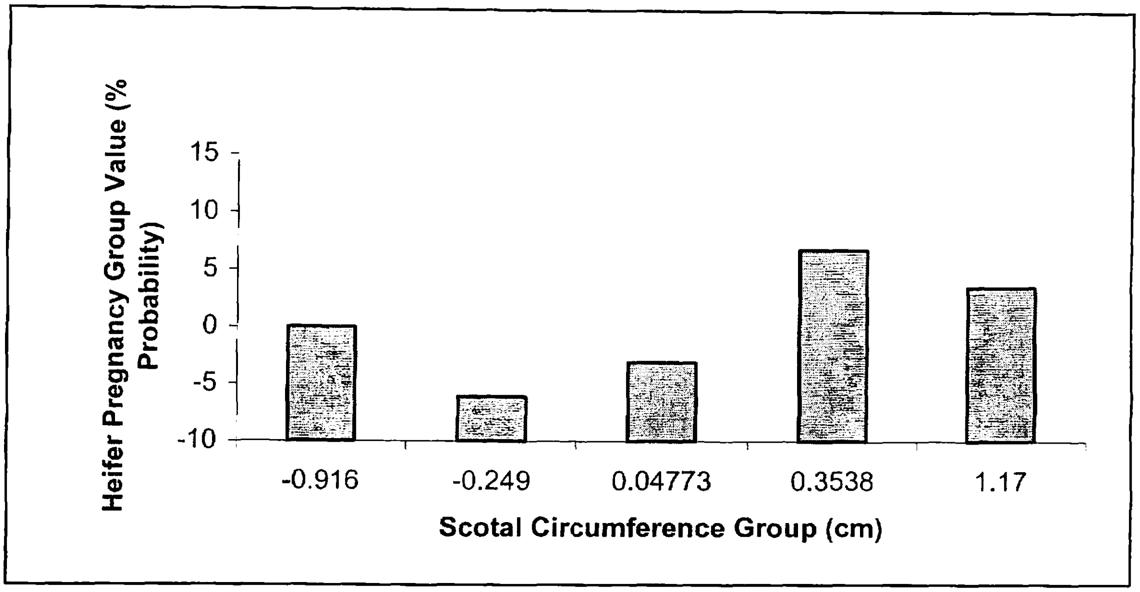
We then looked at the relationship of scrotal circumference to heifer pregnancy in the RAAA data. Scrotal circumference records on 26,743 yearling bulls related to the heifers with pregnancy observations were used to produce scrotal circumference EPDs. The Heritability of scrotal circumference estimated from these data was 47 percent, and the genetic trend for Red Angus scrotal circumference is illustrated in Figure 4.

Figure 4. Genetic Trend of Scrotal Circumference



We evaluated scrotal circumference's relationship to heifer pregnancy by looking at the heifer pregnancy genetic merit for five progressively larger additive genetic groups of scrotal circumference. Figure 5 shows the results of this analysis.

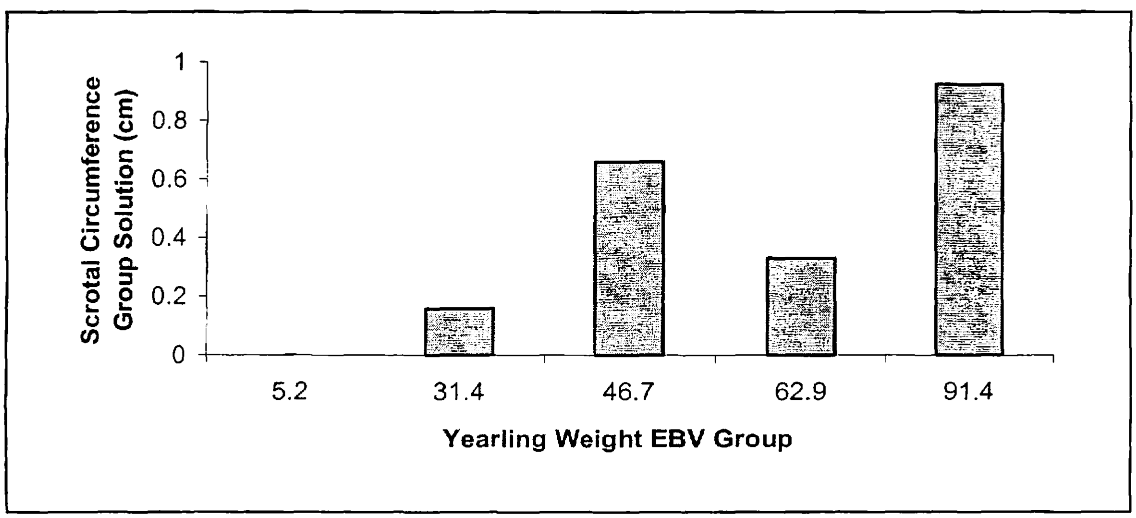
Figure 5. Heifer Pregnancy by Scrotal Circumference Breeding Value Group



The relationship between scrotal circumference and heifer pregnancy EPD was favorable in the middle three-scrotal circumference groups. However, the relationship was not consistent in the two groups at each end of the range. Again, this indicates there may be an inconsistent (non-linear) relationship between scrotal circumference and heifer pregnancy.

Figure 6 shows the relationship between scrotal circumference and yearling weight. This figure shows a generally positive relationship between scrotal circumference EPD and yearling weight EPD.

Figure 6. Scrotal Circumference by Yearling Weight Group



Careful study of Figures 1 through 6 show an apparently contradictory relationship between scrotal circumference, yearling weight, and heifer pregnancy. These types of relationships happen regularly in nature and can be explained by the fact that only some of the genes that affect a trait, effect correlated traits in the same way. In this case, some of the genes that favorably effect yearling weight also tend to make scrotal circumference larger. But these genes also tend to make these animals mature more slowly. Genetically larger animals tend to mature more slowly.

There are other genes that will make scrotal circumference larger that are not related to growth. It is likely that these genes reflect the activity of the endocrine system and the hormones involved in reproductive development. Animals that tend to have genetically larger scrotal circumference development at a yearling age because of these genes will tend to have daughters that reach puberty at younger ages.

The results of this study suggest that it is difficult for breeders to separate these two antagonistic genetic effects by using scrotal circumference measurements alone.

Conclusions

There are several important implications of the results of this project. Probably the most significant is that Red Angus' positive selection progress in the growth traits, which has resulted in substantially larger yearling weights (Figure 2), appears to have resulted in a small to moderate decrease in genetic potential for pregnancy in heifers bred to calve at two years of age.

The second important result is the illustration of the need for EPDs for the economically relevant trait of heifer pregnancy, and not EPDs for the indicator trait of scrotal circumference. Having an EPD for scrotal circumference instead of heifer pregnancy would not provide the appropriate selection tool to improve female first calf fertility. This point is made especially clear when the genetic trend for heifer pregnancy in Figure 1 is compared to the genetic trend for scrotal circumference in Figure 4. Clearly it would be misleading to assume heifer fertility was improving because scrotal circumference was improving. The scrotal circumference had a positive genetic trend, not because of increased fertility, but because it is positively related to growth.

Growth is generally unfavorably related to the genetic potential for heifer pregnancy. The results of this study clearly show that larger scrotal circumference size does not necessarily mean the bull's daughters will be more fertile as heifers.

It is important for breeders to realize that bulls with high growth EPDs will not necessary have daughters that are less fertile as first calf heifers. By having an EPD for heifer pregnancy you will be able to find bulls with the genetic potential to improve both sale weight and fertility of heifers.

The results of this study show that a heifer pregnancy EPD should be included in the breed sire summaries. Heifer pregnancy is an economically relevant trait. Improved genetic potential for heifer pregnancy effects profitability by reducing the number of heifers developed as replacements and/or the feed inputs required developing heifers for breeding. It also will help to ensure that shorter breeding seasons can be used to get heifers pregnant. Finally, a heifer pregnancy EPD will allow breeders interested in increasing the genetic potential for growth to maintain adequate levels of fertility in first calf females.

American Angus Association Centralized Ultrasound Processing Protocol

John Crouch, Director, Performance Programs

Realizing the importance of stringent guidelines for data management relative to using ultrasound technology for determining body composition in live animals, the American Angus Association Board of Directors approved funding for research on Centralized Ultrasound Processing (CUP) in 1997. The objectives of this research were three fold:

1. To develop a system of uniform guidelines for gathering and interpreting ultrasound images.
2. To develop adjustment factors and genetic parameters.
3. To determine the feasibility of incorporating ultrasound technology into the genetic evaluation process for determining body composition in Angus cattle.

In order to accomplish these objectives selected technicians, hardware and software were used in an effort to gather and interpret these measurements in the most uniform manner possible.

The following protocol has been established relative to the collection of ultrasound data.

1. Animals must have registered parents.
2. Animals must be enrolled in Angus Herd Improvement Records.
3. Animals must have weaning weights processed through Angus Herd Improvement Records.
4. Yearling contemporary groups are first defined by weaning contemporary group and then further defined as to management.
5. Age ranges are clearly defined for yearling bulls, developing heifers and feedlot steers.
6. Minimum gain is suggested.
7. Strict protocol regarding animal preparation is observed.
8. Participating technicians must qualify through the Centralized Ultrasound Processing Training and Qualification Program sponsored by participating breed organizations and Iowa State University.

The results of the research were most favorable and revealed strong and positive genetic correlations to actual carcass data.

Whole Herd Reporting and Commercial Marketing Programs

Bilynn Schutte, Red Angus Association of America

Whole Herd Reporting (WHR) has been a topic of conversation in the cattle industry and among participants of BIF Annual Meetings for a number of years. Advantages and disadvantages for the implementation of this program as a tool for performance registration have been discussed, and the bottom line is that WHR helps to reduce the bias in data submitted to a breed association for the calculation of genetic predictions.

The integrity of an EPD is only as good as the quality of the performance data that is submitted on a particular trait. As a result, one of the main advantages of WHR is that complete contemporary group information is recorded. Another advantage is the ability to track generations of complete reproductive performance data, and develop economically relevant reproductive EPDs such as Heifer Pregnancy and Stayability. However, there is an additional benefit of WHR that often gets overlooked. The integration of WHR allows a breed association to identify a large commercial producer database.

In 1995, the Red Angus Association of America (RAAA) became the first major breed association to implement WHR. Total Herd Reporting (THR), Red Angus's version of Whole Herd Reporting, involves an annual assessment fee structure that requires the production of every female on inventory and the performance of every calf raised through weaning be submitted on an annual basis. With the annual assessment, the owner or breeder is also entitled to a free transfer of current-year calves within a specified time. The complete recording of transfer information creates a "paper trail" that provides information on commercial customers relative to the number of purebred animals purchased over a period of time, as well as their contact information. The advantage of identifying a large commercial customer database has a significant effect on many of the programs within the RAAA.

The Feeder Calf Certification Program (FCCP) is a genotypic and source identification system that was developed in conjunction with RAAA's implementation of WHR. The FCCP was introduced in 1995 along with THR. The intent of the FCCP is to provide a service for the Association membership and their commercial customers by providing marketing options for Red Angus influenced cattle.

The program was developed in cooperation of the USDA's Meat Grading and Certification Branch in accordance with their Product Quality Control program, and follows the general principles of ISO 9000. The foundation of the program starts with the Schedule GLA (General Live Angus) requirement for the Genotypic Method, which states:

> "Cattle eligible for Angus influenced beef programs based on genotype must have positive identification (ear tags, tattoos, brands, etc.), and be traceable back to provable (e.g. registration papers) Angus parentage. Qualifying cattle must be traceable to one registered parent or two

registered grandparents. Programs which claim a specified percentage of Angus heritage must use this method."

The FCCP was the first genotypic and Processed-Verified program audited by the USDA. Unlike other programs that rely solely on a phenotypic description verified at the point of harvest for entrance into branded beef programs, the FCCP provides direct genetic traceability to at least one registered Red Angus parent. Traceability through each industry segment is possible through a special Red Angus ear tag that has a unique serial number on the back. Cattle that are tagged as Red Angus are eligible to enter into approved Angus banded product lines that these cattle normally wouldn't be eligible for phenotypically.

This unique serial tagging system allows the Red Angus Association to produce an auditable trail of inspection and training records, receipts, and invoices. Auditors from the USDA Meat Grading and Certification Branch (MGCB) then review the program documentation to ensure that all requirements have been met throughout all segments of production. Compliance audits are also completed annually by MGCB personnel at the Red Angus Association office, and at approved procurement facilities. Furthermore, a Red Angus staff member trained under FCCP guidelines randomly completes ranch and feedlot audits. The MGCB Quality Manager assesses the entire program, and either approves the procedures or reports non-compliances. Surveillance audits are also completed every six months to ensure that the system is properly maintained and procedures are being followed.

In order to educate commercial producers about the FCCP and various other commercial marketing programs, a one-year subscription of the American Red Angus Magazine (ARA) is given at no cost to all non-RAAA producers who have had an animal transferred to them. This has allowed the ARA to take a commercial focus and offer producers timely information about the FCCP as well as new technologies and production practices. Without THR and the benefit of the free transfer, complete customer information would not be available.

The advantages and disadvantages of WHR are arguable for each individual breed association. The RAAA's overall goal is to strive to have the best objectively described cattle in the industry and to provide the best service in the industry to its customers (commercial producers). The implementation of Total Herd Reporting has been critical to helping the association work towards this goal, and this type of registry system has improved the production of Red Angus cattle. The RAAA's THR and FCCP combined systems have given the Red Angus seedstock segment reliable genetic predictions to sell bulls and females, the commercial segment a competitive way to market feeder cattle, the feeding segment a value-based marketing option, and the packing segment a genotypic and source verified product that can be included in branded beef programs that are acceptable to consumer demands.

WHERE IS THE BEEF SEEDSTOCK INDUSTRY HEADED?

Harlan Ritchie, Distinguished Professor of Animal Science, Michigan State University

Yogi Berra once said, "Predicting is tricky, especially about the future." Looking into the future is indeed tricky business. As the visionary Peter Drucker aptly said, "The best we can do is analyze current trends and extrapolate them into the future." That is what I will attempt to do in this paper.

A Changing Agriculture

U.S. agriculture is in the midst of major structural change to a more industrialized model of production, similar to changes that have already occurred in other industries (Boehlje, et al., 1999a,b). This change is characterized by increased consolidation and coordination, resulting in formation of what is known in the agribusiness world as "food supply chains." In agriculture, structural change occurred first in the poultry industry, followed by the pork industry, and now it is coming to the beef industry. The often-asked question is, "How far will the beef industry go?" Certainly not as far as poultry, and probably not as far as pork. However, there may be some trends we can foresee by studying these industries, especially the pork industry.

The Poultry and Pork Industries

The top five broiler companies have almost 55% of total market share in the chicken industry. Tyson Foods, the largest company, has about a quarter of the U.S. chicken market. Seedstock sources in the broiler sector have narrowed down to just six companies. In the turkey sector, there are only three seedstock sources. The poultry industry is totally integrated throughout the supply chain, from hatchery through processor. Pork production is not totally integrated through the processing phase, but is coordinated in varying degrees through the finishing phase. More than 40% of U.S. hogs are marketed by operations producing over 50,000 hogs per year. The 50 largest producers market 50% of the nation's hogs. Smithfield, the largest producer, markets 14% of all U.S. hogs. From 1993 to 2000, the percentage of U.S. hogs marketed in some type of prearranged, value-based contractual arrangement with packers increased from 11% to 74% (Grimes and Meyers, 2000). In the beef industry, when one considers alliances, futures, contracts, formulas, grids, and all other marketing arrangements, it is estimated that 35 to 40% of fed cattle are now being marketed on some basis other than the spot/cash market.

On the genetic side, use of artificial insemination (A.I.) by commercial swine producers has grown from 15% in 1990 to 70-75% today (Nugent, 2000; See, 2000). Over 90% of the sows in the 50 largest operations are bred A.I. Genetic companies provide about two thirds of today's commercial seedstock (including semen and live breeding stock.) Independent seedstock breeders supply the remaining one third. Approximately 100 independent breeders account for the lion's share of this. Of the 100 independent breeders that are still marketing to significant numbers of commercial producers about 25 have become "full-service genetic providers." They generally supply more than one breed, often three or four breeds. They sell semen as well as boars and employ customer service representatives.

Most of the genetics provided by the swine companies can be accounted for by ten firms. A few of them are global in scope and provide genetics for widely diverse environments. Genetic lines are specifically designed for their targeted environments. The companies have acquired two thirds of U.S. market share by making optimum use of within-breed selection, breed differences (complementarity), heterosis, and more recently DNA technology. They are full-service oriented, offering assistance in nutrition, herd health, total quality management (TQM), marketing and risk management, record systems, and technology updates.

Much of the genetics that swine companies market to commercial producers consists of composites of two or more breeds. In the future, it is possible that composite genetics could play a larger role in the beef industry. Ben Ball of Elders, Ltd., a global agribusiness company, predicted that the beef industry will eventually adopt breeding systems somewhat similar to the pork industry (Ball, 1998). He projected that the commercial sector will use "lines based on complementary genetic mixes that are composites of pure breeds." He added that, "pure breeds will still be necessary to support these commercial lines." Composite systems have already been adopted by some commercial cattle producers who found it difficult to manage traditional rotational crossbreeding systems, because they required more breeding pastures and breeds of bulls. They can also result in large swings in biological type from one generation to another, making it difficult to optimize breed composition to match both the environment and the marketplace. Consequently, a number of larger seedstock breeders are producing hybrids/composites as well as purebreds for their commercial customers.

Beef Breeds and Breeders

Very few of the 50-plus beef cattle breeds in the U.S. will disappear, but they will likely sort into three groups: 1) ten breeds, or perhaps less, that will provide the genetic make-up of the bulk of the commercial cattle population; 2) a few breeds having unique attributes that will be involved in niche markets; 3) recreational breeds that will provide pleasure and entertainment to hobby breeders via shows, field days, etc.

Associations hoping to position their breed to capture a significant share of the commercial market will first and foremost need to have a database large enough to enable producers to source genetics capable of meeting diverse production and marketing goals. Application of increasingly sophisticated statistical methodology may result in future sire summaries having EPDs (Expected Progeny Differences) for as many as 25-30 traits. If this comes about, we desperately need a decision support system that will weight these traits for their relative economic value under specific production and marketing environments. The result could be an overall selection index for each sire based on potential profit. The Australian Angus Society is already publishing profit indexes on bulls in their sire summary (Parnell and Barwick, 1999). The index combines eleven traits into a dollar value that is defined as expected net profitability per cow bred. In the U.S., a profitability index has been developed to rank bulls in the Angus Sire Alliance, sponsored by Circle A Angus and ABS Global Inc. (Herring, 1999). In Canada, Caron and Kemp (2000) have designed a selection index to compare Charolais sires for terminal production of market calves.

Construction of selection indices has ranged from complex matrix algebra computations, requiring difficult-to-obtain data and numerous estimates, to overly simplified unproven methods, with few alternatives between the two. However, Hammett (2000) recently used an intermediate approach to design an innovative user-friendly index that can be customized to an individual producer's production and marketing system.

The seedstock sector is at a crossroads where more than superior pedigrees and outstanding EPDs will be required (Hammett,2000). Commercial customers are continually expecting more from their genetic providers. In order for mainstream seedstock breeders to ensure their sustainability well into the future, it will be necessary that they strive to become "full-service genetic providers." Smaller breeders who are unable or unwilling to make this transition on their own could potentially remain viable by partnering or networking with other smaller breeders having similar objectives, in order to gain enough scale to form a full-service alliance. Others could align themselves with a full-service provider and become satellite cooperating herds for the full-service nucleus firm. In some instances, full-service providers may license their genetics to breeders in other regions as a means of expanding their market base.

A number of seedstock producers have already positioned themselves as full-service providers. The services they offer are similar to those provided by the genetic companies and mainstream independent breeders in the swine industry, as noted previously. Among other characteristics, they have relatively large populations of cattle at their disposal and offer more than one breed of cattle, and in some cases, hybrid seedstock. Examples of the services provided now and/or in the future are: assistance in merchandising feeder calves; programs for retained ownership that will return feedyard performance and carcass data on every animal; special feeder calf and heifer sales for customers; heifer development programs; assistance in carcass data collection; assistance in selecting and joining an alliance; contracting of specific matings two years in advance of delivery of bulls; free consulting service; low or no interest payment plans; one-year insurance policy on bulls; hosting field days and educational seminars; assistance in designing selection indices tailored to individual customer needs; fetal sexing of replacement heifers; ultrasound measures of live cattle for carcass traits; EPDs of hybrid seedstock; pelvic measurements; and breeding soundness exams (Grant, 1995; Gordon, 1999a,b; Ritchie, 2000).

Breed Associations

In the midst of the changing structure of the beef seedstock sector, it will be important for breed associations to assume a proactive role if their breeds are to be major suppliers of seedstock to the commercial sector. In the near future, associations will have an opportunity to add a new generation of EPDs that have a more direct impact on profitability than previous EPDs. Examples are tenderness, heifer pregnancy, cow maintenance, days to market, calf survival, and male fertility. As noted before, increasing the number of EPDs creates an ever-increasing need for a decision support system such as multiple-trait selection indices.

Points of control in a modern food supply chain tend to lie at the ends of the chain: genetics on one end and information from end-users on the other end (Boehlje, 1999b). This suggests that breed associations and their constituencies are uniquely positioned to participate in the governance of the beef supply chain. Following is a list of potential areas of activity in which associations could play a role. Several associations are already engaged in some of these activities.

- Assist breeders in the evolving process of becoming full-service genetic providers.
- Assist breeders that have common objectives in development of coordinated marketing programs.
- Facilitate linkages between adjoining industry sectors, such as seedstock breeders and commercial producers, commercial producers and feedyards, and feedyards and packers.
- Provide specific services for the commercial sector, such as sire selection, assistance in marketing the calf crop, and assisting commercial producers in identifying feedyards for retained ownership.
- Assisting feedyards in identifying commercial herds for the kind of genetics they need.
- Assistance in collecting carcass data.
- Develop relationships with alliances that have coordinated breeding and marketing programs.
- Develop relationships with other agribusiness entities, such as A.I./genetics, nutrition, and animal health companies.
- Develop a systematic program for producing and recording hybrid seedstock.
- Continuing to up-grade educational programs, such as an informative breed publication that reviews current technology and industry trends, special publications targeted to commercial cow-calf producers and feedyards, high quality symposia and seminars, and innovative junior activities.
- Creation of foreign marketing initiatives.

In the future, it may be necessary for small and mid-sized breed associations to ally or merge with other associations in order to provide quality programs and services that are of mutual benefit to their members. This has already occurred in the swine industry (Anderson, 2000). In 1994, three associations – Duroc, Hampshire and Yorkshire – consolidated to form the "National Swine Registry" (NSR). In 1998, they were joined by the Landrace Association. These four breeds have retained their identity, but are now much stronger financially because they are able to share resources – one executive director, three field representatives, one marketing program director, and an office staff under one roof. NSR has engaged in a national swine evaluation program that generates EPDs, publishes a sire summary, and has developed three multiple-trait selection indices (Terminal Sire Index, Sow Productivity Index, and Maternal Line Index).

Summary

Whether we like it or not, the beef industry is on the verge of major change to a more industrialized model of production and marketing. The industry will not integrate to the extent of poultry or pork, but there will be increased coordination throughout the supply chain. There will be demands on each sector of the industry to add value. The seedstock sector will not be exempt from these trends. Individual seedstock breeders will evolve to becoming "full-service genetic providers." The same will be true for breed associations. As a result, there will be varying forms of consolidation, as has been the case in other industries.

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FRANK BAKER MEMORIAL SCHOLARSHIP AWARD RECIPIENT ESSAYS

IMPORTANT CONSIDERATIONS FOR IMPLEMENTATION OF ACROSS COUNTRY GENETIC EVALUATIONS

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INTRODUCTION

The advent of increased transfer of genetic material between countries, along with the development of better models and increased computing power, has made the possibility of implementing across country genetic evaluations more feasible. The spread of genetic material into various points on the globe has increased the genetic ties between many countries, and elevated the interest of beef producers throughout the world in genetically evaluating seedstock on an international basis. The production of genetic values on a multi-country basis provides improved marketing opportunities for all involved, as well as increasing the accuracy of evaluation due to the extra performance and pedigree information that is made available.

There are several issues, however, that must be addressed, both by breeders and researchers, before the widespread implementation of across country genetic evaluations can become a reality. Breeders and breed associations must address the issues of cooperation between breed associations in various countries, as well as establishing procedures relating to identifying international animals, setting a common base and reporting results. Researchers must address issues relating to analysis procedures. These issues include dealing with whether genetic parameters are the same, or at least proportional, across countries, and if animals rank the same in each country. Heterogeneous genetic parameters; genetic parameters differing across countries; and significant changes in the superiority of animals across countries that provide proof of important genotype by country interactions would hinder the usefulness of across country evaluations. Thus it is important to investigate differences in genetic parameters across countries and genotype by country interactions in order to correctly implement international genetic evaluation programs. The purpose of this paper is to address some of the challenges that researchers will face as breed associations begin to move towards international genetic evaluation programs; namely the issues of heterogeneous variances and genotype by country (or environment) interactions.

REVIEW OF LITERATURE

Genotype by Environment Interactions

The potential re-ranking of animals across countries due to the presence of genotype by environment interactions is of primary concern when considering the possibility of across country genetic evaluations. Genotype by environment interactions can be manifested in two ways; firstly, by the presence of a correlation between genetic performance in the two environments that is significantly less than one, and secondly, by heterogeneous variances. Genotype by environment interactions become very important if individuals of a particular population are to be reared under different conditions, as is the case for across country evaluations. The presence of genotype by environment interactions may mean that the best genotype in one environment (or country) is not the best in another environment (or country). For example, it is obvious that the breed of cattle with the best performance in temperate climates is unlikely to also have the best performance in tropical climates. However, this distinction becomes less obvious when examining the performance of the same breed across many predominantly temperate climates in different countries.

Sire by environment effects were found to be insignificant in a study by Tess et al. (1979) in Simmental-sired calves. Weaning weight records were assigned to three major regions in the United States; Montana, Midwest (Iowa and Illinois) and Texas. Each possible combination of two major regions were analyzed using least squares procedures, producing three separate analyses. A mixed model containing region, herd within region, sire, age of dam, sire by region interaction and sire by herd within region interaction effects with a linear partial regression on weaning age was used. The authors found that sire by region interaction effects were not sufficiently large to be of practical importance. However, sire by herd within region was a more important source of variation than sire variance. The authors suggested this indicated that past studies of sire by location interactions using sire progeny methods, where herd and sire by herd interaction effects were not included, may have resulted in sire by location interactions being inflated by a sire by herd interaction effect. Genetic correlations between sire progeny performance, calculated using estimated variances, ranged from 0.42 to 0.90.

Bertrand et al. (1985) studied sire by environment interactions for weaning weight records in Polled Hereford cattle. The data were divided into nine geographical regions in the United States. Two data sets were analyzed with mixed sire models. The first data set was designed to analyze sire by herd variances, and the second data set was designed to analyze sire by region variances. The estimated genetic correlations were 0.59 and 0.37 for sire progeny performance across contemporary groups within herds and across contemporary groups and herd within regions, respectively. The genetic correlation of sire progeny performance across regions was 0.64. The authors found sire by environment interactions to be present, and recommended that breeding values be computed by regions for the Polled Hereford breed.

Sire by environment interactions were observed in the Limousin breed by Bertrand et al. (1987). Birth and weaning weight records were analyzed using a sire model. Initial analyses of the data produced estimates of sire by contemporary group with region interaction variances that were larger than the sire variance for both birth and weaning weight. Including dam effects did account for some of the sire by environment interaction. However, even after the reduction, the sire by contemporary group within region interactions were significant enough for the authors to conclude that rank changes of sire progeny performance were occurring across contemporary groups. The authors suggested performing separate sire evaluations for some regions in the Limousin breed.

Notter et al. (1992) used a sire model to investigate the presence of sire by herd interactions for weaning weight in Australian Angus cattle using restricted maximum likelihood (REML) procedures. Interaction effects were tested by comparing log likelihoods of models that included sire by herd interaction to those that included only sire effects. Different adjustment procedures were evaluated, including standardizing the data, accounting for relationships among sires and adjusting for maternal breeding values of the dam. The authors found that sire by herd interactions were consistently large and significant, ranging from 63 to 91% of the sire component and from 3.3 to 6.2% of the phenotypic variance. Restriction to selected data sets, adjustment for maternal breeding values, standardization of the data and inclusion of sire relationships had little effect on the interaction component of variance. Sire by herd interactions were determined to be partly due to effects of common environment, differential non-random mating and heterogeneity of variances among herds.

Herring (1995) used a reduced animal model to evaluate the possibility of a combined across country genetic evaluation to compare bulls from different countries utilizing weaning weight data from three North American Hereford associations. Herring (1995) found that conversion methods evaluated were not a good alternative to a combined genetic evaluation due to the inability to account for genetic trends, base differences and genotype by environment interactions. The author also found no significant sire by country or sire by region within country interactions present in the data.

Meyer (1995) estimated genetic parameters for New Zealand and Australian Angus cattle using an animal model. A bivariate analysis treating weaning weight in Australia and New Zealand as different traits was conducted using DFREML. Treating weaning weight in Australia and New Zealand as different traits produced estimates of the direct genetic and maternal genetic correlations of 0.97 and 0.82 respectively. Hence, the author concluded that the same genes influenced weaning weight performance in the two countries. The author also found that the correlations between breeding values of high accuracy sires in both countries agreed with their expectation, thus providing no indication of genotype by country interactions.

De Mattos et al (2000b) investigated the possibility of genotype by environment interactions for weaning weight between different regions of the United States (US), and between Canada, Uruguay and the US for populations of Hereford cattle. Pairwise analyses were conducted between countries and regions within the US for estimation of covariance components and the genetic correlations between environments. Relatively large data sets and animal models were used for these analyses. The genetic correlation estimates for direct genetic effects were found to be 0.86, 0.90 and 0.88 for US-Canada, US-Uruguay and Canada-Uruguay respectively. The genetic correlation estimates for maternal genetic effects were found to be 0.82, 0.85 and 0.84 for US-Canada, US-Uruguay and Canada-Uruguay respectively. All estimates are greater than 0.80, which many studies consider large enough to conclude that no interaction was present (Robertson 1959, cited by de Mattos et al. 2000b). Similar results were found for the analyses for regions within the US. De Mattos et al (2000b) concluded these results indicated that a joint genetic evaluation for Hereford cattle could be conducted using a model that treated Canada, Uruguay and the US as a single population for weaning weight performance.

Early studies into the significance of genotype by environment interactions utilized sire and sire-maternal grandsire models. There are no available papers that compare differences in the size of the genotype by environment interaction effects estimated from sire models in comparison to animal models. Ferreira et al. (1999), however, compared estimates of variance components and predictions of breeding values for birth, weaning and yearling weight from Hereford cattle using different statistical methods to determine whether simpler models produce estimates similar to those produced by more complex alternatives. The authors found relatively low correlations and, correspondingly, low rank correlations between estimates of breeding values from sire models compared to animal models. As well, large differences were found in maternal heritability estimated using the sire-maternal grandsire model compared to animal models. Ferreira et al. (1999) concluded that the use of sire models would result in less genetic improvement from selections than the use of a full animal model. Thus, animal models are preferable to sire and sire-maternal grandsire models for the analysis of field data and the investigation of genotype by environment interactions. The investigation of differences in the ranking of the same sires across different environments usually forms the basis for the study of genotype by environment interactions. Hence, de Mattos et al. (2000b) suggested that evidence of significant sire by region interactions found in past studies were not due to some biological phenomena, but due to the application of less accurate sire and sire-maternal grandsire models.

Heterogeneous Variances

Incorporating heterogeneous variances into genetic evaluations

The presence of heterogeneous variances will have a significant influence on genetic evaluation procedures. Heterogeneous variances may be present in several situations, including across sexes, herds or countries. In general, homogeneity of variance or covariance is not a requirement in a best linear unbiased prediction (BLUP) analysis (Gianola 1986). However, heterogeneity may reduce the reliability of ranking and selection procedures based on Henderson's mixed model equations which require appropriate variance components to provide solutions with BLUP properties (Reverter et al. 1997).

Once heterogeneous variances have been quantified, the next challenge is to include them in the analysis in a computationally feasible way. This is especially relevant for across country genetic evaluations, which involve very large data sets. Much research in this area has been undertaken in the dairy industry. Gianola (1986) presented procedures for ranking candidates for selection and for estimating genetic and environmental parameters when variances are heterogeneous. The author suggests a multiple trait approach that considers performance in each environment as a separate trait. The author noted that the best linear unbiased predictor accounts automatically for heterogeneous variance, provided that the covariance structure is known and that the assumptions of the model hold. Furthermore, under multivariate normality, BLUP allowing for heterogeneous variance maximizes expected genetic progress. The author acknowledges, however, that the computations involved with this approach are seldom feasible in data sets as large as the ones being generated in national sire evaluation programs because of the size of the matrices involved. If herds are the source of heterogeneity, a large number of variances and covariances would need to be estimated. Further, individual parameters would not be well estimated, as there would be little information on each of them.

Garrick and Van Vleck (1987) reviewed breeding value estimation with mixed models for various situations involving heterogeneous variance components. The authors note that, in practice, variance components are frequently estimated ignoring genotype by environment interactions, and then routinely used for evaluation purposes. Increasing evidence suggests the presence of systematic changes in variance components associated with mean level of performance. In situations involving greater heritability in more variable populations, there is likely to be little reduction in progress from assuming homogeneity. The authors concluded that selection assuming homogeneity can be very efficient when heritability, and therefore accuracy of selection, is greatest in the more variable environment. Conversely, considerable reduction in response results when heritability is greater in the less variable environment.

According to Garrick et al. (1989) models that have a single random factor can be easily modified to account for heterogeneous genetic and residual variances by scaling the observations to standardize the genetic variance, then using heterogeneous residual parameters. The authors maintain, however, that this is not possible for models with two or more random factors, unless the random factors can all be scaled by the same constant. The authors conclude that evaluations accounting for heterogeneous genetic and residual effects require transforming the model (incidence) matrices for random effects, in addition to accounting for heterogeneous residual parameters. Garrick et al. (1989) state that if heterogeneous variance are ignored in evaluations, in the absence of selection, the prediction error variance will be increased, but the predictors will remain unbiased. However, the regression of predicted merit on actual merit won't, in general, be one, resulting in under or over evaluations of individual animals, depending on subclass. Furthermore, evaluations of sires would be misleading when progeny are distributed unevenly by subclass.

Foulley et al. (1990) presented a statistical model for identifying sources of heterogeneity of residual variance in mixed linear models. The method was based on a log-linear model for the residual variances from which parameters can be estimated and hypotheses tested using the marginal likelihood function. An important feature of the method is the possibility of identifying significant sources of heterogeneity of residual variance via likelihood ratio tests. This procedure can be used for constructing parsimonious structural models, so the number of parameters needed for assessing heterogeneous variances is as small as possible. This can be especially important with large data sets which have a high number of subclasses with very little information about dispersion parameters.

Meuwissen et al. (1996) presented a method to correct for heterogeneity of phenotypic variances that accounts for breed or genetic group effects and reduction in variance from selection. Heritabilities were assumed to be homogeneous, and a multiplicative mixed model that simultaneously estimates breeding values and heterogeneity factors was used. Phenotypic heterogeneous variance estimates accounted for differences among breed and genetic groups, relationships between animals and reductions in variance from selection. This method provided breeding values that avoided favoring animals from inferior genetic groups, herds with closely related animals and from later parities, while being computationally feasible with large data sets. When applied to Dutch national dairy data, the mean differences between parent averages and the EBV of progeny-tested bulls were reduced by 38% when heterogeneous variances were considered. The variance of EBVs minus the parent averages were reduced by 18%. Since variances were homogeneous within herds the authors suggested a simplified model with variances estimated within herds.

Reverter et al. (1997) evaluated the appropriateness of the multiplicative mixed model presented by Meuwissen et al. (1996) to handle data from live animal real-time ultrasound scans for the Angus breed. Measurements were taken at 600 days of age, when records were likely to be heterogeneous across herds. A multiplicative mixed model that simultaneously estimated breeding values and heterogeneity factors was used, and heritability was re-estimated after scaling the data with the correction factors to assess the improvement in genetic evaluation and to detect changes in rankings of individuals and herds. Re-estimates of heritability increased by an average of 4.2% for all traits as a result of correcting for heterogeneity. Correlations between EBV with and without heterogeneity correction were greater than 0.97 for all traits. However, some substantial re-ranking of herds was observed for some traits in smaller herds. The authors concluded that some additional improvement in breeding value prediction and in the rankings of individuals and herds may be gained by correcting for across-herd heteroskedasticity.

Presence of Heterogeneous Variances in beef cattle

Heterogeneous variances have been reported for growth traits in beef cattle. Much of the research in beef cattle has focussed on the heterogeneity of variances between sexes. Garrick et al. (1989) quantified heterogeneity for weight traits by partitioning variation into direct and maternal genetic components, separately for males and females and for first-cross calves compared to later generations of Simmental cattle. The authors also investigated power transformations of the observations that may result in homogeneous genetic and residual variance. Heterogeneous phenotypic variance by sex-percent Simmental subclass was quantified by this study. As well, it was found that increased phenotypic variance arose from increased direct genetic, maternal genetic and residual partitions. Furthermore, the increase in direct genetic variance in males relative to females was not in proportion to the increase in residual variance, such that heritability was lower in males then females. First-cross progeny exhibited less variation and lower heritability than later generations. No evidence was found by these authors to suggest that the genetic correlation between sex-percent subclasses was significantly different from one. Power transformations, including log transformations, had the effect of reducing, but not removing, heterogeneous variance in birth and weaning weight. The tendency for males to exhibit more variation than females remained in the log-transformed weight data. The authors found that transformations of post weaning gain did not reduce heterogeneity and resulted in male records exhibiting less variation than female records. The authors concluded it is unlikely that a transformation could be found that would simultaneously stabilize direct genetic, maternal genetic and residual components of variance. As a result of this study, national genetic evaluations of American Simmental cattle, beginning July 1988, accounted for heterogeneous genetic residual variances by sex-percent Simmental subclasses using a sire-maternal grandsire model.

Lee and Pollak (1997) investigated the influence of partitioning data by sex on parameter estimates. Weaning weight data were simulated using homogeneous variance components for males and females for random and selected populations. REML estimates were obtained for direct and maternal genetic and permanent and temporary environmental variances and genetic covariance between direct and maternal effects by analyzing complete and split data. The results of this study indicated that splitting data by sex affects estimates of variance and covariance components in selected populations. Analyzing records from only one sex did not account for selection in the other sex. As the national genetic evaluation for Simmental cattle uses heterogeneous variance and covariance components obtained from analyses of split data, the authors recommended that these parameters be re-estimated using a multiple trait approach.

Lee et al. (1997) used weaning weight records from Simmental cattle to examine heterogeneity of parameters across sexes with a multiple trait approach where male and female were treated as two traits. Estimates of direct and maternal genetic variances for male data were smaller than for females, although estimates of permanent and temporary environmental variances were larger. Direct-maternal genetic covariance estimate for females were four times larger than for males, while genetic correlations for females and males were –0.20 and –0.05. The data were also analyzed using a single trait model with sexes together. The likelihood ratio test statistic comparing the multiple trait model to the single trait model indicated that the model incorporating heterogeneous (co)variance components fit the data better. The data were also partitioned by sex and analyzed to compare estimates from partitioned data with those from the multiple trait analysis using all data. Estimates from the female data set were similar to those using the multiple trait model. However, differences of (co)variance components estimated from the two models were observed for males. These differences were small with the exception of male direct-maternal genetic correlation. The authors concluded that the results of this study indicated that the Simmental national cattle evaluations should allow for heterogeneous variance by sex.

A small number of studies have investigated the heterogeneity of variances across countries. Meyer (1995) estimated genetic parameters for Australian and New Zealand Angus cattle using an animal model which included maternal genetic and permanent environmental effects as additional random effects. In general, estimates for both countries were in agreement. The biggest difference occurred for birth weight for which direct heritability was almost 0.1 lower in New Zealand. This difference could not be attributed to potentially unreliable recording, and was assumed to be real. Combined matrices of estimates were formed from correlation estimates and genetic parameter estimates for individual traits. Overall, the New Zealand estimates agreed well with the Australian genetic parameters for Angus cattle, with the exception of an assumed maternal genetic correlation of zero between birth and weaning weight. The author found that the correlation matrices for Australian and New Zealand Angus could be regarded as identical for most purposes. Therefore, the adoption of a single set of covariance matrices for genetic evaluation for growth traits, jointly or separately, was recommended.

De Mattos et al. (2000a) used records from Hereford populations in the United States, Canada and Uruguay to determine whether genetic parameters for weaning weight were homogeneous across the three countries. Covariances were estimated using a complete animal model, relatively large data sets and the same methodology for the three countries. Ten samples were obtained from each country, and the estimates were pooled by calculating the mean of the ten samples from within each country. Direct and (maternal) heritability estimates were 0.24 (0.16), 0.20 (0.16), and 0.23 (0.18) for the US, Canada and Uruguay respectively. Covariance between direct and maternal was negative in all countries, accounting for 6, 8 and 10% of the total phenotypic variation respectively. The total dam effect was 32.5, 37.0 and 34.0% in US, Canada and Uruguay respectively. The authors concluded that the estimates for direct and maternal heritabilities, and the proportion of the total variance due to the maternal permanent environmental variance, were in general agreement among countries for all three analyses. As well, correlations between direct-maternal genetic effects were similar between Canadian and US populations, with a slightly larger negative value for the Uruguayan population. Thus, the authors concluded that the genetic and environmental parameters across the three countries were relatively homogeneous.

CONCLUSIONS AND IMPLICATIONS TO GENETIC IMPROVEMENT OF BEEF CATTLE

Many early studies that observed the presence of genotype by environment interactions utilized sire or sire-maternal grandsire models (Bertrand et al. 1985, Bertrand et al. 1987 and Notter et. al. 1992). Sire and sire-maternal grandsire models have been shown to result in less genetic improvement from selections than the use of a full animal model (Ferreira et al. 1999). This suggests that evidence of significant sire by region interactions found in these studies may not be due to some biological phenomena, but due to the application of less accurate sire and sire-maternal grandsire models. Thus, animal models are preferable to sire and sire-maternal grandsire models for the analysis of field data and the investigation of genotype by environment interactions. However, more recent studies using animal models have reported that genotype by environment interactions were not significant (Herring 1995, Meyer 1995 and de Mattos et al. 2000b). Thus, based on the current literature, it appears that animals are not re-ranking significantly across countries, and that across country genetic evaluations can certainly be implemented, as long as genotype by environment interactions are studied before implementation.

Heterogeneous variances have been observed in beef cattle (Garrick et al. 1989 and Lee et al. 1987). Furthermore, much progress has been made in the development of computationally feasible models that can account for these heterogeneous variances in large data sets in the dairy industry (Meuwissen et al. 1996). These models have also been shown to be successful in handling heterogeneous variances in beef cattle (Reverter et al. 1997). Thus, there are models available to researchers conducting across country genetic evaluations when heterogeneous variances exist for use in large data sets for beef cattle.

These findings have significant implications for the genetic improvement of beef cattle. The fact that, so far, studies using animal models have not observed significant genotype by country interactions or across country heterogeneous variances indicates that across country genetic evaluations may be able to be implemented without the challenge of handling these interactions. However, even if heterogeneous variances are present in the data, there are still options available to researchers who have to account for these variances in beef cattle data.

Furthermore, the implementation of across country genetic evaluations will have wide reaching implications on the genetic improvement of beef cattle. Beef producers will have access to genetic evaluations which are more accurate, due to the added pedigree and performance information made available from inclusion of data from additional countries. This will enable producers to make selection decisions with greater confidence, with the knowledge that their decision is based on data from over the globe. Producers will also have improved marketing opportunities, particularly when the evaluations include data from countries that import substantial amounts of genetic material from the United States. Genetic evaluations that include data from Australia and New Zealand, as well as countries in South America, would allow many seedstock producers to greatly enhance the marketability of their genetic material. Thus, the implementation of across country genetic evaluations would be of great benefit to beef producers in the United States, and throughout the world.

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RISK, UTILITY AND ACCURACY IN BEEF CATTLE BREEDING DECISIONS

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Introduction

Livestock improvement involves defining breeding objectives, identifying individuals likely to breed improved offspring and making appropriate matings among them (Hill et al., 1998). A breeding objective usually comprises some measure of genetic merit for a number of traits together with the economic importance of each trait included in the objective (Hazel et al., 1994). Identification of superior individuals is accomplished through genetic evaluation for individual traits, the products of which, in the North American beef industry, are expected progeny differences (EPDs). A limitation of genetic evaluation is that EPDs are usually presented without context–i.e., are not related to the goal of genetic improvement (Bourdon 1998).

Whenever future profit is known with certainty, a legitimate goal of genetic improvement is to maximize discounted profit (Dematawewa et al., 1998). Marketing contracts in conjunction with estimates of animal performance enable future income to be predicted with reasonable certainty over a short time period, however production and market changes over a longer time horizon cannot be known with certainty. To date, most breeding objectives have specified profit maximization as the goal of genetic improvement (Newman et al., 1992; MacNeil, 1996), implying that future circumstances are known with certainty or that risk does not impact on breeding decisions. In reality, neither implication is true. This essay discusses the role of risk, utility and accuracy in beef cattle breeding decisions.

Review of Literature

Risk in beef cattle breeding decisions
The financial outcomes of beef cattle breeding decisions are inherently uncertain. Uncertainty arising from incomplete knowledge of future production, pricing and from imperfect genetic predictions are present in all beef cattle breeding decisions. It was suggested (Meuwissen, 1991) that the variance of selection response is an indicator of risk in the breeding program. A breeding decision that incurs minimal risk might involve selecting animals on the basis of genetic merit for traits that maximize selection response toward a breeding objective while minimizing variance of selection response (in that objective). Before considering how risk can be incorporated in breeding decisions, it is informative to summarize sources of uncertainty in breeding decisions.

Uncertainty in beef cattle breeding decisions may result from:

1. *Unclear distinction between economically relevant and indicator traits.* Economically relevant traits (ERT) are defined as the combination of traits that (together with their economic values - EV) maximizes response toward the breeding objective for a

given breeding, production and marketing system (Golden and Bourdon 1999). A unit genetic change in an economically relevant trait directly impacts future enterprise profitability. In contrast, indicator traits are usually measurable on candidates before selection decisions are made and do not impact enterprise profit. Measuring indicator traits and incorporating these measures in genetic prediction can add accuracy (via genetic correlations) to genetic prediction of ERT. The accuracy of selection decisions including both indicator traits and ERT is lower than for selection decisions that include ERT only (Golden and Bourdon 1999).

Genetic change for indicator traits does not provide evidence of genetic gain in the ERT (Golden 2000). For example, the estimated genetic trend for scrotal circumference in the American Red Angus breed is positive. From favorable genetic correlation between scrotal circumference and female fertility traits, it is expected that a desirable genetic trend for heifer fertility EPD would result. The reverse is true; mean heifer pregnancy EPD decreased over time (an undesirable trend) while scrotal circumference EPD increased. It was hypothesized (Golden et al., 2000) that due to positive genetic change in yearling weight, heifers are larger, but less physiologically mature at a given age than in previous generations and inherent heifer fertility has declined. Inclusion of indicator traits rather than ERT in selection decisions increases risk in two ways; 1) it lowers the accuracy of the selection decision and 2 it can mask undesirable genetic trends in ERT.

2. *Market signals may not exist or be poorly understood for certain traits.* The inclusion of traits in a breeding program for which market signals are unclear is inherently risky in two respects. First, if payments for this new trait are not forthcoming at some time in the future, the seedstock breeder may not be compensated for the cost of genetic improvement. Second, imprecise marketing signals may over-or underestimate the expected selection response toward an economic objective for this trait. A higher genetic response toward an economic breeding objective was obtained from over-rather than underestimation of economic values, when the magnitude of over-or underestimation of EV was equidistant (Vandepitte and Hazel 1977; Amer and Hofer 1994). From a modeling study, Amer and Hofer (1994) suggested that including a new trait in a breeding objective for which current pricing signals do not exist appears warranted if the expected magnitude of the economic value is high compared with other traits in the breeding objective.

3. *The outcome of genetic evaluation is a series of predictions of genetic merit.* These genetic predictions never have perfect accuracy. Individually, sires with a lower accuracy, i.e., young sires without progeny records, are inherently riskier than sires with more information included in their genetic prediction. In general, less accurate selection, selection of fewer sires or dams, and fast turnover of generations can lead to an increase in variance of selection response (Meuwissen, 1997).

4. *Economic values are estimates derived from models that may not represent the true state of nature.* Economic values are dependent on the biological and economic parameters included in profit equations or bioeconomic models. Reasons why

breeding objectives may differ over time, across locations and among breeders with different sets of customers include (MacNeil, 1996):

- different roles in mating, production and marketing systems
- the impact of legislation on management practices such as manure disposal and management of groundwater nutrient contents (Steverink et al., 1994)
- conflicting signals from consumers such as the desire for reduced fat but enhanced taste from beef (Gibson and Wilton, 1998)

Across a number of studies, the efficiency of index selection appears to be relatively robust to errors in EV. Errors in economic values of ± 50% reduced the efficiency of index selection by less than 1% for each of seven traits included in a selection index (Vandepitte and Hazel, 1977). Similarly, Amer and Hofer (1994) concluded that little justification exists for accounting for uncertainty in economic value estimation. However, Gibson and Wilton (1998) argued that small changes in the breeding objective can be an important advantage in a highly competitive livestock breeding industry. An example of a competitive breeding industry might be a collection of AI companies supplying semen to large dairy markets.

In general, some sources of risk in beef cattle breeding decisions have been described, but no attempt has been made to quantify the value of risk in beef cattle breeding decisions.

Utility

A utility function links utility or satisfaction to the amount of one or more goods that are available (Debertin, 1992). Agricultural economists frequently define utility maximization as the criterion by which choices are made by the ranch manager. A rancher's utility usually encompasses elements of income (or profit) as well as risk. If expected income and utility were the same, (i.e., risk neutrality is assumed) then a breeder interested in utility maximization would always have as a goal, profit maximization. Under this assumption, economically-based breeding objectives for livestock that ignore elements of risk would derive economic values as the impact of an independent genetic change on discounted future income or profit.

Decision makers show risk preference, risk neutrality or risk aversion. A risk averse decision maker receives decreasing marginal utility from taking on more risk while for a risk preferring decision maker, greater utility is obtained from riskier decisions. It would be safe to assume that most ranchers show aversion to risk, a result of having a large capital investment in land and livestock relative to returns. To account for risk in breeding decisions, it must be assumed that the parties investing in genetic improvement aim to maximize utility. In such a case, utility (U) is a function of expected income E(I) and variance of income V(I) (Dematawewa et al., 1998) so that:

$$U_{max} = u[E(I), V(I)] \quad [1]$$

Most ranchers prefer to increase income and lessen risk, so the following criteria must be satisfied:

$$\frac{\partial U}{\partial E(I)} > 0, \text{ and } \frac{\partial U}{\partial V(I)} < 0 \qquad [2]$$

Utility was expressed as a function of expected income and risk in [1], where risk for a breeding program was defined as the variance of predicted income. In most commercial beef cattle operations, a pool of candidate sires is available from which one or the best set of sires is chosen. Each sire produces an expected income with an associated risk (variance of predicted income). It was shown in a dairy cattle application (Dematawewa et al. 1998) that for a set of S selected sires, utility from [1] can be described as a function of expected income and variance of income:

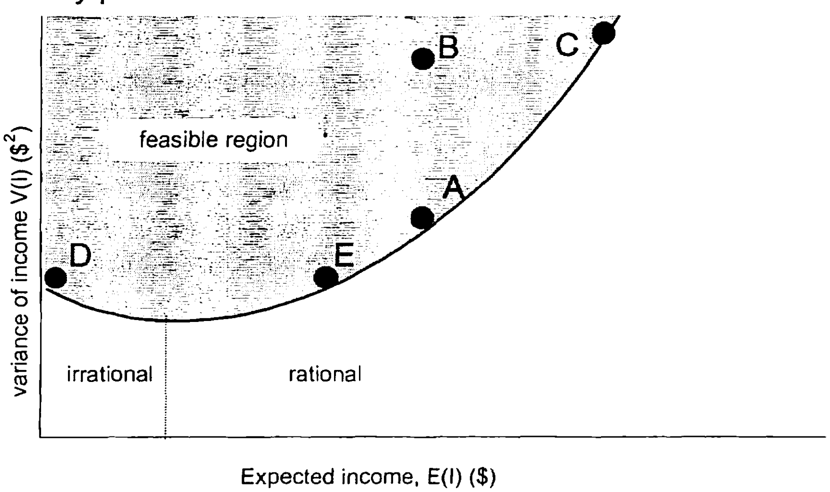
$$E(I) = \sum_{i=1}^{S} n_i \; E(I)_i$$

where $E(I)_i$ = income expected from sire i, from each of S sires and n_i= number of daughters from sire i. The variance of income for a particular set of sires can be given by:

$$\text{risk} = V(I)$$
$$= \sum_{i=1}^{S} n_i^2 V(I)_i + 2\sum_{i=1}^{S}\sum_{j>i}^{S} n_i n_j \text{Cov}(I_i, I_j) \qquad [3]$$

Risk (from [3]) is a function of the number of sires selected and the number of matings to each sire. The covariance of incomes between two sires [Cov (I_i, I_j)] results from the covariance between breeding values of sires and income variance. The ideal set of sires would be those that produce the highest E(I) with the minimum V(I). The set of candidates for selection can be plotted against their expected income and variance of income. A hypothetical expected income variance (E-V) frontier is plotted in Figure 1.

Figure 1. The typical shape of the expected income variance frontier (Dematawewa et al., 1998). Five sires, each having a different expected income and variance of incomes are represented by points A-E.

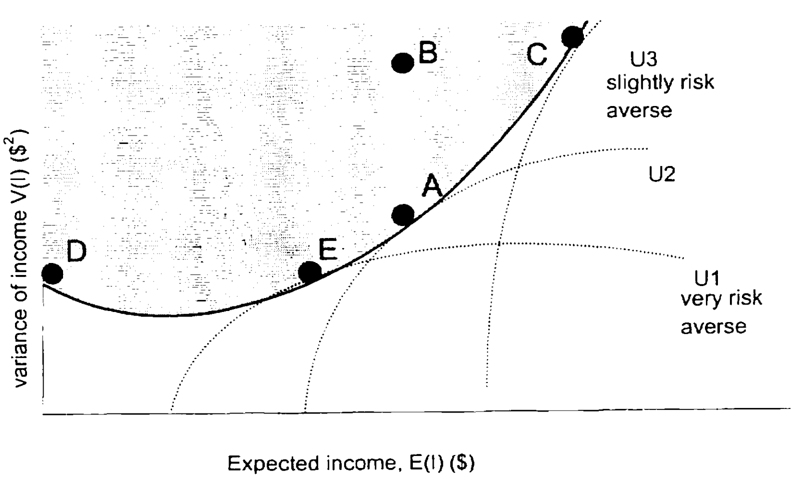


Each point on the E-V frontier represents a set of sires for which expected income has minimum variance. The feasible region represents the set of possible sires. Due to lower bounds on genetic variance (and variance of income) no sires exist outside the feasible region. Sires would usually be selected that are on the E-V frontier, for example, a sire represented by the point A would be selected by a risk averse bull-buyer over sire B despite both sires having identical expected income. A risk preferring bull buyer might prefer sire B since he has a higher probability of being better than some extreme value than does A. By chance, it is more likely that a progeny of the less accurate sire will be vastly superior such an individual could, in turn be used to sire the next generation (Woolliams and Meuwissen, 1993).

No breeder would select sire D within the irrational region since there are sires that are equally risky (have the same variance of income) but with a greater expected income in the rational region (sire E). Within a population making genetic progress in E(I), sire C would represent the youngest generation of candidate sires. A breeder who prefers risk will likely select sires with the highest expected income independent of income variance, preferring younger unproven sires such as sire C.

Iso-utility functions representing risk preferences of individual breeders can be modeled using [1]. Three hypothetical iso-utility lines representing extremely risk averse (U1) to slightly risk averse decision makers (U3) are shown in Figure 2. Each utility curve is upward sloping and shows diminishing marginal utility from incurring extra risk as specified in [2]. The tangent of the utility function to the E-V frontier represents sire selection decisions that maximize utility for the decision maker. A breeder who is slightly risk averse (U3) would likely select young sires with high expected income but also high variance of income. A conservative bull-buyer who is extremely risk averse (U1) would tend to select proven sires with the expectation of lower income and decreased variance of selection response.

Figure 2: Utility functions representing three different levels of risk aversion for individual breeders plotted against the E-V frontier for sires.



Using utility functions in breeding decisions

Utility functions can provide a comparison between different breeding schemes, between breeds, or between sires within breeds. Different breeding schemes were compared for utilities representing different levels of risk aversion (Meuwissen, 1991). Utility was defined as a function of both the expected rate and standard deviation of genetic gain: $U= E(\Delta G) +2\sigma(\Delta G)$. With maximum risk aversion, open nucleus breeding schemes gave the highest utility while conventional progeny testing schemes had the lowest utility. The higher utility of open nucleus breeding schemes over conventional progeny testing was achieved through higher expected ΔG in the open nucleus scheme despite having a higher standard deviation of genetic gain. Similarly, Schneeberger and Freeman (1980) used utility functions to discriminate between sire breeds where sire breeds differed in expectation of incidence of dystocia.

Incorporating accuracy in breeding decisions

The accuracy of genetic prediction for a particular trait on an animal is a function of heritability as well as the amount of information (pedigree and performance records) available for that trait and other correlated traits either on the animal itself or its relatives. Commercial beef cattle producers select candidate sires that have EPDs comparable across a number of herds. Accuracy values associated with EPD are a measure of the likelihood of a bull being different from zero by an amount given by the genetic prediction. However, as noted by Golden and Bourdon (1999), the accuracy of comparison between candidate sires depends on the distribution of individuals across contemporary groups and the degree of genetic linkage between contemporary groups. Current accuracy values do not fully reflect the risk of comparing the predicted genetic merit of unrelated sires from different contemporary groups.

When accuracy is viewed in light of making multiple-trait selection decisions, the definition of accuracy needs to be extended to account for how precisely the traits describe the goal of genetic improvement. This goal might include elements of profit maximization and risk reduction. The highest accuracy animals in a population will be sires with progeny records however, in a population making genetic progress, the younger animals will, on average, have higher merit. The dilemma for beef cattle breeders becomes how to manage the trade-off between the enhanced genetic merit of young sires and risk associated with purchasing these individuals.

An index incorporating weights on both estimated breeding values (EBV) and accuracy values (as correlation between true and predicted genetic merit - r_{TI}) was developed by Klieve et al. (1993). The weighting accorded to accuracy values was greater (more positive or negative) when breeders were assumed to be extremely risk averse or risk preferring, respectively. For two populations representing animals with moderate or high accuracy EBVs (r_{TI} = 0 to 1.0 and .5 to 1.0 respectively), weightings applied to accuracy values were $\pm$ .5 and $\pm$ 1.5σ_p, respectively. These results suggest that more emphasis can be placed on accuracy in selection decisions when the mean accuracy value of the population is high. Penalizing prediction error variance in breeding decisions results in selection of more accurate sires and reduces co-selection of sibs (Woolliams and Meuwissen, 1993).

Selecting individual sires is a tactical decision-making process that should be made in light of the breeding objective, anticipated level of risk as well as constraints such as the bull (or semen) purchase price and availability. Taking account of the costs of improved genes, younger unproven bulls may represent a more profitable investment decision with a young bull incurring a lower purchase price (over the lifetime of the bull) than either purchasing a proven sire or semen from such a bull.

Implications for beef cattle breeding programs

All selection decisions made by seedstock breeders and commercial producers incur a certain level of risk. In a rational economic context, commercial producers would purchase sires from breeders providing a high level of service in addition to bulls that increase profit and minimize risk. In practice, bulls are likely purchased on the basis of breeder reputation, bull cost and convenience, with EPDs and their accuracies accounting for only a small portion of variance in purchase price (Charteris, 1999). It is argued that selecting sires with high EPD accuracy is largely ineffective in reducing the risk of selection decisions. The problem is not that accuracies are calculated incorrectly rather, their efficacy in discriminating genetic differences between sires can be limited when sires are distantly related with poor genetic linkages between contemporary groups. Furthermore, EPDs are often published for indicator traits rather than traits directly influencing ranch profit.

Within the context of current genetic prediction technologies, choosing a large number of parents to sire the next generation (e.g. semen from several bulls rather than one bull) offsets any extra risk resulting from selecting animals with low accuracies. Accounting for differing accuracies when making selection decisions (i.e., selecting animals with higher accuracies) more than offsets any increase in variance of selection response resulting from selecting individuals that are related.

Academic animal breeders and breed associations should explore strategies for incorporating risk assessment into multiple-trait selection strategies. Some assessment of risk may be incorporated into bioeconomic simulation for inherently risky decisions such as introducing a new breed (or biotype) in a new environment or including a new trait in genetic evaluation for which no previous production and marketing data exist. Web-based delivery appears the most likely technology to incorporate some form of risk assessment in beef cattle breeding decisions.

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MINUTES OF BIF BOARD OF DIRECTORS MEETINGS

Beef Improvement Federation

Mid-Year Board of Directors Meeting
October 16, 1999
Minutes

Present: Altenburg, Boggs, Lloyd, Williams, Weaber, Holliman, Hutzel, Silcox, Cunningham, Anderson, Cundiff, McClung, Dillard, Dolezal, Quinn, Fink, O'Neill

Absent: Green, Chase, Crouch, Doubet, Evans, B. Hough, McLane, Smith

Guests: Todd Johnson, Twig Marston

The mid-year meeting of the Beef Improvement Federation Board of Directors was called to order by President Altenburg at 8:05 a.m. 10/16/99. Altenburg welcomed attendees and made opening comments. Additional items were added to the agenda as listed below:

Item 23 – NCE
Item 24 – Guideline re-writes
Item 25 – Mid-year 2000

Altenburg requested the agenda be cleared. Boggs distributed minutes from the Roanoke 1999 annual convention board meeting. Correction was made on page 3 regarding board meeting date as December rather than October. Also, the spelling correction of "Pollack" to "Pollak" was made. Minutes were approved as corrected (Anderson/Hutzel). Motion carried.

Boggs distributed financial report (1/1/99 to 10/14/99). Dues were down slightly from the past. The biggest decline was proceedings sale. Expenses are in line with predictions. ICAR project still accounts for $4000 in committed expenses. Fund balance was $58,945.94, of which $55,893.92 was in a money market and the residual in a checking account. One unexpected expense was tied to a committee presentation from the Roanoke convention. Motion to approve the financial report was made by Anderson, seconded by Fink. Motion carried.

1999 Roanoke Convention Report
Boggs distributed a written report (by Norm Vincel) on Roanoke Convention. A financial summary was included. A total of 488 persons attended the convention, 320 of which paid full registration. The convention income was $98,458 and expenses were $87,414.18. Vincel also indicated in writing that media persons had asked about a reduced registration fee. Discussion was held. Virginia had chosen to fund the convention with no liability to BIF. Most recent conventions have chosen to be "on their own" financially. Additional areas of discussion included speaker expenses and their length of hotel stay. Fink asked how speaker expenses were handled. Hutzel moved to

have a guideline for speakers of 2 nights plus travel. Seconded by Holliman. Motion carried.

Issue of expenses for committee speakers was discussed. Typically the committee speakers/reporters do not have travel paid as explained by Cundiff. Motion was made by Fink that BIF will not pay committee expenses unless approved by the board. Seconded by Williams. Motion carried.

Virginia had requested that BIF pay for additional 100 proceedings that were requested by BIF. Discussion was held on the responsibility of paying for the proceedings. Also, the issue of printing responsibility was described. Anderson moved that BIF pay for the 100 copies, seconded by O'Neill. Motion carried. Media had requested a reduced rate for registration. Weaber indicated that a reduced rate may be in order since the media provide a service to BIF. Dillard suggested that a reduced rate including meals would be important. Boggs reminded the board that the host committee establishes the registration amounts. A media mailing list does exist. Weaber suggested a media credentials form is created to be reviewed by host committee/executive director. Motion was made by Weaber to have a media credential policy developed and put in place for the BIF 2000 convention. Seconded by Quinn. Motion carried. Silcox stated the need for a resolution: Therefore be it resolved, the Virginia hosts did a great job and BIF was very pleased with the convention activities.

2000 Wichita Convention Report

Altenburg introduced Twig Marston and Todd Johnson to lead the Wichita 2000 Convention discussion. Marston distributed a convention schedule outline for July 12-15, 2000. Also, tours were described. Twig indicated that Mark Gardiner coordinated the tour stops. Also, a block of rooms is reserved at the Hilton at Garden City to accommodate tour attendees. Marston said that both program tours will receive equal press release. Discussion was held. Host committee has arranged hotel accommodations and blocked rooms for Tuesday July 11 through Saturday July 15 with the Hyatt Regency, Wichita, KS, as well as The Broadview Hotel. Boggs requested that Johnson visit with hotel regarding space for Saturday night stayover. Johnson, estimating attendance of 500 and 600 persons, presented a proposed budget. Additional 100 proceedings were listed in the budget. Fink indicated that additional sponsorship was available if these sponsors were given time on the program. Lloyd commented on the advantages and disadvantages of providing sponsors speaker time. McClung commented on the use of advertising in Virginia, with posters and recognition of sponsors.

A five-minute time period was suggested, allowing comments about the value of BIF, as explained by Quinn. Host committee would need to ask the sponsor for a short specific set of comments. Boggs suggested that these comments from sponsors be kept out of the general sessions. O'Neill asked if the sponsors had ever been asked to sponsor a page in the proceedings. Motion was made by Cunningham to accept Wichita 2000 convention presentation from the host committee. Seconded by Quinn. Motion carried.

2000 Wichita Program Committee

Galen Fink summarized the outline of the Wichita July 12-14, 2000, "Technologies" general sessions. Anderson described the Wednesday night program on Economically Relevant Traits. Fink continued a summary of Thursday speakers and Friday presentations. He asked if the board had any additional revisions or comments. O'Neill asked how the discussion periods would be handled to allow ample time for questions. Program committee was Fink, Boggs, McClung, Anderson, B. Hough, Green, Dolezal, Marston. Altenburg and Dillard suggested that "ownership" of the technology should be addressed on the program, such as in the "ethics" topic. Also, breakout topics in the committees may include this topic. Marston commented that additional speakers requested by the board would be welcomed if needed. Marston said that 40-50% of attendance at convention would probably be cattle producers. Boggs indicated that speakers would tell producers what is currently available in new technologies and what is the potential impact in the future. Motion was made by Hutzel to accept the program committee report. Seconded by Holliman. Motion carried.

Standing Committees

Emerging Technologies report by Green was presented in written form as read by Altenburg. National carcass merit report was attached as well. No further action was taken.

Genetic Prediction report was given by Cundiff. Cundiff indicated that a mailing for Genetic Prediction workshop had been distributed. The dates are December 2-4, 1999, Embassy Suites, Kansas City, MO. An additional program copy was distributed to the board. The WCC-100 Technical Committee conducting research on Genetic Prediction in Beef Cattle has chosen to meet in conjunction with the BIF workshop. Topics will include multi-breed evaluation, marker-assisted selection, and international evaluation. A registration of $110 per person will be assessed. Cundiff included a printed workshop budget based on 100-125 participants. BIF will underwrite up to $2500 of the $10,000 in expenses.

Altenburg reflected on discussions from previous night regarding committee responsibilities. Committees needed time to work on Guidelines and input from a producer steering committee. Silcox suggested that the guidelines revision could be initialized at the genetic prediction workshop, since committee members would be present. Cundiff suggested individuals to assist in editing the Guidelines (such as R.L. Willham).

Anderson indicated that he had contacted individuals about topics for Kansas. Multiple-trait selection committee may address "managing risk" in Multiple-trait selection. New methods for screening data, such as contemporary groups, may be discussed. As a take-off from the general session, the issue of convenience traits may be addressed. Managing risk from the use of EPDs, accuracy, managing heterosis is another topic of interest. Also, use of ultrasound EPDs versus carcass EPDs for selection choices may be included.

Cunningham gave the live animal and carcass evaluation report. He updated the board on centralized ultrasound processors meeting. He suggested that for Wichita, the ultrasound genetic prediction topic be visited regarding contemporary groups and endpoints.

Producer applications committee report was given by Dolezal. Issues to be addressed may include – Carcass data, How do I use it? Producers will be contacted for more specific input. The session may also be directed toward educators (extension personnel for example). Boggs commented that dealing with information overload is important. Quinn asked if a producer could report on cloning or new technologies used in Kansas. How does future technology fit into my program? Fink suggested feeding of bulls and production efficiency, having a producer deliver the message (pros versus cons).

Bob Weaber presented the Whole Herd update for Bob Hough. The disposal codes guidelines are complete, but these may need additional review before re-printing guidelines. Reporting schedules for fall versus spring cows are of interest in the committee, also. Challenges of inventory vs. whole herd reporting in associations will be discussed.

Altenburg suggested that a list of steering committee members for each committee (approx. 8 members) be provided at the board meeting following the annual meeting.

Break (Return at 10:45 a.m.)

Boggs asked who would be the voting body in the standing committees. Would these steering committees be the only persons with voting privileges? Silcox referred to the committee voting procedures in By-Law 13, Sec. 1. This section states that any paid participant to an annual meeting who is from the ranks of the member organizations may participate and vote in the proceedings of any committee meeting. All of the committee activities must be approved by the executive board. Cundiff suggested that the steering committee could bring issues to the full committee to vote on at the annual meeting. This approach is used in other organizations. Further discussion was held on By-Laws interpretation. Altenburg summarized the discussion. Each standing committee will have a steering committee but all committee participants will have voting privileges as described in the By-Law 13, Sec. 1.

Frank Baker Essay Contest

Cundiff summarized essay participation and explained that student travel expenses have limited the number of entries at some convention locations. He suggested that the contest be continued.

Poster Contest

Altenburg presented the report from Green. Green requested the board determine the need for continuing this contest. Hutzel moved to have BIF discontinue the poster contest. Seconded by Anderson. Discussion was held. Question was called. Motion carried. O'Neill asked about the information available on the web site. Is there the potential to showcase the student work (contest) on the web site (to increase participation)?

O'Neill made the motion to consider the Homepage activity made by students as a competition. Motion retracted by O'Neill. Boggs indicated that winners could be listed on the web site in future.

Future Sites for BIF Convention

Texas contact, Joe Paschal, had suggested to Boggs the San Antonio TX site for BIF Convention 2001. Dates proposed fall in the last of May, first of June 2001. Discussion was held. A hotel on the San Antonio riverwalk was proposed by the Texas group. The NAAB symposium would be held on Wed night, with tours on Saturday (King Ranch and YO Ranch). Lloyd said that NCBA would be in San Antonio in 2001 (end of January, first part February)

Boggs indicated that Jim Gosey would like to host BIF in Lincoln, NE. The projected year would be 2002. Dillard indicated that Florida is targeted for 2002 also. A location such as Orlando would need to be booked in advance.

Williams suggested the TX group consider additional tour stops. Discussion was held on future location commitments. Discussion was held with respect to switching the NE with FL. Motion was made by Cunningham (second by Fink) to hold meeting in San Antonio TX for 2001, Lincoln, NE in 2002, Florida in 2003 (Orlando area).

Re-Districting of BIF Regions

A motion was tabled at the previous board meeting (6/16/99: It was proposed to keep the east region in its current form but change the central and west regions to north and south by drawing a boundary line running east-west along the southern borders of IA, NE, WY, ID, and OR). Anderson/Weaber asked that the motion to change districts be removed from table. Motion carried. Discussion was held. Question. The re-districting proposal from the 6/16/99 meeting in Roanoke was defeated.

Current By-Law 4, Sec. 2 explains the current regions. Silcox presented the new re-districting regions proposal (handout). Motion by Cunningham to approve realignment as presented by Silcox. Seconded by Anderson. Motion carried.

Silcox made another mention of the Ag. Canada change needed on page 5 of By-Laws. Boggs indicated that a mailing to the membership could handle these by-law changes.

Cunningham/Holliman asked to change Ag. Canada to Canadian Breeds Council. Motion carried.

Central Regional Secretary Position

Altenburg described that Dolezal was no longer in an Extension position but the by-laws do not restrict her continued service. Silcox agreed and stated that restrictions were not listed in the by-laws, and the executive board appoints this regional secretary position. Discussion was held. No action was taken.

Executive Director Appointment

Boggs described that his new administrative position would not make it possible for him to continue as BIF executive director. Altenburg describe the logistics of replacing the director position with Silcox or Dolezal. Green had declined interest due to other commitments. Expansion of regional secretary responsibilities was discussed. Boggs, Silcox, and Dolezal made comments on the executive director position.

Motion by Anderson, second by Hutzel, to have Ronnie Silcox as Executive Director and Sally Dolezal as Associate to Executive Director and Central Region Secretary. Motion carried unanimously.

Lunch break 12:00 noon; Meeting resumed 1:00 p.m. by Altenburg.

Silcox asked about the operating budget for BIF. Boggs presented last year's budget as an example for the future year (handout). He suggested an audit after January 1, 2000, and transfer of the checking account to Silcox. Altenburg suggested that Silcox present a revised budget at Wichita. An additional handout from Boggs gave a statement of revenues and expenditures 1/1/98 to 12/31/98. Sale of proceedings would help on the projected income as indicated by Boggs. Discussion was held about postage from Canadian meeting. The board discussed the billing of these expenses (approx. $600-$700) to the Calgary meeting group. Editorial expenses of $1750 for Beef magazine layout are not listed on the budget. Also, a conference call expenditure needs to be budgeted.

Eastern Region Secretary Position (added to agenda)

Silcox and Dolezal suggested Darrh Bullock, University of Kentucky, Extension Beef Specialist, as an eastern regional secretary candidate. Boggs suggested John Hall, VPI, as an additional candidate for regional secretary. Silcox also suggested Scott Greiner, VPI. Cundiff suggested Roger McCraw, NC State. Williams suggested Comerford. Altenburg opened the floor for nomination. McClung nominated Scott Greiner. Anderson nominated Darrh Bullock. Williams/Holliman moved that nominations cease. Hand vote was taken Greiner (3) Bullock (8). Bullock will be the Eastern region secretary chosen. Altenburg will contact Bullock.

ICAR Study

Travel for Keith Bertrand with a maximum of $2500 was approved in the past board meeting. Hutzel/Holliman moved to approve the $1350 contribution to the ICAT study. Motion carried.

Miles City ARS Review

O'Neill and Altenburg attended the Miles City activity and found the results favorable.

Tenderness Project

Williams suggested that collection of data is not easily accomplished. Cunningham stated that Beefmaster dropped out of the project. He stated that protocol is running more smoothly. Four to five bulls are close having enough data to have DNA work. The 4 ½ year time frame has been reasonable on a project of this scope. The written paper from Green was distributed earlier in the meeting. Discussion was held.

NCBA Update

Lloyd gave an update on NCBA activities as follows: She distributed a handout from NCBA on injection site quality control. The non-fed beef tour video by "Mr. Food" was discussed. Lloyd also distributed the Johne's Disease brochure. This fall a market cow audit will be held with results presented at the convention. Beef advertisement for 10/11-10/31 are commercials on key media programs. Women 25-54 years of age preparing the meal are targeted in this $30 million campaign. Instrument grading will be placed in Monfort plant soon as stated from Bo Reagan by Lloyd. The 2000 NCBA Convention will be held on Jan 26-29, 2000, in Phoenix. Lloyd indicated that the genetic workshop at NCBA was very much appreciated by NCBA. In future years she suggested this approach be taken again as topics arise. The national beef cattle database will be available for sale at the 2000 NCBA convention.

Boggs asked if the NCBA convention could be carried on satellite. Lloyd said this approach is still under consideration. Nov 1-2, 1999, is a Beef Summit in New York is directed toward purveyors, retailers, and packers.

Homepage Update

Boggs reported that the home page is set up, but the domain name change is taking extensive time (www.bif.org). By switching domain days, this process would be over. The page will be at a private location in Rapid City. Anderson asked if the location should be changed relative to the web site. Boggs indicated that he corresponds with the company via e-mail. Capturing the domain name "bif.com" was suggested by Cunningham so BIF would have it in control too.

Fact Sheet Update
Dolezal distributed a handout of the fact sheets in progress. She indicated that new lead authors would be chosen for those write-ups not initiated up to this point.

Awards committee

Quinn, Holliman, Hutzel, Silcox, Williams were named to the awards committee by Altenburg. The committee will decide chair position.

Guidelines for Producer of Year

Boggs asked if choosing for the Producer of Year awards was part of awards committee or the responsibility of executive director. Also, questions were asked as to how the producer award applications were evaluated. Boggs said that no guidelines are available to place emphasis on areas. Fink moved to have Altenburg select a committee to develop guidelines for evaluating the Producer award applications. Seconded by McClung. Discussion was held. Dillard said not to restrict the criteria to the point where you keep out new innovations and ideas. Cundiff indicated that the winners bring publicity to BIF as well as the producer. Both entities benefit. Question. Motion carried.

Altenburg appointed the committee of Dolezal, O'Neill, and Anderson, to develop producer award application review criteria. Committee results must be completed by 12/1/99.

Altenburg appointed the Nominating committee (selection of producers for future officers) – Weaber, Lloyd, B. Hough.

National Cattle Evaluation

John Pollak visited with some of BIF board on Friday evening to update group on the proposal to develop a national cattle evaluation center. Four universities (GA, IA, Cornell, CSU) would work cooperatively as a virtual center for genetic evaluation research. Existing universities would share resources in this research area. Altenburg gave an update on the purpose of this virtual center. Those involved hoped 30% of the monies would be used by institutions outside the four. The university administration, NCBA, and BIF representatives will meet before the December GP workshop. BIF has been asked to help sponsor this meeting and meal. O'Neill suggested that a written response be drafted to send to deans and administrators regarding the importance of this topic. Dillard commented on the importance of contacts to legislators on this issue. Value to the beef industry and other universities would need to be emphasized. Kent Anderson was chosen by Altenburg to represent BIF at the meeting in December.

Guidelines Revision

Altenburg stated that committee chairs can initiate the guidelines revision and an editor can be selected. An electronic copy is definitely needed. Boggs suggested that areas of revision need to be identified. Altenburg set the 7/15/99 deadline to allow the committee (chaired by Cunningham) to evaluate the revision process.

Midyear 2000 meeting

Boggs indicated that moving the mid-year board meeting location from Kansas City would need to be planned now. Dillard stated that the Estes Park location was discussed for October 2000. However, the KCI location is convenient. Altenburg suggested the mid-year date be set at convention. Boggs suggested an earlier contact with Embassy if the Kansas City location is desired. Discussion was held on other hotel possibilities. Altenburg asked Williams to check the Oct 20-21 dates or Oct 27-28,2000 for tentative dates and report at Wichita.

Official Publication

The official publication of BIF is still listed as American Beef Cattlemen. Discussion was held as other potential publicity avenues. Fink moved to approach Beef magazine as an official publication of BIF seconded by Cunningham. Fink/Cunningham withdrew motion.

Quinn suggested a beef booth at beef cattle symposium in Greeley. Those board members close to the location would be helpful.

Boggs stated that committee chairs need to submit minutes for proceedings.

Quinn suggested a single-sheet BIF description with publications and web site for general publicity. Boggs thought that S. Doubet worked on this earlier.

As a future agenda item, O'Neill indicated the need to discuss end-product and future programming ideas. Boggs suggested that a committee be directed toward end-product. Standing committees for review this year are Emerging Technologies and Live Animal/Carcass. Cunningham suggested that the live animal and carcass evaluation committee could be re-directed more specifically toward end-product topics. Discussion was held on whether to change the Live Animal/Carcass name. Anderson/Williams so moved to change committee name to Live Animal, Carcass, and End Product Committee. Motion carried.

Weaber moved to continue Emerging Technologies committee. Seconded by Quinn. Motion carried.

Motion to adjourn by Cunningham. Seconded by Quinn. Motion carried. 3:09 p.m.

MINUTES

Beef Improvement Federation
Annual Board of Directors Meeting
Wichita, Kansas
July 12, 2000

The annual meeting of the Board of Directors of the Beef Improvement Federation was called to order by President Willie Altenburg . Ronnie Greene was asked to start the meeting with a prayer. Additions and changes were made to the agenda. Introductions of board members followed.

Minutes from the mid-year board meeting had been distributed to board members. A motion was made and seconded to accept the minutes. The motion passed.

Financial reports for 1999 and the first half of 2000 were presented. A motion was made to accept the financial statement. The motion passed.

BIF involvement with ICAR was discussed. It was suggested that a written report on involvement with ICAR is needed with recommendations as to BIF's role. Ronnie Silcox is to contact Keith Bertrand.

Proposed budget for 2000 was discussed. A motion to accept the budget passed. It was suggested that an audited transfer of funds from Boggs to Silcox be made. There was a discussion over how money was to be handled. A motion was made for Officers and the Executive Secretary to make conservative investments of funds (i.e. CD's). This motion passed.

Ronnie Silcox brought up that there are still a number of copies of BIF's History available. A motion was made to sell books at the convention for $5 each. Motion passed.

By-law changes were discussed. Copies of proposed changes had been sent to members. No action was taken by the board since this was to be handled in the annual meeting.

The nominating committee reported that nominations for new officers were Galin Fink, President and Connie Quinn, Vice President.

Election of board members was discussed. Kent Anderson second term expired. It was reported that James Smith did not wish to run for re-election for second term as At-large board member. Bob Hough's first term ended and he could be re-elected. Connie Quinn's first term as Central board member expired. Due to the proposed changes in by-laws, her re-election could be affected. Since she was nominated as Vice-president, it was decided that this was not an issue. Officers serve until the end of their term of office.

Darrh Bullock was introduced as the new Eastern Region Secretary to replace Ronnie Silcox following his move to Executive Director.

Bob Weaber's position on the board was discussed. Since he is leaving the Gelbvieh association there was concern over whether he should remain on the board. Since he had not left yet, it was decided that that would need to be addressed after the change.

Regional Secretary positions was discussed. Ronnie Green had moved from a University position to an industry position. There was discussion about university representation on the board. A motion was made to for Ronnie Green to remain as Western Region Secretary. The motion passed. Galen Fink is to appoint a committee to evaluate regional secretary positions.

A list of paid members was passed out. Membership was discussed. A motion was made to appoint a membership committee to plan member recruitment and to look into how members fit with bylaws descriptions. Motion passed.

Todd Johnson and Twig Marston reported on the convention and gave and update on how things were running.

Robert Williams reported on hotels for the midyear board meeting in Kansas City. A list of hotels was distributed. It was decided that the Durry Inn would be the first choice and the Sumner Suites would be second. Dates were discussed and a motion passed to hold the meeting on October 20-21. Silcox was to check on availability and report back.

Standing committees were discussed and the formation of a steering committee to coordinate activities was suggested. No action was taken.

Joe Paschal reported on plans for the 2001 convention in San Antonio, Texas on July 11-14. Texas will sponsor the convention. Plans are to try to keep registrations similar to the 2000 level. The question was raised about commercial sponsors having a hospitality suite. There was no objection as long as the agreement was clear about requirements.

Jim Gossey made the offer to host the 2002 convention in Lincoln, Nebraska. Hosts will include the Nebraska Cattlemen's Association, MARC and The University of Nebraska. Dates have not been set, but will probably be in June.

Jed Dillard reported that discussions had been held with the Florida Cattlemen's Association about the 2003 convention. A firm decision has not yet been made. A decision is expect before the midyear meeting.

Silcox reported on awards to be presented at the convention. Larry Cundiff reported that there were ten entries in the Frank Baker Scholarship essay contest and that this was the best participation ever. The $500 scholarship is to pay travel for a graduate student. A motion was made that the money could be paid early to a winner if they needed it to travel to the convention. The motion passed.

Committee chairs reported on committee plans. Larry Cundiff gave a summary of the Genetic Prediction workshop held in December and reported that the Genetic Prediction Committee would begin work on guidelines. Other committee chairs gave an update on speakers. Kent Anderson indicated that at new chair for the Multiple Trait committee was needed. A motion was made to cover travel expenses for Harris Lewin in the Emerging Technology Committee. The motion passed. A second motion was made to allow the executive committee to make decisions related to covering speaker expenses in advance of inviting the speaker. The motion passed.

A motion was made to have committee chairs and other interested persons meet at the midyear meeting to discuss *Guidelines* revisions. Motion passed. Robert Williams will chair.

A report on fact sheets was made by Sally Dolezal. There was discussion on how to send out fact sheets. Web page and the possibility of a CD were discussed.

The home page was discussed. It was suggested and agreed that the homepage address needs to be listed more prominently. A committee was appointed to look into improving the website composed of Bullock, Quinn, Dolezal and O'Neill.

Renee Lloyd reported on NCBA activities and Connie Quinn reported on a promotional sheet developed to use at meetings.

The meeting was adjourned with a follow up scheduled for Friday night.

MINUTES

Beef Improvement Federation
Board of Directors Post-Convention Meeting
July 14, 2000

The meeting was called to order by Galin Fink. The first order of bussiness was to appoint committees based on the previous meeting.

The committee to evaluate the regional secretaries position consists of Bob Hough, Rene Lloyd, Connie Quinn and Darrh Bullock.

The committee to review membership is S. R. Evans, Loren Pelton, Marty Ropp, Terry O'Neill, Gini Chase and John Crouch.

Darrh Bullock was appointed to chair the Multiple Trait Committee.

Robert Williams was appointed to chair the *Guidelines* Committee.

Ronnie Silcox gave an update on the midyear board meeting. Hotel rooms had been reserved at the Durry Inn in Kansas City for October 20-21.

Hans Schild from ICAR joined the meeting and gave a summary of ICAR activities. A survey on worldwide reporting is running that was funded by BIF. The next meeting is in Petoria, South Africa in November. Hans requested that BIF continue to be involved with ICAR. A motion was made that BIF send someone to the meeting. The motion passed. Following discussion Darrh Bullock was selected.

The program committee for the 2001 convention was named and includes Connie Quinn, Sally Dolezal, Darrh Bullock, Ronnie Green, Rene Lloyd, Robert Williams and Jimmy Holliman.

A committee was appointed to study compensation for the Executive Secretary composed of Willie Atlenburg, Doug Frank and Richard McClung.

The meeting was adjourned.

FINANCIAL STATUS REPORTS

Beef Improvement Federation

Statement of Revenues and Expenditures
Cash Basis
January 1, 1999 to December 31, 1999

Revenues:

Dues	$10,700.00
Guidelines and Proceedings	$872.50
Interest Income - Checking	$68.27
Interest Income - Money Market	$1,950.74
Genetic Prediction Workshop	$5,040.00
Total Revenues	**$18,631.51**

Expenditures

Bank Charges	$5.95
Clerical Assistance	$1,088.00
Legal and Accounting	$42.40
Office Expenses and Supplies	$55.94
Postage and Freight	$1,655.44
Printing/Copies	$254.48
Executive Director Expenses	$1,200.00
Awards	$3,574.00
Editorial - Beef Articles	$1,750.00
Convention Expense	$720.08
Conference Call	$271.84
Homepage Development	$1,482.20
Mid-Year Board Meeting	$957.21
ICAR	$2,978.06
Genetic Prediction Workshop	$4,656.45
Total Expenditures	**$20,692.05**

Excess Revenues over Expenditures	**$(2,060.54)**

Beef Improvement Federation
Statement of Fund Balance

As of December 31, 1999

Assets:

Cash in Checking Account	$3,375.41
Cash in Money Market Savings Account	$52,373.51
Total Assets	**$55,748.92**

Liabilities and Fund Balance:

Fund Balance - January 1, 1999	$57,809.46
Current Year Excess (Deficit)	$(2,060.54)
Fund Balance - December 31, 1999	**$55,748.92**

Total Liabilities and Fund Balance	**$55,784.92**

Beef Improvement Federation

Statement of Revenues and Expenditures
Cash Basis
January 1, 2000 to July 10, 2000

Revenues:

Guidelines and Proceedings	$187.50
Interest Income - Checking	$80.63
Interest Income - Money Market	$715.71
Convention (For Proceedings from VA Tech)	$5,280.00
Genetic Prediction Workshop	$925.00
Dues	$8,900.00
Total Revenues	**$16,088.84**

Expenditures

Bank Fees (Checks)	$38.30
Clerical Assistance	$950.00
Legal and Accounting	$80.00
Postage and Freight	$375.66
Printing/Copies	$360.87
Homepage Development	$277.21
Genetic Prediction Workshop	$2,604.89
Office Supplies	$123.87
Convention Awards	$1,866.80
Total Expenditures	**$6,677.60**

Excess Revenues over Expenditures	**$9,411.24**

Beef Improvement Federation
Statement of Fund Balance

As of July 10, 2000

Assets:	
Cash in Checking Account	$6,608.24
Cash in Money Market Savings Account	$48,089.22
Cash in Checking Account	$8,462.70
Cash in Money Market Savings Account	$2,000.00
Total Assets	**$65,160.16**
Liabilities and Fund Balance:	
Fund Balance - January 1, 2000	$55,748.92
Current Year Excess (Deficit)	$9,411.24
Fund Balance - July 10, 2000	**$65,160.16**
Total Liabilities and Fund Balance	**$65,160.16**

MEMBER ORGANIZAITONS AND DUES PAID

BIF MEMBER ORGANIZATIONS & DUES FOR 2000

Beef Cattle Improvement Associations

BCIA	Dues
Alabama BCIA P.O. Box 2499 Montgomery, AL 36102-2499 (334) 265-1867	$100
Animal & Veterinary Science Department University Of Idaho P.O. Box 1827 Twin Falls,ID 83303-1827 (208) 736-3638 www.avs.uidaho.edu	$100
Florida BCIA Rt. 1 Box 2500 Lee, FL 32059 (850) 971-5779	$100
Georgia Cattleman's Bull Test Committee P.O. Box 24510 Macon, GA 31212 (912) 474-6560 www.gabeef.org	$100
Illinois BCIA 1207 W. Gregory Drive MC-630 University of Illinois Urbana, IL 61801 (217) 333-2647	$100
Indiana Beef Evaluation Program 1151 Lilly Hall Purdue University West Lafayette, IN 47907-1151 (765) 494-4831 www.ansc.purdue.edu/ibep	$100
Iowa Cattleman's Association P.O. Box 1490 Ames, IA 50014 (515) 296-2266 www.beef.org	$100
Kansas Livestock Association 6031 SW 37th St. Topeka, KS 66614 (785) 273-5115 www.kla.org	$100

BCIA	Dues
Kentucky Cattleman's Association 804 WP Garrigus Bld Lexington, KY 40546 (859) 257-7514	$100
Maryland Cattleman's Association 1129 Animal Science Center College Park, MD 20742-2311	$100
Michigan Cattleman's Association P.O. Box 24041 Lansing, MI 48909 (517) 336-6780	$100
Minnesota BCIA 536 Inca Lane, NE New Brighton, MN 55112	$100
Mississippi BCIA Box 9815 Mississippi State, MS 39762 (662) 325-7466	$100
Missouri BCIA P.O. Box 408 Jackson, MO 63700 (573) 243-3581	$100

BCIA	Dues
Nebraska Cattleman 1335 H Street Lincoln, NE 68508 (402) 475-2333 http://nebraskacattleman.org	$100
New Mexico BCIA Animal Resources Department Cooperative Extension Service New Mexico State University Box 30003 MS 3AE Las Cruces, NM 88003	$100
North Carolina BCIA NCSU Box 7621 Raleigh, NC 27695-7621 (919) 515-2761	$100
Ohio Cattleman's Association 10600 US Hwy 42 Marysville (614) 873-6736 www.ohiobeef.org	$100
Oklahoma Beef Inc. P.O. Box 1895 Stillwater, OK 74076-1895 (405)642-1181	$100

BCIA	Dues
South Dakota Beef Breeds Council P.O. Box 314 Kennebec, SD 57544 (605) 869-2272 www.sdcattlemen.org	$100
Tennessee BCIA P.O. Box 1071 Knoxville, TN 37901 (865) 974-7294	$100
Texas Agricultural Extension Service Rt. 2 Box 589 Corpus Christi, TX 78406-9704 (361) 265-9203 http://animalscience-extention.tamu.edu	$100
Wyoming BCIA University of Wyoming P.O. Box 3684 Laramie, WY 82071 (307) 766-3100	$100

Breed Associations

BA	Dues
American Angus Association 3201 Frederick Ave. St. Joseph, MO 64506 (816) 383-5100 angus@angus.org	$600
American Brahman Breeders Assn. 3003 S. Loop West Suite 140 Houston, TX 77054 (713) 349-0854 www.brahman.org	$200
American Chianina Association P.O. Box 890 Platte City, MO 64079 (816) 431-2808 www.chicattle.org	$200
American Gelbvieh Association 10900 Dover St. Westminster, CO 80021 (303) 465-2333 www.gelbvieh.org	$300
American Hereford Association 1501 Wyandotto Kansas City, MO 64108 (816) 842-3757 www.hereford.org	$500

BA	Dues
American International Charolais Assn. P.O. Box 20247 Kansas City, MO 64195 (816) 464-5977 www.charolaisusa.com	$300
American Maine Anjou Assn. 760 Livestock Exchange Bldg Kansas City, MO 64102 (816) 474-9555 www.maine-anjou.org	$200
American Red Brangus Assn. 3995 E. HWY 290 Dripping Springs, TX 78620 (512) 858-7285 www.brangususassc.com	$100
American Salers Association 7383 S. Alton Way Suite 103-C Englewood, CO 80112 (303) 770-9292 www.salersusa.org	$200

BA	Dues
American Shorthorn Association 8288 Hascall St. Omaha, NE 68124 (402) 393-7200 www@beefshorthornusa.com	$200
American Simmental Association 1 Simmental Way Bogeman, MT 59718 (406) 587-4531 www.simmental.org	$300
American Tarentaise Association P.O. Box 34705 N. Kansas City, MO 64116 (816) 421-1993	$100
Beefmaster Breeders United 6800 Park Ten Blvd. Suite 290 West San Antonio, TX 78213 (210) 732-3132 www.beefmasters.net	$300
Canadian Angus Association 214, 6715-8 St. NE Calgary, AB T2E 747 (403) 571-3580 www.cdnangus.ca	$300

BA	Dues
Canadian Charolais Association 2320 41st Ave. NE Callary, Alta T2E 6W8 (403) 250-9242 www.charolais.com	$300
Canadian Gelbvieh Association 110, 2116-27 Ave NE Calgary, Alberta T2E7A6 (403) 250-8640 www.gelbvieh.ca	$100
Canadian Hays Converter Assn. 550, 1207-11 Ave SW Calgary, AB T3C0M5 (403) 245-6923	$100
Canadian Hereford Association 5160 Skyline Way NE Calgary, AB T2E 6V1 (403) 275-2662 www.hereford.ca	$300
Canadian Limousin Association 2320-41 Ave NE Calgary, AB T2E 6W8 www.limousin.com	$200

BA	Dues
Canadian Simmental Association #13 4101- 19th St. Calgary, AB T2E 7C4 (403) 250-7979 www.simmental.com	$300
International Brangus Breeders Association P.O. Box 696020 San Antonio, TX 78269 (210) 696-4343 www.int-brangus.org	$300
North American Limousin Foundation 7383 S. Alton Way Suite 100 Englewood, CO 80112 (303) 220-1693 www.nalf.org	$300
North American South Devon Assn. 2514 Ave. S. (409) 927-4445 www.southdevon.com	$100
Red Angus Association of America 4201 I-35N Denton, TX 76207 (940) 387-3502 www.redangus1.org	$300
Santa Gertrudis Breeders International P.O. Box 1257 Kingsville, TX 78364 (361) 592-9357 www.sghi.org	$200
Senepol Cattle Breeders Assn. P.O. Box 808 Stathem, GA 30666 (800)SENEPOL www.senepolcattle.com	$100
United Bradford Breeders 422 East main Suite 218 Nacogdoches, TX 75961 (936) 569-8200 www.bradfords.org	$100

Other Organizations

Org.	Dues
ABS Global P.O. Box 459 DeForest, WI 53532 (608) 846-3721 www.absglobal.com	$100
Accelerated Genetics E10890 Penny Lane Baraboo, WI 53913 (608) 356-8357 www.accelgen.com	$100
Beefbooster Inc. 26, 3515 27th st. NE Calgary, AB (403) 291-9771 www.beefbooster.com	$100
Colorado Cattleman's Association 8833 Ralston Rd Arvada, CO 80002-2239 (303) 431-6422	$100
Composite Cattle Breeder's International Alliance CSU, Chico College of Agriculture Chico, CA 95929-0310 (530) 898-4539 web.csuchino.edu/~slsmith/CCBIA	$100
Connors State College Rt. 1 Box 1000 (918) 463-2931	$100
Dickinson Research Extension Center Dickinson Research Extension Center 1133 State Ave. Dickinson, ND 58601 (701) 483-2427	$100
eMerge Interactive 11001 West 120th Ave., Suite 400 Broomfield, CO 80021 (303) 410-4230 www.cattleinfonet.com	$100
Farmland Industries, Inc. P.O. Box 7305 Dept. 200 Kansas City, MO 64116 (816) 891-3644	$100
Genex Cooperative, Inc. 100 MBC Drive Shawano, WI 54166 (715) 526-7553 www.crinet.com	$100

Org.	Dues
Great Western Beef Expo 508 S. 10th Ave. Suite 1 Sterling, CO 80751 (970) 522-3200	$50
Midwest MicroSystems, LLC 4701 Innovation Dr. Lincoln, NE 68521 (402) 472-3980 www.midwestmicro.com	$100
National Association of Animal Breeders, Inc, P.O. Box 1033 Columbia, MO 65205-1033 (573) 445-4405 www.naab-css.org	$100
National Cattleman's Beef Association 5420 S. Quebec St. Englewood, CO 80111 (303) 694-0305 www.beef.org	$100
Select Sires, Inc. 11740 Rout 42 Plain City, OH 43064 (614)873-4683	$100
Taylor's Black Simmentals, LLC Box 176 Winona, KS (785) 846-7749	$50

2000 BIF
AWARDS PRESENTATIONS

SEEDSTOCK PRODUCER HONOR ROLL OF EXCELLENCE

John Crowe	CA	1972
Dale H. Davis	MT	1972
Elliot Humphrey	AZ	1972
Jerry Moore	OH	1972
James D. Bennett	VA	1972
Harold A. Demorest	OH	1972
Marshall A. Mohler	IN	1972
Billy L. Easley	KY	1972
Messersmith Herefords	NE	1973
Robert Miller	MN	1973
James D. Hemmingsen	IA	1973
Clyde Barks	ND	1973
C. Scott Holden	MT	1973
William F. Borror	CA	1973
Raymond Meyer	SD	1973
Heathman Herefords	WA	1973
Albert West III	TX	1973
Mrs. R. W. Jones, Jr.	GA	1973
Carlton Corbin	OK	1973
Wilfred Dugan	MO	1974
Bert Sackman	ND	1974
Dover Sindelar	MT	1974
Jorgensen Brothers	SD	1974
J. David Nichols	IA	1974
Bobby Lawrence	GA	1974
Marvin Bohmont	NE	1974
Charles Descheemacker	MT	1974
Bert Crame	CA	1974
Burwell M. Bates	OK	1974
Maurice Mitchell	MN	1974
Robert Arbuthnot	KS	1975
Glenn Burrows	NM	1975
Louis Chestnut	WA	1975
George Chiga	OK	1975
Howard Collins	MO	1975
Jack Cooper	MT	1975
Joseph P. Dittmer	IA	1975
Dale Engler	KS	1975
Leslie J. Holden	MT	1975
Robert D. Keefer	MT	1975
Frank Kubik, Jr.	ND	1975
Licking Angus Ranch	NE	1975
Walter S. Markham	CA	1975
Gerhard Mittnes	KS	1976
Ancel Armstrong	VA	1976
Jackie Davis	CA	1976
Sam Friend	MO	1976
Healey Brothers	OK	1976
Stan Lund	MT	1976
Jay Pearson	ID	1976
L. Dale Porter	IA	1976
Robert Sallstrom	MN	1976
M.D. Shepherd	ND	1976
Lowellyn Tewksbury	ND	1976

Harold Anderson	SD	1977	William Borror	CA	1977
Robert Brown	TX	1977	Del Krumwied	ND	1979
Glen Burrows	NM	1977	Jim Wolf	NE	1979
Henry, Jeanette Chitty	NM	1977	Rex & Joann James	IA	1979
Tom Dashiell	WA	1977	Leo Schuster Family	MN	1979
Lloyd DeBruycker	MT	1977	Bill Wolfe	OR	1979
Wayne Eshelman	WA	1977	Jack Ragsdale	KY	1979
Hubert R. Freise	ND	1977	Floyd Mette	MO	1979
Floyd Hawkins	MO	1977	Glenn & David Gibb	IL	1979
Marshall A. Mohler	IN	1977	Peg Allen	MT	1979
Clair Percel	KS	1977	Frank & Jim Wilson	SD	1979
Frank Ramackers, Jr.	NE	1977	Donald Barton	UT	1980
Loren Schlipf	IL	1977	Frank Felton	MO	1980
Tom & Mary Shaw	ID	1977	Frank Hay	CAN	1980
Bob Sitz	MT	1977	Mark Keffeler	SD	1980
Bill Wolfe	OR	1977	Bob Laflin	KS	1980
James Volz	MN	1977	Paul Mydland	MT	1980
A. L. Frau		1978	Richard Tokach	ND	1980
George Becker	ND	1978	Roy & Don Udelhoven	WI	1980
Jack Delaney	MN	1978	Bill Wolfe	OR	1980
L. C. Chestnut	WA	1978	John Masters	KY	1980
James D. Bennett	VA	1978	Floyd Dominy	VA	1980
Healey Brothers	OK	1978	James Bryany	MN	1980
Frank Harpster	MO	1978	Charlie Richards	IA	1980
Bill Womack, Jr.	AL	1978	Blythe Gardner	UT	1980
Larry Berg	IA	1978	Richard McLaughlin	IL	1980
Buddy Cobb	MT	1978	Bob Dickinson	KS	1981
Bill Wolfe	OR	1978	Clarence Burch	OK	1981
Roy Hunt	PA	1978	Lynn Frey	ND	1981

Harold Thompson	WA	1981
James Leachman	MT	1981
J. Morgan Donelson	MO	1981
Clayton Canning	CAN	1981
Russ Denowh	MT	1981
Dwight Houff	VA	1981
G. W. Cronwell	IA	1981
Bob & Gloria Thomas	OR	1981
Roy Beeby	OK	1981
Herman Schaefer	IL	1981
Myron Aultfathr	MN	1981
Jack Ragsdale	KY	1981
W. B. Williams	IL	1982
Garold Parks	IA	1982
David A. Breiner	KS	1982
Joseph S. Bray	KY	1982
Clare Geddes	CAN	1982
Howard Krog	MN	1982
Harlin Hecht	MN	1982
William Kottwitz	MO	1982
Larry Leonhardt	MT	1982
Frankie Flint	NM	1982
Gary & Gerald Carlson	NS	1982
Bob Thomas	OR	1982
Orville Stangl	SD	1982
C. Ancel Armstrong	KS	1983
Bill Borror	CA	1983
Charles E. Boyd	KY	1983
John Bruner	SD	1983
Leness Hall	WA	1983
Ric Hoyt	OR	1983
E. A. Keithley	MO	1983
J. Earl Kindig	MO	1983
Jake Larson	ND	1983
Harvey Lemmon	GA	1983
Frank Myatt	IA	1983
Stanley Nesemeier	IL	1983
Russ Pepper	MT	1983
Robert H. Schafer	MN	1983
Alex Stauffer	WI	1983
D. John & Lebert Shultz	MO	1983
Phillip A. Abrahamson	MN	1984
Ron Beiber	SD	1984
Jerry Chappel	VA	1984
Charles W. Druin	KY	1984
Jack Farmer	CA	1984
John B. Green	LA	1984
Ric Hoyt	OR	1984
Fred H. Johnson	OH	1984
Earl Kindig	VA	1984
Glen Klippenstein	MO	1984
A. Harvey Lemmon	GA	1984
Lawrence Meyer	IL	1984
Donn & Sylvia Mitchell	CAN	1984
Lee Nichols	IA	1984
Clair K. Parcel	KS	1984
Joe C. Powell	NC	1984
Floyd Richard	ND	1984
Robert L. Sitz	MT	1984
Ric Hoyt	OR	1984

J. Newbill Miller	VA	1985
George B. Halterman	WV	1985
David McGehee	KY	1985
Glenn L. Brinkman	TX	1985
Gordon Booth	WY	1985
Earl Schafer	MN	1985
Marvin Knowles	CA	1985
Fred Killam	IL	1985
Tom Perrier	KS	1985
Don W. Schoene	MO	1985
Everett & Ron Batho	CAN	1985
Bernard F. Pedretti	WI	1985
Arnold Wienk	SD	1985
R. C. Price	AL	1985
Clifford & Bruce Betzold	IL	1986
Gerald Hoffman	SD	1986
Delton W. Hubert	KS	1986
Dick & Ellie Larson	WI	1986
Leonard Lodden	ND	1986
Ralph McDanolds	VA	1986
W.D. Morris/James Pipkin	MO	1986
Roy D. McPhee	CA	1986
Clarence VanDyke	MT	1986
John H. Wood	SC	1986
Evin & Verne Dunn	CAN	1986
Glenn L. Brinkman	TX	1986
Jack & Gini Chase	WY	1986
Henry & Jeanette Chitty	FL	1986
Lawrence H. Graham	KY	1986
A. Lloyd Grau	NM	1986
Matthew Warren Hall	AL	1986
Richard J. Putnam	NC	1986
R.J. Steward/P.C. Morrissey	PA	1986
Leonard Wulf	MN	1986
Charles & Wynder Smith	GA	1987
Lyall Edgerton	CAN	1987
Tommy Branderberger	TX	1987
Henry Gardiner	KS	1987
Gary Klein	ND	1987
Ivan & Frank Rincker	IL	1987
Larry D. Leonhardt	WY	1987
Harold E. Pate	IL	1987
Forrest Byergo	MO	1987
Clayton Canning	CAN	1987
James Bush	SD	1987
R.J. Steward/P.C. Morrissey	MN	1987
Eldon & Richard Wiese	MN	1987
Douglas D. Bennett	TX	1988
Don & Diane Guilford & David & Carol Guilford	CAN	1988
Kenneth Gillig	MO	1988
Bill Bennett	WA	1988
Hansell Pile	KY	1988
Gino Pedretti	CA	1988
Leonard Lorenzen	OR	1988
George Schlickau	KS	1988
Hans Ulrich	CAN	1988
Donn & Sylvia Mitchell	CAN	1988
Darold Bauman	WY	1988
Glynn Debter	AL	1988

William Glanz	WY	1988
Jay P. Book	IL	1988
David Luhman	MN	1988
Scott Burtner	VA	1988
Robert E. Walton	WA	1988
Harry Airey	CAN	1989
Ed Albaugh	CA	1989
Jack & Nancy Baker	MO	1989
Ron Bowman	ND	1989
Jerry Allen Burner	VA	1989
Glynn Debter	AL	1989
Sherm & Charlie Ewing	CAN	1989
Donald Fawcett	SD	1989
Orrin Hart	CAN	1989
Leonard A. Lorenzen	OR	1989
Kenneth D. Lowe	KY	1989
Tom Mercer	WY	1989
Lynn Pelton	KS	1989
Lester H. Schafer	MN	1989
Bob R. Whitmire	GA	1989
Dr. Burleigh Anderson	PA	1990
Boyd Broyles	KY	1990
Larry Earhart	WY	1990
Steven Forrester	MI	1990
Doug Fraser	CAN	1990
Gerhard Gueggenberger	CA	1990
Douglas & Molly Hoff	SD	1990
Richard Janssen	KS	1990
Paul E. Keffaber	IN	1990
John & Chris Oltman	WI	1990
John Ragsdale	KY	1990
Otto & Otis Rincker	IL	1990
Charles & Rudy Simpson	CAN	1990
T.D. & Roger Steele	VA	1990
Bob Thomas Family	OR	1990
Ann Upchurch	AL	1991
N. Wehrmann/R. McClung	VA	1991
John Bruner	SD	1991
Ralph Bridges	GA	1991
Dave & Carol Guilford	CAN	1991
Richard/Sharon Beitelspacher	SD	1991
Tom Sonderup	NE	1991
Steve & Bill Florshcuetz	IL	1991
R. A. Brown	TX	1991
Jim Taylor	KS	1991
R.M. Felts & Son Farm	TN	1991
Jack Cowley	CA	1991
Rob & Gloria Thomas	OR	1991
James Burns & Sons	WI	1991
Jack & Gini Chase	WY	1991
Summitcrest Farms	OH	1991
Larry Wakefield	MN	1991
James R. O'Neill	IA	1991
Francis & Karol Bormann	IA	1992
Glenn Brinkman	TX	1992
Bob Buchanan Family	OR	1992
Tom & Ruth Clark	VA	1992
A. W. Compton, Jr.	AL	1992
Harold Dickson	MO	1992
Tom Drake	OK	1992

Robert Elliott & Sons	TN	1992
Dennis, David, Danny Geffert	WI	1992
Eugene B. Hook	MN	1992
Dick Montague	CA	1992
Bill Rea	PA	1992
Calvin & Gary Sandmeier	SD	1992
Leonard Wulf & Sons	MN	1992
R. A. Brown	TX	1993
Norman Bruce	IL	1993
Wes & Fran Cook	NC	1993
Clarence/Elaine/Adam Dean	SC	1993
D. Eldridge & Y. Adcock	OK	1993
Joseph Freund	CO	1993
R. B. Jarrell	TN	1993
Rueben, Leroy, Bob Littau	SD	1993
J. Newbill Miller	VA	1993
J. David Nichols	IA	1993
Miles P. "Buck" Pangburn	IA	1993
Lynn Pelton	KS	1993
Ted Seely	WY	1993
Collin Sander	SD	1993
Harrell Watts	AL	1993
Bob Zarn	MN	1993
Ken & Bonnie Bieber	SD	1994
John Blankers	MN	1994
Jere Caldwell	KY	1994
Mary Howe di'Zerega	VA	1994
Ron & Wayne Hanson	CAN	1994
Bobby F. Hayes	AL	1994
Buell Jackson	IA	1994
Richard Janssen	KS	1994
Bruce Orvis	CA	1994
John Pfeiffer Family	OK	1994
Calvin & Gary Sandmeier	SD	1994
Dave Taylor / Gary Parker	WY	1994
Bobby Aldridge	NC	1995
Gene Bedwell	IA	1995
Gordon & Mary Ann Booth	WY	1995
Ward Burroughs	CA	1995
Chris & John Christensen	SD	1995
Mary Howe de'Zerega	VA	1995
Maurice Grogan	MN	1995
Donald J. Hargrave	CAN	1995
Howard & JoAnne Hillman	SD	1995
Mack, Billy, Tom Maples	AL	1995
Mike McDowell	VA	1995
Tom Perrier	KS	1995
John Robbins	MT	1995
Thomas Simmons	VA	1995
D. Borgen & B. McCulloh	WI	1996
Chris & John Christensen	SD	1996
Frank Felton	MO	1996
Galen & Lori Fink	KS	1996
Cam, Spike, Sally Forbes	WY	1996
Mose & Dave Hebbert	NE	1996
C. Knight & B. Jacobs	OK	1996
Robert C. Miller	MN	1996
Gerald & Lois Neher	IL	1996
C. W. Pratt	VA	1996
Frank Schiefelbein	MN	1996

Ingrid & Willy Volk	NC	1996
William A. Womack, Jr.	AL	1996
Alan Albers	KS	1997
Gregg & Diane Butman	MN	1997
Blaine & Pauline Canning	CAN	1997
Jim & JoAnn Enos	IL	1997
Harold Pate	AL	1997
E. David Pease	CAN	1997
Juan Reyes	WY	1997
James I. Smith	NC	1997
Darrel Spader	SD	1997
Bob & Gloria Thomas	OR	1997
Nicholas Wehrmann & Richard McClung	VA	1997
James D. Bennett Family	VA	1998
Dick & Bonnie Helms	NE	1998
Dallis & Tammy Basel	SD	1998
Duane L. Kruse Family	IL	1998
Abigail & Mark Nelson	CA	1998
Airey Family	MB	1998
Dave & Cindy Judd	KS	1998
Earl & Nedra McKarns	OH	1998
Tom Shaw	ID	1998
Wilbur & Melva Stewart	AB	1998
Adrian Weaver & Family	CO	1998
Kelly & Lori Darr	WY	1999
Kent Klineman & Steve Munger	SD	1999
John Kluge	VA	1999
Kramer Farms	IL	1999
Noller & Frank Charolais	IA	1999
Lynn & Gary Pelton	KS	1999
Rausch Herefords	SD	1999
Duane Schieffer & Terry O'Neill	MT	1999
Tony Walden	AL	1999
Ralph Blalock, Sr., Blalock, Jr. & David Blalock	NC	2000
Larry & Jean Croissant	CO	2000
John C. Curtin	IL	2000
Galen, Lori & Megan Fink	KS	2000
Harlin & Susan Hecht	MN	2000
Banks & Margo Herndon	AL	2000
Kent Klineman & Steve Munger	SD	2000
Jim & Janet Listen	WY	2000
Mike & T.K. McDowell	VA	2000
Vaughn Meyer & Family	SD	2000
Blane & Cindy Nagel	SD	2000
John & Betty Rotert	MO	2000
Alan & Deb Vedvei	SD	2000

SEEDSTOCK PRODUCER OF THE YEAR

John Crowe	CA	1972
Mrs. R. W. Jones	GA	1973
Carlton Corbin	OK	1974
Leslie J. Holden	MT	1975
Jack Cooper	MT	1975
Jorgensen Brothers	SD	1976
Glenn Burrows	NM	1977
James D. Bennett	VA	1978
Jim Wolfe	NE	1979
Bill Wolfe	OR	1980
Bob Dickinson	KS	1981
A.F. "Frankie" Flint	NM	1982
Bill Borror	CA	1983
Lee Nichols	IA	1984
Ric Hoyt	OR	1985
Leonard Lodoen	ND	1986
Henry Gardiner	KS	1987
W.T. "Bill" Bennett	WA	1988
Glynn Debter	AL	1989
Doug & Molly Hoff	SD	1990
Summitcrest Farms	OH	1991
Leonard Wulf & Sons	MN	1992
R. A. "Rob" Brown	TX	1993
J. David Nichols	IA	1993
Richard Janssen	KS	1994
Tom & Carolyn Perrier	KS	1995
Frank Felton	MO	1996
Bob & Gloria Thomas	OR	1997
Wehrmann Angus Ranch	VA	1997
Flying H Genetics	NE	1998
Knoll Crest Farms	VA	1998
Morven Farms	VA	1999
Fink Beef Genetics	KS	2000

FINK BEEF GENETICS RECEIVES THE 2000 BIF OUTSTANDING SEEDSTOCK PRODUCER AWARD

Wichita, Kansas – Galen and Lori Fink were named the Beef Improvement Federation (BIF) Outstanding Seedstock Producers of the Year at the 32nd Annual Convention in Wichita, Kansas on July 14, 2000.

Innovation, customer service and an encompassing view of the beef industry best describes the forces that drive Fink Beef Genetics. The business name in itself emphasizes their dedication to producing more than seedstock cattle, but actually providing genetic packages for their customers.

Completely unique may be the best way to describe the beginnings and day-to-day operations of Fink Beef Genetics, located near Manhattan, Kansas. Starting with one Angus cow, no land and little money in 1977, Fink Beef Genetics has grown to a seedstock operation that today includes Angus, Charolais and F1s. The business incorporates all segments of the beef industry from conception to consumption.

Galen and Lori Fink, along with their daughter Megan, run Fink Beef Genetics. The business operates entirely with rented land, purchased feeds and basically no outside labor. The operation has use AI exclusively since 1977 and implants more than 1000 embryos each year. Cooperator herds were devised in 1990 to utilize the commercial producer's land ownership and management to form a profitable relationship for both parties. In addition, the Finks are partners in Genetics Plus, a commercial heifer development company, and Integrated Genetic Management, a genetic management company that deals with feeder and heifer calf procurement and turn-key breeding programs.

High accuracy sires dominate the breeding program and all pedigrees are stacked several generations deep to prevent surprises for customers. Seedstock, embryos and semen are sold nationwide through public auctions, e-commerce and private treaty.

With over 95% of their bulls going to commercial herds, developing ways to return value to customers is a primary goal for the Finks. Customer service programs include Fink-influence feeder calf and commercial heifer sales, seminars about industry alliances and bus tours to feedlots and packing plants.

Both Galen and Lori have served leadership roles with the Kansas Livestock Association and Kansas Angus Association.

BIF is pleased to recognize Fink Beef Genetics with its Outstanding Seedstock Producer Award.

2000 SEEDSTOCK PRODUCER AWARD NOMINEES

Blue Ston Farms
John C. Curtin, Blue Mound, Illinois

This registered Angus cow-calf operation dates back to 1936 when the first heifers were purchased for 4-H club projects. The herd has improved and has grown gradually over the years, as land was acquired, to its present size of 100 brood cows. About 20 heifers are added to the herd each year and some non-productive cows are culled. This is mainly an early spring calving program, but also calves 10-15 cows in the fall. Their goals are to produce heifers for the 4-H club projects and bulls for commercial producers with an emphasis on carcass traits. They utilize improved pastures for grazing during summer months and feed corn silage and grass hay to the lactating cows and yearling heifers during the winter months after the fall corn stalk fields have been gleaned. This herd is located in Central Illinois in what is considered some of the best corn and soybean land in the country.

Crow Creek Cattle
Larry & Jean Croissant
Briggsdale, Colorado

Crow Creek Cattle is a family operation including Larry and Jean as owner-operators with son, Brian, helping with the work and management decisions. Crow Creek Cattle seedstock business uses Croissant Red Angus as a handle. Their operation acquired their first registered Red Angus Cattle in 1982. At that time, it was a sidelight to their primary farming and private feedlot business. In 1996, they changed their focus to a cow/calf unit coupled with a feed yard. This required a physical move as well. They are located in short grass country northeast of Briggsdale, Colorado on Crow Creek. There base operation includes 5400 deeded acres of grass, 320 acres of State Lease, 1900 acres of private lease and a 1200 head feedyard. Currently, they run 200 cows of which about half are registered Red Angus and replacement females as yearlings. They are growing their own seedstock business through retaining registered replacements and a breed up program using the Red Angus category Iv classification.

This year they marketed 30 registered bulls. They also have been showing and marketing a small group of open commercial heifers sired by their bulls at the Colorado Cattlemen's Association (CCA) Producers show at the National Western Stock Show (NWSS) in Denver, Colorado. They have not marketed any registered females due to their internal growth. All of the feeder calves are predominately sired by their bulls. They feed the calves and market them through the Red Angus Alliance with Excel. Full carcass data is gathered on about 100 calves which is enough to get their bulls listed in the Red Angus Sire Summary.

This primary forage program is low intensity cell grazing during the summer, saving enough forage for early fall grazing and then moving the cows to leased corn stalks or other aftermath feeds. The winter forage is local feed they buy standing and put up from the drylanders around them. They calve in mid-February through mid-April and wean early, usually in early September. This works well for the spring market, better utilizing poorer quality fall feed stuffs, and marketing their fed calves in April.

Double -H Charolais
Harlin & Susan Hecht, Pynesville, Minnesota

Double-H Charolais, located at Paynesville, Minnesota, is owned by Harlin & Sue Hecht, three sons and two daughters-in-law. Double-H was established in Feb. of 1968 with the purchase of four Charolais females. The herd has now grown and stabilized at 50 purebred females and 20 crossbred recipient cows. The calving season runs from January through March and September through October in order to satisfy customer needs. This presents older bulls for the Double-H Bull Sale each year. These older bulls are not two year olds who require more feed and labor, yet are old enough to service more cows as preferred by their customers. This bull sale is held the last Saturday in February in Bagley, Minnesota, a location with a heavy concentration of commercial cow herds. Double-H Charolais has performance tested every animal since its inception in 1968 and has tested several herd sires on the American-International Charolais Association Sire Evaluation Program and the Canadian Conception to Consumer Program. The calves from these programs are evaluated all the way from conception through carcass data. This herd has also produced approximately 12 AICA Sterling Dams of Distinction including the very first Sterling Dam of Distinction in the U.S. Her head is mounted and now hangs in the AICA office in Kansas City.

The Double-H herd is well known throughout the United States and Canada for its quality and performance. Double-H and many of their customers successfully exhibit cattle at state and national shows. Several national division champions and state fair grand champions have been shown by Double-H. The show string has been an excellent form of promotion for this program along with print media and an excellent Internet web page. This web page features herd sires, donor cows and news of Double-H activities throughout the year.

Harlin & Sue have been honored by many state and national organizations:

1975 - First Outstanding Young Beef Producer by the Minnesota Beef Cattle Improvement Association.
1982 - American-International Charolais Association - Seedstock Producer of the Year.
1988 - 92 - Distinguished service award by the Minnesota Beef Council.
1990 - American-International Junior Charolais Association Conference Honoree.

1996 - Inducted into the Minnesota Livestock Hall of Fame.
1999 - Minnesota Beef Cattle Improvement Association Seedstock Producer of the Year.

Eagle Pass Ranch, L.P.
Kent Klineman and Steve Munger, Highmore, South Dakota

Eagle Pass Ranch is located near Highmore in central South Dakota. The ranch is rich in history. Ted and Clayton Jennings initially developed it in the 1930's, who operated it as Hyland Angus. In the 1950's, they merged with the Leachman family, who had just moved west from Ankony, New York. During this period the operation was known as Ankony Hyland. Munger and Klineman purchased the ranch in 1988 from the Jennings family. They initially stocked the 50,000 acres with 4,500 Angus cross commercial cows. In 1988 they also began the most intensive breed up program in the history of the Gelbvieh breed and quite possibly the most intensive program of any breed, by artificially inseminating all 4,500 cows to Gelbvieh sires and have registered over 7,000 females since 1988, they have artificially inseminated nearly 30,000 cows to Gelbvieh sires and have registered over 7,000 They presently maintain a herd of 1,500 registered Gelbvieh females and 600 registered Angus females on 20,000 acres. Their Angus program started in 1991 when they purchased 100 females from the Hoff Scotch Cap program and 50 females from the Jorgenson Ideal program. They have used embryo transfer aggressively in their Angus program, transferring up to 500 embryos annually. Both a spring and fall calving period is used. They strictly adhere to a rigid culling program to assure that only the "Top Cut" bulls make it to their annual production sales.

Fink Beef Genetics
Galen, Lori and Megan Fink, Manhattan, Kansas

Completely unique may be the best way to describe the beginning and day-to-day operations of Fink Beef Genetics (FBG), located near Manhattan, Kansas. Faced with two low paying, full time jobs, one Angus cow, no land and very little money in 1977, Fink Beef Genetics has grown to a seedstock operation that today includes Angus, Charolais and F(1)'s. The business incorporates all segments of the beef industry from conception to consumption.

Since 1991, owners Galen and Lori Fink, along with their daughter Megan, have devoted their efforts to FBG. The business operates entirely with rented land, purchased feeds and basically no outside labor. The operation has used AI exclusively since 1977 and implants more than 1,000 embryos each year. Cooperator herds were devised in 1990 to utilize the commercial producers' land ownership and management and form a profitable relationship for both parties. High accuracy sires dominate the breeding program and all pedigrees are stacked several generations deep to prevent surprises for customers.

Seedstock, embryos and semen are sold nationwide through public auctions, e-commerce and private treaty. The concept of pre-contracted bulls was developed by FBG in 1991.

Customer service is a major part of the FBG program. Types of services available include the longest running sponsored calf sales in the United States, commercial female sales, seedstock cooperators in five beef alliances, credit for carcass data and working relationships with various feedlots. Fink Beef Genetics has co-founded two companies, Genetics Plus and Integrated Genetic Management, that focus on providing customers complete genetic assistance.

Since 1992, Finks have owned and developed the Little Apple Brewing Company Restaurant in Manhattan. This experience has provided insight into the beef industry from conception to consumption.

Flying Y Cattle Company
Jim and Janet Listen, Laramie, Wyoming

Flying Y Cattle Company, owned by Jim and Janet Listen and managed by Dave and Ronda Whitman, is located on the Laramie River, fifteen miles southwest of Laramie, WY. This ranch is the home to approximately 500 mother cows and is composed of irrigated hay meadows, sub-irrigated pastures and short grass summer pastures,. Over 400 head are recorded with the American Gelbvieh Association as purebred or percentage Gelbvieh/Angus cross.

Two-year old heifers begin calving, in late January, about two weeks before the older cows and all the calves are on the ground by April 1. Over half of the calves born on the ranch are AI, sired by top Angus and Gelbvieh bulls. After a short, synchronized AI season in early May, the cow/calf pairs are put on pasture, with only salt and mineral supplement, until the first week of September. At this time, the calves receive all their preconditioning vaccinations and final decisions are made regarding seedstock prospects.

Calves are weaned on the ranch about Sept. 20 and placed on a medicated weaning ration for two weeks. Calves not selected as bull prospects or replacement heifers are sent to a feedlot for finishing. By retaining ownership and collection of complete carcass data they are able to monitor the progress in their breeding program from conception to harvest.

For several years Flying Y has participated in the WBCIA Bull Test as well as the Feedlot and Carcass Evaluation Program. Sire groups are evaluated in both programs as a comparison to the balance of the calf crop on feed at other locations. Seedstock developed on the Laramie Plains at 7200 feet elevation is available to commercial producers through an annual bull sale held at the ranch in mid-March of each year. Only the top 20% of the bull calves born on the ranch are offered private treaty.

Homestead Farm
Banks and Margo Herndon, Hatchechubee, Alabama

Homestead Farm is a registered Angus operation located in rural east central Alabama near the little town of Hatchechubbee. In 1979, Homestead Farm was founded with the goal to develop and maintain a small herd of highest quality Angus cattle that would strengthen the genetic base of other purebred breeders. Currently, the cattle operation calves 25 to 30 registered calves in the fall of each year. Homestead Farm consists of 100 acres of pasture and hay land and 700 acres of timber.

There are no full time employees, with the majority of the work being done by family members. Banks Herndon takes care of herd management, including artificial insemination and Margo Herndon is the bookkeeper for the operation.

To achieve the goals set for the operation, Homestead Farm utilizes the Heat Watch System to maximize the number of females bred AI. Embryo transfer technology is also employed to produce top genetic material. Cows are culled based on production, performance records, EPD's and phenotype.

Bull calves are consigned to numerous central bull test stations and consignment sales each year. Homestead Farm has had the good fortune to top several test stations both in terms of performance and price in the last several years. Many of the bulls have become herd sires in purebred Angus herds. Their best females are marketed through consignment sales.

Banks Herndon's interest in cattle began as a young boy exhibiting 4-H steers and continued after graduation from college. Today, Homestead Farm is striving to make a difference in the Angus business.

Locust Level Farms
Mike and T.K. McDowell, Vernon Hill, Virginia

Locust Level Farms is located in the Southern Piedmont area of Virginia with operations in both Halifax and Pittsylvania Counties. It is a diversified operation of row crops along with the 150 cow purebred Angus program. Flue-cured tobacco is produced as a cash crop while all other crops are utilized through the cattle program. With approximately 500 acres of permanent pasture, an additional 200 acres of annual and perennial hays are grown which are also used for strip grazing. 125 acres of corn are grown along with 100 plus acres of various small grains. Recent quota cuts in flue-cured tobacco have reduced that production from over 70 acres to 30 acres. Locust Level consists of a total of approximately 2000 acres owned and leased.

Along with 150 registered cows, 50 commercial cows are maintained as embryo recipient cows. The use of cooperator herds for the production of embryo calves and summer grazing along with various partnerships rounds out the production side of the farm. Due largely to the topography of available grazing areas, the cows are maintained mostly in 20 to 25 animal unit groups. This also lends itself to the intensive A.I. and embryo transfer program to be carried out mostly by Mike, with little outside help. All cows at Locust Level are bred A.I. or implanted with embryos.

Calving season starts in September and ends in March with a break in December and January. While this may seem extensive for the number of cows, it best fits the resources of facilities, labor, and feed at Locust Level. Also, the calving season compliments the bull development and marketing program. In many ways, Locust Level is non-traditional in cattle production terms due to the need to efficiently balance the total operation with the excessive demands on labor and resources for crop production and to fit into the given land area.

Nagel Cattle Company
Blane and Cindy Nagel, Springfield, South Dakota

Nagel Cattle Company (NCC) is located in the southeastern corner of South Dakota along the Missouri River. Nagel Company is a family run operation that derives all of its income from cattle and agriculture. NCC is a diversified seedstock operation that specializes in purebred Maine-Anjou cattle. The Nagels started their operation in 1990 on a full time basis after Blane graduated from South Dakota State University. Blane and Cindy have four children, Landon 14, Shayna 6, Cheysney 4, and Cheylee 8 months. In addition to their purebred and cattle finishing operations, Cindy Nagel owns and operates Midwest Sonatech, which is a livestock ultrasound business. Blane's father, John Nagle, owns and operates a 1500 head feedlot. The majority of cattle fed through the feeding operation are home raised but they do custom feed a percentage of the cattle. They specialize in feeding heifers with in-weights in the 600-700 range and out-weights typically ranging from 1150-1250. Blane's brother, Bryan Nagel, also owns and operates a 1500 head feedlot. In this feedyard Nagel's custom feed steer and heifers. The Nagel operation is somewhat unique in that each member of the family owns his own operation but they work together on day to day activities and farming. Blane's primary focus is the cow/calf side of the operation. Currently, he runs 200 mature registered Maine-Anjou cows and about 100 commercial cows, mostly Angus or Angus/Maine cross. The Nagels start calving heifers at the end of January and cows start calving about the second week in February. Both groups are AI'd for one cycle then exposed to cleanup bulls for 45 days. The Nagels host two production sales. A female sale is held in conjunction with two purebred Maine-Anjou operations in November. The bull sale is held the last of February.

Rotert Angus and Midwestern Cattle Services
John & Betty Rotert and Family, Montrose, Missouri

Rotert Angus and Midwestern Cattle Services is located in west-central Missouri, in the southwestern corner of Henry County. The Rotert's moved to this location in 1956 after they were married and have lived and worked there ever since, except for the few years they attended the University of Missouri.

The Angus cowherd started in 1956 with 4 registered Angus cows. By January of 1957 they had 8 Angus females, the basis of the cowherd.

They have 150 head of Angus cattle at their location and approximately 600 cows in four breeds, Angus, Simmental, Charolais and Gelbvieh, in cooperator herds. They sell approximately 250 head of bulls of those 4 breeds annually. The cowherd is divided equally between fall and spring calves.

Rotert Angus and Midwestern Cattle Services is a charter member of Professional Beef Genetics. PBG is a group of seedstock producers who have joined together to raise and market bulls more efficiently and provide the customer with better genetics, better service, and more opportunities to enhance their profitability in the commercial cattle business.

The Rotert's are dedicated to producing and providing superior genetics that will help commercial cattlemen succeed in a value based market place.

They believe in producing better bulls through improved genetics, not pampered environments. They rely heavily on the use of EPDs, artificial insemination, and the latest technologies to make genetic progress.

PBG has an "Open House" sale in March and November of each year.

Rotert Angus and Midwestern Cattle Services are partners in Midwestern Cattle Services with Bob Harriman. Midwestern Cattle Services markets source verified feeder cattle. Many of these calves are from producers who have purchased high performance bulls from them. These commercial producers put high emphasis on EPDs with performance and high carcass merit when buying bulls from them.

Shade Tree Simmental
Ralph Blalock, Sr., Blalock, Jr., & David Blalock
Wilson, North Carolina

Shade Tree Simmentals is a family owned and operated, diversified farming operation and beef cattle seed stock producer located in Lucama, North Carolina. Mr. Ralph Blalock, Sr. and two of his three sons, Ralph Blalock, Jr. and David Blalock, began the cattle partnership in 1975. Today the Shade Tree operation consists of 30 purebred brood cows, 72 acres of forage and 1100 acres of row cropland. Tobacco, corn, wheat, soybeans and hay are produced by the family operation. The cattle program is forage based. Cattle utilize grass between 10 to 12 months a year, depending upon the weather. Supplemental feeding is provided during inclement weather and the breeding season.

Ralph, Sr. purchased Simmental cattle at the first NC State Simmental Sale that was held in 1975 (The 1999 NC State Simmental Sale was dedicated to Ralph, Sr.). Mr. Blalock and his sons committed to a complete artificial insemination program with the initial females, and for 17 years, a herd bull was never used. Embryo transfer was utilized beginning in 1989. The operation has concentrated on calving ease, growth, and milking ability, striving for a balance of commercially important traits. The Simmental Sire Summary is considered the bible in making sire selections at Shade Tree. New genetics have been added to the herd from other purebred operations that emphasize balanced EPD'S. The Blalocks have purchased both females and embryos from Dickinson Simmentals of Kansas. Shade Tree females calve from October to January. This calving season allows the opportunity to consign bulls to various performance tests in the southeast. Shade Tree bulls have been tested in centralized bull testing programs in three states and bulls have been sold into six states.

The major emphasis has been placed on building a strong, consistent performance oriented cow herd. Maternal strengths are believed to be the key to success of the commercial cow calf operations. The Shade Tree motto is "Great females don't just happen, they are bred to be great."

Sodak Angus Ranch
Vaughn Meyer & Family, Reva, South Dakota

The Sodak Angus was homesteaded in 1909. They have raised purebred Red Angus since 1956 and Black Angus since 1972. The ranch is comprised of 10,000 dry land acres in Northwest South Dakota that is mostly pasture, with some hay and feed grains. They run about 550 purebred cows, which calve between February and April of each spring. The cows and yearling replacement heifers are synchronized and Aled for the first heat in early May. After AI is completed the cows and heifers are grouped by sire groups and run on pasture for the summer. The calves spend the summer on native pasture without creep and are weaned and processed in early October before going on feed test. The top bull calves are sold in the annual production sale, the first Monday in March.

Vedvei Charolais Ranch
Alan & Deb Vedvei, Lake Preston, South Dakota

Vedvei Charolais is a family owned business located North of Lake Preston in East-Central South Dakota. Vedvei Charolais was first started in the spring of 1986 and has continued to raise purebred Charolais Cattle since. Today they operate just over 1250 acres with 120 registered cows and a few commercial cows that are used for recipients in the Embryo Transplant program. The main cow herd calves in the spring of the year starting with the first calf heifers around February 10th and the older cows in March. Calving is usually finished by the end of April. There is also a small fall calving herd that Vedvei

Charolai would like to build. This allows for better use of labor, bulls, and provides another marketing opportunity. Working with a commercial producer in Iowa allows Vedvei Charolais to utilize his commercial cows as recipients for the ET program.

Cows are their business and they manage to make a profit. They also believe the commercial customers are the success or failure of the business, so the breeding program and goals are set with the commercial producers in mind.

COMMERCIAL PRODUCER HONOR ROLL OF EXCELLENCE

Chan Cooper	MT	1972
Alfred B. Cobb, Jr.	MT	1972
Lyle Eivens	IA	1972
Broadbent Brothers	KY	1972
Jess Kilgore	MT	1972
Clifford Ouse	MN	1973
Pat Wilson	FL	1973
John Glaus	SD	1973
Sig Peterson	ND	1973
Max Kiner	WA	1973
Donald Schott	MT	1973
Stephen Garst	IA	1973
J.K. Sexton	CA	1973
Elmer Maddox	OK	1973
Marshall McGregor	MO	1974
Lloyd Mygard	MD	1974
Dave Matti	MT	1974
Eldon Wiese	MN	1974
Lloyd DeBruycker	MT	1974
Gene Rambo	CA	1974
Jim Wolf	NE	1974
Henry Gardiner	KS	1974
Johnson Brothers	SD	1974
John Blankers	MN	1975
Paul Burdett	MT	1975
Oscar Burroughs	CA	1975
John R. Dahl	ND	1975
Eugene Duckworth	MO	1975
Gene Gates	KS	1975
V. A. Hills	KS	1975
Robert D. Keefer	MT	1975
Kenneth E. Leistritz	NE	1975
Ron Baker	OR	1976
Dick Boyle	ID	1976
James D. Hackworth	MO	1976
John Hilgendorf	MN	1976
Kahau Ranch	HI	1976
Milton Mallery	CA	1976
Robert Rawson	IA	1976
William A. Stegner	ND	1976
U.S. Range Exp. Station	MT	1976
John Blankers	MN	1976
Maynard Crees	KS	1977
Ray Franz	MT	1977
Forrest H. Ireland	SD	1977
John A. Jameson	IL	1977
Leo Knoblauch	MN	1977
Jack Pierce	ID	1977
Mary & Stephen Garst	IA	1977
Todd Osteross	ND	1978
Charles M. Jarecki	MT	1978
Jimmy G. McDonnal	NC	1978
Victor Arnaud	MO	1978
Ron & Malcolm McGregor	IA	1978
Otto Uhrig	NE	1978
Arnold Wyffels	MN	1978
Bert Hawkins	OR	1978
Mose Tucker	AL	1978
Dean Haddock	KS	1978
Myron Hoeckle	ND	1979
Harold & Wesley Arnold	SD	1979
Ralph Neill	IA	1979
Morris Kuschel	MN	1979

Bert Hawkins	OR	1979
Dick Coon	WA	1979
Jerry Northcutt	MO	1979
Steve McDonnell	MT	1979
Doug Vandermyde	IL	1979
Norman, Denton, & Calvin Thompson	SD	1979
Jess Kilgore	MT	1980
Robert & Lloyd Simon	IL	1980
Lee Eaton	MT	1980
Leo & Eddie Grubl	SD	1980
Roger Winn, Jr.	VA	1980
Gordon McLean	ND	1980
Ed Disterhaupt	MN	1980
Thad Snow	CAN	1980
Oren & Jerry Raburn	OR	1980
Bill Lee	KS	1980
Paul Moyer	MO	1980
G. W. Campbell	IL	1981
J. J. Feldmann	IA	1981
Henry Gardiner	KS	1981
Dan L. Weppler	MT	1981
Harvey P. Wehri	ND	1981
Dannie O'Connell	SD	1981
Wesley & Harold Arnold	SD	1981
Jim Russell & Rick Turner	MO	1981
Oren & Jerry Raburn	OR	1981
Orin Lamport	SD	1981
Leonard Wulf	MN	1981
Wm. H. Romersberger	IL	1982
Milton Krueger	MO	1982
Carl Odegard	MT	1982
Marvin & Donald Stoker	IA	1982
Sam Hands	KS	1982
Larry Campbell	KY	1982
Lloyd Atchison	CAN	1982
Earl Schmidt	MN	1982
Raymond Josephson	ND	1982
Clarence Reutter	SD	1982
Leonard Bergen	CAN	1982
Kent Brunner	KS	1983
Tom Chrystal	IA	1983
John Freitag	WI	1983
Eddie Hamilton	KY	1983
Bill Jones	MT	1983
Harry & Rick Kline	IL	1983
Charlie Kopp	OR	1983
Duwayne Olson	SD	1983
Ralph Pederson	SD	1983
Ernest & Helen Schaller	MO	1983
Al Smith	VA	1983
John Spencer	CA	1983
Bud Wishard	MN	1983
Bob & Sharon Beck	OR	1984
Leonard Fawcett	SD	1984
Fred & Lee Kummerfeld	WY	1984
Norman Coyner & Sons	VA	1984
Franklyn Esser	MO	1984
Edgar Lewis	MT	1984
Boyd Mahrt	CA	1984
Neil Moffat	CAN	1984
William H. Moss, Jr.	GA	1984
Dennis P. Solvie	MN	1984
Robert P. Stewart	KS	1984
Charlie Stokes	NC	1984
Milton Wendland	AL	1985
Bob & Sheri Schmidt	MN	1985
Delmer & Joyce Nelson	IL	1985

Harley Brockel	SD	1985
Kent Brunner	KS	1985
Glenn Harvery	OR	1985
John Maino	CA	1985
Ernie Reeves	VA	1985
John R. Rouse	WY	1985
George & Thelma Boucher	CAN	1985
Kenneth Bentz	OR	1986
Gary Johnson	KS	1986
Ralph G. Lovelady	AL	1986
Ramon H. Oliver	KY	1986
Kay Richardson	FL	1986
Mr. & Mrs. Clyde Watts	NC	1986
David & Bev Lischka	CAN	1986
Dennis & Nancy Daly	WY	1986
Carl & Fran Dobitz	SD	1986
Charles Fariss	VA	1986
David J. Forster	CA	1986
Danny Geersen	SD	1986
Oscar Bradford	AL	1987
R. J. Mawer	CAN	1987
Rodney G. Oliphant	KS	1987
David A. Reed	OR	1987
Jerry Adamson	NE	1987
Gene Adams	GA	1987
Hugh & Pauline Maize	SD	1987
P. T. McIntire & Sons	VA	1987
Frank Disterhaupt	MN	1987
Mac, Don & Joe Griffith	GA	1988
Jerry Adamson	NE	1988
Ken/Wayne/Bruce Gardiner	CAN	1988
C. L. Cook	MO	1988
C. J. & D. A. McGee	IL	1988
William E. White	KY	1988
Frederick M. Mallory	CA	1988
Stevenson Family	OR	1988
Gary Johnson	KS	1988
John McDaniel	AL	1988
William A. Stegner	ND	1988
Lee Eaton	MT	1988
Larry D. Cundall	WY	1988
Dick & Phyllis Henze	MN	1988
Jerry Adamson	NE	1989
J. W. Aylor	VA	1989
Jerry Bailey	ND	1989
James G. Guyton	WY	1989
Kent Koostra	KY	1989
Ralph G. Lovelady	AL	1989
Thomas McAvoy, Jr.	GA	1989
Bill Salton	IA	1989
Lauren & Mel Schuman	CA	1989
Jim Tesher	ND	1989
Joe Thielen	KS	1989
Eugene & Ylene Williams	MO	1989
Phillip, Patty & Greg Bartz	MO	1990
John J. Chrisman	WY	1990
Les Herbst	KY	1990
Jon C. Ferguson	KS	1990
Mike & Diana Hooper	OR	1990
James & Joan McKinlay	CAN	1990
Gilbert Meyer	SD	1990
DuWayne Olson	SD	1990
Raymond R. Peugh	IL	1990
Lewis T. Pratt	VA	1990
Ken & Wendy Sweetland	CAN	1990
Swen R. Swenson Cattle	TX	1990
Robert A. Nixon & Son	VA	1991
Murray A. Greaves	CAN	1991

James Hauff	ND	1991
J. R. Anderson	WI	1991
Ed & Rich Blair	SD	1991
Reuben & Connee Quinn	SD	1991
Dave & Sandy Umbarger	OR	1991
James A. Theeck	TX	1991
Ken Stielow	KS	1991
John E. Hanson, Jr.	CA	1991
Charles & Clyde Henderson	MO	1991
Russ Green	WY	1991
Bollman Farms	IL	1991
Craig Utesch	IA	1991
Mark Barenthsen	ND	1991
Rary Boyd	AL	1992
Charles Daniel	MO	1992
Jed Dillard	FL	1992
John & Ingrid Fairhead	NE	1992
Dale J. Fischer	IA	1992
E. Allen Grimes Family	ND	1992
Kopp Family	OR	1992
Harold/Barbara/Jeff Marshall	PA	1992
Clinton E. Martin & Sons	VA	1992
Lloyd & Pat Mitchell	CAN	1992
William Van Tassel	CAN	1992
James A. Theeck	TX	1992
Aquilla M. Ward	WV	1992
Albert Wiggins	KS	1992
Ron Wiltshire	CAN	1992
Andy Bailey	WY	1993
Leroy Beitelspacher	SD	1993
Glenn Calbaugh	WY	1993
Oscho Deal	NC	1993
Jed Dillard	FL	1993
Art Farley	IL	1993
Jon Ferguson	KS	1993
Walter Hunsuker	CA	1993
Nola & Steve Kleiboeker	MO	1993
Jim Maier	SD	1993
Bill & Jim Martin	WV	1993
Ian & Alan McKillop	ON	1993
George & Robert Pingetzer	WY	1993
Timothy D. Sutphin	VA	1993
James A. Theeck	TX	1993
Gene Thiry	MB	1993
Fran & Beth Dobitz	SD	1994
Bruce Hall	SD	1994
Lamar Ivey	AL	1994
Gordon Mau	IA	1994
Randy Mills	KS	1994
W. W. Oliver	VA	1994
Clint Reed	WY	1994
Stan Sears	CA	1994
Walter Carlee	AL	1995
Nicholas Lee Carter	KY	1995
Charles C. Clark, Jr.	VA	1995
Greg & Mary Cunningham	WY	1995
Robert & Cindy Hine	SD	1995
Walter Jr. & Evidean Major	KY	1995
Delhert Ohnemus	IA	1995
Olafson Brothers	ND	1995
Henry Stone	CA	1995
Joe Thielen	KS	1995
Jack Turnell	WY	1995
Tom Woodard	TX	1995
Jerry & Linda Bailey	ND	1996
Kory M. Bierle	SD	1996
Mavis Dummermuth	IA	1996
Terry Stuart Forst	OK	1996

Don W. Freeman	AL	1996
Lois & Frank Herbst	WY	1996
M/M George A. Horkan, Jr.	VA	1996
David Howard	IL	1996
Virgil & Mary Jo Huseman	KS	1996
Q. S. Leonard	NC	1996
Ken & Rosemary Mitchell	CAN	1996
James Sr/Jerry/James Petik	SD	1996
Ken Risler	WI	1996
Merlin Anderson	KS	1997
Joe C. Bailey	ND	1997
William R. "Bill" Brockett	VA	1997
Arnie Hansen	MT	1997
Howard McAdams, Sr & Howard McAdams, Jr.	NC	1997
Rob Orchard	WY	1997
Bill Peters	CA	1997
David Petty	IA	1997
Rosemary Rounds & Marc & Pam Scarborough	SD	1997
Morey & Pat Van Hoecke	MN	1997
Randy & Judy Mills	KS	1998
Mike & Priscilla Kasten	MO	1998
Amana Farms Inc.	IA	1998
Terry & Dianne Crisp	AB	1998
Jim & Carol Faulstich	SD	1998
James Gordon Fitzhugh	WY	1998
John B. Mitchell	VA	1998
Holzapfel Family	CA	1998
Mike Kitley	IL	1998
Wallace & Donald Schilke	ND	1998
Doug & Ann Deane and Patricia R. Spearman	CO	1998
Glenn Baumann	ND	1999
Bill Boston	IL	1999
C-J-R Christensen Ranches	WY	1999
Ken Fear, Jr.	WY	1999
Giles Family	KS	1999
Burt Guerrieri	CO	1999
Karlen Family	SD	1999
Deseret Ranches of Alberta	CAN	1999
Nick & Mary Klintworth	NE	1999
MW Hereford Ranch	NE	1999
Mossy Creek Farm	VA	1999
Iris, Bill & Linda Lipscomb	AL	1999
Amana Farms, Inc.	IA	2000
Tony Boothe	AL	2000
Glenn Clabaugh	WY	2000
Connie, John & Terri Griffith	KS	2000
Frank B. Labato	CO	2000
Roger & Sharon Lamont & Doug & Shawn Lamont	SD	2000
Bill & Claudia Tucker	VA	2000
Wayne & Chip Unsicker	IL	2000

COMMERCIAL PRODUCER OF THE YEAR

Chan Cooper	MT	1972
Pat Wilson	FL	1973
Lloyd Nygard	ND	1974
Gene Gates	KS	1975
Ron Blake	OR	1976
Steve & Mary Garst	IA	1977
Mose Tucker	AL	1978
Bert Hawkins	OR	1979
Jess Kilgore	MT	1980
Henry Gardiner	KS	1981
Sam Hands	KS	1982
Al Smith	VA	1983
Bob & Sharon Beck	OR	1984
Glenn Harvey	OR	1985
Charles Fariss	VA	1986
Rodney G. Oliphant	KS	1987
Gary Johnson	KS	1988
Jerry Adamson	NE	1989
Mike & Diana Hopper	OR	1990
Dave & Sandy Umbarger	OR	1991
Kopp Family	OR	1992
Jon Ferguson	KS	1993
Fran & Beth Dobitz	SD	1994
Joe & Susan Thielen	KS	1995
Virgil & Mary Jo Huseman	KS	1996
Merlin & Bonnie Anderson	KS	1997
Randy & Judy Mills	KS	1998
Mike & Priscilla Kasten	MO	1998
Giles Ranch	KS	1999
Mossy Creek Farm	VA	1999
Bill Tucker	VA	2000

BILL TUCKER RECEIVES THE 2000 BIF OUTSTANDING COMMERCIAL PRODUCER AWARD

Wichita, Kansas – Bill Tucker was named the Beef Improvement Federation (BIF) Outstanding Commercial Producer of the Year at the 32nd Annual Convention in Wichita, Kansas on July 14, 2000.

Bill Tucker manages Tucker Family Farms along with his wife, Claudia, and three daughters. Tucker Family Farms is a seventh generation family farming operation in the heart of Amherst County, Virginia in the foothills of the eastern slope of the Blue Ridge Mountains. Evolving from a general farming operation encompassing fruit, tobacco, grain, timber and livestock the Tuckers have focused primarily on their cattle operation since the 1970's.

Today's 800 cow base with complete retained ownership of all progeny and replacement females utilizing a contract grower arrangements is a significant change from previous family interests. Bill took over the direct management of the family's 100-cow herd of primarily Polled Hereford cows in 1976 when he convinced his father to cross the straightbreds to Angus sires. Gelbvieh sires were added in 1983. AI became a cornerstone of the operation in 1984, mass heifer mating in 1986, backgrounding in 1989, retained ownership through slaughter in 1992 and sale of surplus breeding stock to an expanded customer base in 1993.

Today the Tuckers concentrate much effort on the marketing and development of their trademark "Target 2000" replacement line of ¾ Angus x ¼ Gelbvieh females. They have topped the past four major statewide commercial female sales while selling 80% of those heifers to repeat customers with consignment lots of not less than 25 head.

Since 1994 the Tuckers have developed a series of profit enhancing services for their customers. Their ongoing calf buy back program pays $2.00 premiums on steers and $4.00 premiums on heifers over the top market in the area if the calves come from Tucker Genetics. Their expanded contract grower operation now enlists about 500 cows throughout Virginia.

The Tuckers are founders of "Target Feeders", an evolving backgrounding, feeding and carcass data collection system for their customers as well as certain other cattle groups.

Bill Tucker is past president of the Virginia BCIA and a board member of the Virginia Beef Expo. Tucker is past president of the Virginia Forage and Grassland Council and Current Director of the American Forage and Grassland Council.

BIF is pleased to recognize Bill Tucker as Outstanding Commercial Producer.

2000 COMMERCIAL PRODUCER AWARD NOMINEES

Amana Farms, Inc.
Amana Society, Inc., Amana, Iowa

The ancestors of the Amana people first came to the United States in 1842, settling near Buffalo, New York. The group soon sought land further west, and in 1855 established the Amana Colonies in eastern Iowa. By 1865, seven villages were established on nearly 26,000 acres.

On arrival in America, the group adopted a religious communal way off life. The communal ways lasted until 1932. Since then, the religious and economic aspects of the community have been separate. The businesses were then incorporated as the Amana Society, Inc. and members of the communal system were distributed stock in the corporation.

The Amana Farms Beef Division is just one of the divisions of the Amana Society Inc. A cow herd of 2350 Gelbvieh/Angus cross bred cows as well as a 500 head stocker operation is maintained on the farms 6000 acres of pasture. The Beef Division Manager is responsible for developing a yearly budget as well as monthly forecasts predicting the financial success of the business.

Producing replacement heifers and feeder cattle, developing bred heifers are the primary duties of the three herd supervisors. 80% of the cows calve in April and May. The remaining 20% calve in August and September.

The operation also has a 3000 head feed lot, which it uses to finish its calves, develop its breeding heifers and custom feed cattle. The Amana Society also markets beef under its own brand name in midwestern grocery stores.

Boothe and Boothe Farms
Tony Boothe, Millport, Alabama

Boothe and Boothe Farms is located in western Alabama in Pickens County, only a short distance from the Mississippi border. The farm was established in 1965 and currently consists of 300 acres divided between hay, pasture and timberland. Boothe and Boothe Farms is a family operation in which 50 to 60 cows represents the herd size the family can properly manage.

Brahman F(1) genetics was the foundation of the cow herd. Today, Boothe and Boothe Farms is primarily a commercial Angus-based operation that is geared toward producing cattle to please the end consumer as well as excel in their environment. To do this, performance records are key in placing a value on each sire and dam in the operation. Those sires and dams which do not produce the desired products are culled from the herd. Sire selection is based on a strict set of EPD value criterion, along with correct phenotype for structure and disposition. Replacement heifers are developed from the top one-third of each year's heifer crop based on performance. They are also selected for structure, disposition, udder traits and reproductive traits of the dam. For the past three years, Boothe and Boothe Farms has been recognized as the top 30 to 99 head weaning weight herd participating in Alabama BCIA.

Steer calves are marketed through a local board sale in August, with a few steers marketed as 4-H club calves. Surplus replacement heifers are marketed off the farm or consigned to replacement heifer sales.

Clabaugh Cattle Company
Glenn Clabaugh, Gillette, Wyoming

Claubaugh Cattle Company is a ranching operation located 25 miles north of Gillette, Wyoming. As owner and operator of the family ranch, Glenn and his wife Sylvia, have strived to find better ways to survive this sometimes "trying industry".

The Red Angus breed was their choice when beginning their performance work. They retain a base herd of 450 mother cows. For 20 years they have kept individual records on every cow on the ranch. The key to their performance testing is the computer. They artificially inseminate over half of their cows which allows for improvement in genetics at a much faster pace.

First-calf heifers start calving in February followed by the three-year old cows two weeks later. The older cows begin in March. Weaning has been shortened to 150 days of age. After a preconditioning period, calves are sent to a custom feed lot to be finished and sold to a packer on a formula basis.

The heifer replacement calves are sent to a heifer development center. These replacement heifers are AI'd for 45 days with an average pregnancy rate of 92%. A cut of the heifers are contracted for sale at pregnancy checking time. The rest return home.

After pregnancy checking at the ranch, open cows are sent to a custom feedlot. They receive a fattening ration for a 90 day feeding period and are sold directly to the packer.

A group of our commercial Red Angus bulls have been placed in the WBCIA Bull Test for the last 4 years. Some of these bulls are sold and some return for use at the ranch.

All farming is no-till and all crops are green chopped and stored in silage bags. Meadow hay is baled and ground as needed. Silage and hay, as well as any supplements needed for the ration, are mixed in a truck-mounted mixer and fed in concrete bunks in all winter pastures.

Griffith Seedstock
Connie, John and Terry Griffith, WaKeeney, Kansas

The Griffith family has been raising beef cattle in northwest Kansas since 1878. Located in an area averaging 22" of moisture per year, the land is now split evenly between dryland cultivation and native range. The beef cow operation dovetails with the farming program following them to better utilize land, labor and machinery.

They usually calve about 240 registered Red Angus cows. They calve in 55-60 days, with heifers beginning in February and cows in March. In April and May, they sell enough pairs to summer the balance on about 2,500 acres of native grass. Weaning begins in early September and background calves until just prior to calving season. They sell about 30 registered yearling bulls in late winter, and finish all the remaining steers in a custom feedlot to sell on a carcass-quality grid. They raise all their own replacement heifers, except for a few purchased registered Angus cows.

In late fall and early winter, they make extensive use of crop residue and dormant native grass. The cows then receive prairie hay, cane hay and alfalfa until greenup, usually in late April. They make some use of wheat and forage sorghum pasture, depending on weather conditions and crop prices.

The goal of Griffith Seedstock is to have a self-sustaining herd of efficient, well-adapted cows producing desirable end products, whether replacement seedstock or quality carcasses. Whatever market conditions bring they believe that kind of cattle optimizes their profitability.

LaMont Farms Inc.
Roger and Sharon Lamont & Doug and Shawn Lamont
Carpenter, South Dakota

Lamont Farms Inc. is a family run operation located at Carpenter, South Dakota, which is 35 miles northeast of Huron, South Dakota. Roger and Sharon started the operation in 1960. Doug returned to the farm after graduating from South Dakota State University in 1983. Doug and Shawn were married in 1985 and have three children: Taylor, 12; Austin, 9; and Kaitlyn, 5, the kids help out when possible.

They are currently running a herd of about 850 spring calving cows and have a full calving herd of about 70 cows. They breed about 150 replacement heifers to calve in the spring. They also farm about 3,00 acres of farm ground and hay ground and raise corn, wheat, soybeans, sunflowers, alfalfa and feed. Heifers are exposed for 60 days and calving season will begin about the 20th of February. The cowherd starts calving the first of April. They are bred for sixty days, allowing them to spend more time with the heifers when they are calving and to avoid more winter-like weather when the cowherd starts. All of the older cows calve on grass with little protection, so weather is a factor. The cowherd is bred for sixty days, then bulls are pulled until weaning when they are exposed for forty-five days for fall calving. In order to recover developmental costs, they have found fall calving a very good way of keeping genetics in the herd. It also lets them get more use from the bulls and spreads out the calving workload. If it weren't for the fall harvest pressure, they would be calving out considerably more cows in the fall.

The majority of their cows are Red Angus/Gelbvieh cross. They started out with a herd of straight Herefords, then used Red Angus bulls on them. When the demand for black cattle increased they started using Black Angus on the Hereford cows and Gelbvieh on the red cross cattle. They really like the Angus/Gelbvieh cross. The

LaMonts have experimented with other exotic breeds through the years, but Gelbviehs were the breed that combined the most traits that they were looking for. The herd is about 50 percent red and 50 percent black, so they use both Red and Black Angus and Red and Black Gelbvieh. Since the majority of the ground in the area is farmed, they do travel quite a distance for the summer grazing. Currently they travel about 175 miles west with 240 head, and 45 miles north with about 250 head. Although, checking cattle adds up to a lot of miles traveled, it also spreads the risk of a drought.

Tucker Family Farms
Bill & Claudia Tucker, Amherst, Virginia

Tucker Family Farms is a seventh generation family operation located in the heart of Virginia in Amherst County in the foothills of the eastern slope of the Blue Ridge Mountains. Evolving from a general farming operation encompassing fruit, tobacco, grains, timber, and most domestic livestock the Tucker's have focused primarily on their cattle operation since the 1970's. Today's 800 cow base with complete retained ownership of all progeny and replacement female development with corresponding contract grower arrangements is a significant change from the previous family interests.

Bill took over the direct management of the 100-cow herd of primarily Polled Hereford cattle in 1976 when he convinced his father to cross the straightbred cowherd to Angus sires. Gelbvieh sires were added in 1983. AI became a cornerstone of the operation in 1984, mass heifer mating in 1986, backgrounding calves began in 1989, retained ownership through slaughter in 1992, and sale of surplus breeding stock to an expanded customer base in 1993. Today the Tucker's concentrate much effort on the marketing and development of their trademark "Target 2000" replacement line of 3/4 Angus x 1/4 Gelbvieh females. They have topped the past four major statewide commercial female sales and have averaged over $1000 per heifer in each of them while selling 80% of those heifers to repeat customers with consignment groups of not less than 25 heifers.

Since 1994 the Tucker's have developed a series of profit enhancing service opportunities for their customers. Their ongoing calf buy back program pays $2.00 premiums on steers and $4.00 dollar premiums on heifers over the top market in the area if the calves come from Tucker Genetics. Their expanded contract grower operation now enlists about 500 cows throughout Virginia.

The Tuckers are the founders of "Target Feeders", an evolving backgrounding, cattle feeding, and carcass data collection system for their customers as well as certain other cattle groups. With an eye on pooling resources to command premiums in a value based market at 1000 cattle fed in their first year, the Tucker's are well on their way to their goal of 10,000 cattle by 2005.

Other new projects include the development of a Red line to compliment their "Target 2000" black females. These cattle will be 3/4 Red Angus and 1/4 Gelbvieh and have necessitated the addition of a line of registered Red Angus cattle. An effort is being made to develop this line strictly on fescue to offer fungus resistant cattle for primarily the Southeastern market.

The Tucker's currently operate on about 2500 acres primarily in Amherst County and run about 350 mama cows in both fall and spring herds. They develop heifers both from their own herds and those of their growers, which gives them a genetic base of about 800 cows. Bill, primarily drawing on his experience as past president of both the Virginia BCIA and Virginia Forage Council, has lobbied successfully both at the state and federal level on a variety of agricultural issues. As Director of Legislative Affairs for the American Forage and Grasslands Council he is currently leading a national effort to repeal the "Death Tax". Bill has an Animal Science degree from Virginia Tech with a minor in economics. Bill and Claudia have three daughters, attend Amherst Presbyterian Church, and for recreation enjoy sitting down!

Unsicker Farms
Wayne & Chip Unsicker, Peoria, Illinois

Unsicker Farms operates one of the most progressive, best managed commercial cow-calf operations in Illinois. The cow herd consists of 180 mother cows and 60 bred heifers. Their cropping operation involves 1500 acres in Peoria County.

The Unsicker's initial interest to improve the performance and efficiency of their cow herd started in 1982 with their participation in the University of Illinois Beef Performance Testing Program. Since that time there has been a dramatic improvement in weaning weight, percentage calf crop and overall quality of the herd. Currently their herd is on a commercial record keeping program that provides performance, breeding, health and management records.

In their drive to improve the overall production efficiency, they find the use it necessary to use current technologies of genetics, management and nutrition. Several of these include a Heat-Watch computer program to chart estrus in females for their artificial insemination program. This technology has allowed them to breed a high percentage of their heifers and mature cows to several of the outstanding bulls in the Angus, Gelbvieh and Fleckvieh breeds.

The Unsickers have implemented an F/1-Terminal crossbreeding program to maximize heterosis and utilize complementary of the different breeds. A by-product of their breeding program is the annual "open house" sale of F1 Angus-Gelbvieh females to other commercial producers. Bulls purchased for clean-up following their AI program have been from South Dakota and the Illinois Performance Tested Bull Sale. Heavy emphasis for the AI and natural sires is placed on the EPDs for growth, maternal and carcass traits.

They have narrowed their breeding season to 45 days which results in a very uniform, marketable calf for the feedlot. Carcass data is collected on market animals by retaining ownership through the feedlot phase at the Willrett Feedlot near Malta. Unsickers became involved in the Illinois SPA Program to monitor the pasture, winter forage and productivity of their herd. As a result of the SPA records they have consolidated winter feeding of the cow herd, developed an excellent calf barn, moved away from hay to corn silage for wintering the herd, utilized a computer ration balancing program, and employed early weaning of their calf crop. Intensive grazing management (IGM) has been utilized in their operation for 10 years.

Unsicker Farms has been a gracious host for educational programs such as Management Intensive Grazing and Area Cow-Calf Field Days. There were 265 cattlemen who attended their cow-calf field day in August 1997. Community Colleges have brought classes to their farm and they have employed students for internships. The Unsicker Farm's cattle operation has been featured in several beef magazines including Beef Today, Gelbvieh World, and the Illinois Beef Magazine.

Window Sash Ranch
Frank B. Labato, Center, Colorado

Window Sash Ranch is a commercial cow/calf operation of 280 cows located in the San Luis Valley of Southern Colorado. Three families of Labatos own and operate the current program that was conceptualized in 1973 by Frank Labato and has continued to evolve under the management of his sons, Michael and Anthony. A three-way maternal crossbreeding system utilizing Gelbvieh, Limousine and Red Angus breeds, artificial insemination and a prostaglandin synchronization program on the heifers is the core of the program. Production and management records developed by the University of Wyoming are used. These records emphasize weaning weight indexes as the key indicator of genetic improvement. Emphasis is on production (steer weaning weights rapidly increased from 450 to 600 pounds), developing quality females and in implementing marketing strategies such as retained ownership and branded beef programs. Artificial Insemination (AI) sired calves in the herd averaged 75%, which is indicative of a sound overall program. With an established AI program, they were able to take advantage of trends in the market such as introducing Salers as a terminal breed in the early 80's.

Window Sash Ranch has continued to evolve and take advantage of the high quality genetics that have been developed. Emphasis has shifted from maximum production per cow to maximum profit per cow. The program now runs a composite of Maine Anjou, Black Angus and Black Gelbvieh. Marketing has expanded to include club calves, composite bulls, and several grades of replacement heifers in addition to a feedlot enterprise.

AMBASSADOR AWARD RECIPIENTS

Warren Kester	Beef Magazine	MN	1986
Chester Peterson	Simmental Shield	KS	1987
Fred Knop	Drovers Journal	KS	1988
Forrest Bassford	Western Livestock Journal	CO	1989
Robert C. DeBaca	The Ideal Beef Memo	IA	1990
Dick Crow	Western Livestock Journal	CO	1991
J. T. "Johnny" Jenkins	Livestock Breeder Journal	GA	1993
Hayes Walker, III	America's Beef Cattleman	KS	1994
Nita Effertz	Beef Today	ID	1995
Ed Bible	Hereford World	MO	1996
Bill Miller	Beef Today	KS	1997
Keith Evans	American Angus Association	MO	1998
Shauna Rose Hermel	Angus Journal & Beef Magazine	MO	1999
Wes Ishmael	Clear Point Communications	TX	2000

WES ISHMAEL RECEIVES THE BEEF IMPROVEMENT FEDERATIONS 2000 AMBASSADOR AWARD

Wichita, Kansas - The Beef Improvement Federation (BIF) honored Wes Ishmael with the Ambassador Award at the group's annual convention on July 14, 2000 in Wichita, Kansas. Ishmael was selected for the honor for his dedication and contributions to the beef industry as a livestock journalist.

Ishmael grew up in Longmont, Colorado. His early interest in agriculture lead to his election as president of the Colorado State FFA. Ishmael earned a degree in technical journalism from Colorado State University.

Ishmael served as Director of Communications and Marketing Programs for Colorado Cattle Feeders before joining the editorial staff of *Limousin World* in 1984. He served four years as the publication's editor. In 1990 he moved into the position of director of advertising and communications at the North American Limousin Foundation. Since 1996 Ishmael has operated his own business, Clear Point Communications, based out of Benbrook, Texas.

Ishmael has served as an ambassador in the promotion of performance cattle through the many articles he has written for magazines such *as Limousin World, Beef, Beef Today, Western Cowman* and *The Cattleman.*

Ishmael has served on the board of directors of the Livestock Publications Council (LPC) and received the LPC Distinguished Service Award in 1995. In 1999 Ishmael was named Limousin Promoter of the Year by the North American Limousin Foundation.

Through Clear Point Communications Ishmael continues to provide balanced, well-researched and informative reporting on the beef cattle industry.

Ishmael lives in Benbrook, Texas with his wife, Sharla.

BIF is a federation of state and provincial beef cattle organizations and breed associations involved in beef cattle improvement. Each year BIF recognizes an individual from the livestock media who has promoted BIF principles and beef cattle performance programs. BIF is proud to recognize the many contributions of Wes Ishmael.

PIONEER AWARD RECIPIENTS

Jay L. Lush	IA	1973
John H. Knox	NM	1974
Ray Woodward	ABS	1974
Fred Wilson	MT	1974
Charles E. Bell, Jr.	USDA	1974
Reuben Albaugh	CA	1974
Paul Pattengale	CO	1974
Glenn Butts	PRT	1975
Keith Gregory	MARC	1975
Braford Knapp, Jr.	USDA	1975
Forrest Bassford	WLJ	1976
Doyle Chambers	LA	1976
Mrs. Waldo Emerson Forbes	WY	1976
C. Curtis Mast	VA	1976
Dr. H. H. Stonaker	CO	1977
Ralph Bogart	OR	1977
Henry Holsman	SD	1977
Marvin Koger	FL	1977
John Lasley	FL	1977
W. L. McCormick	GA	1977
Paul Orcutt	MT	1977
J. P. Smith	PRT	1977
James B. Lingle	WYE	1978
R. Henry Mathiessen	VA	1978
Bob Priode	VA	1978
Robert Koch	MARC	1979
Mr. & Mrs. Carl Roubicek	AZ	1979
Joseph J. Urick	USDA	1979
Bryon L. Southwell	GA	1980
Richard T. "Scotty" Clark	USDA	1980
F. R. "Ferry" Carpenter	CO	1981
Clyde Reed	OK	1981
Milton England	TX	1981
L. A. Moddox	TX	1981
Charles Pratt	OK	1981
Otha Grimes	OK	1981
Mr. & Mrs. Percy Powers	TX	1982
Gordon Dickerson	NE	1982
Jim Elings	CA	1983
Jim Sanders	NV	1983
Ben Kettle	CO	1983
Carroll O. Schoonover	WY	1983
W. Dean Frischknecht	OR	1983
Bill Graham	GA	1984
Max Hammond	FL	1984
Thomas J. Marlowe	VA	1984
Mick Crandell	SD	1985
Mel Kirkiede	ND	1985
Charles R. Henderson	NY	1986
Everett J. Warwick	USDA	1986
Glenn Burrows	NM	1987
Carlton Corbin	OK	1987
Murray Corbin	OK	1987
Max Deets	KS	1987
George F. & Mattie Ellis	NM	1988
A. F. "Frankie" Flint	NM	1988
Christian A. Dinkle	SD	1988
Roy Beeby	OK	1989

Will Butts	TN	1989
John W. Massey	MO	1989
Donn & Sylvia Mitchell	CAN	1990
Hoon Song	CAN	1990
Jim Wilton	CAN	1990
Bill Long	TX	1991
Bill Turner	TX	1991
Frank Baker	AR	1992
Ron Baker	OR	1992
Bill Borror	CA	1992
Walter Rowden	AR	1992
James W. "Pete" Patterson	ND	1993
Hayes Gregory	NC	1993
James D. Bennett	VA	1993
O'Dell G. Daniel	GA	1993
M. K. "Curly" Cook	GA	1993
Dixon Hubbard	USDA	1993
Richard Willham	IA	1993
Dr. Robert C. DeBaca	IA	1994
Tom Chrystal	IA	1994
Roy A. Wallace	OH	1994
James S. Brinks	CO	1995
Robert E. Taylor	CO	1995
A. L. "Ike" Eller	VA	1996
Glynn Debter	AL	1996
Larry V. Cundiff	NE	1997
Henry Gardiner	KS	1997
Jim Leachman	MT	1997
John Crouch	MO	1998
Bob Dickinson	KS	1998
Douglas MacKenzie Fraser	AB	1998
Joseph Graham	VA	1999
John Pollack	NY	1999
Richard Quaas	NY	1999
Robert R. Schalles	KS	2000
J. David Nichols	IA	2000
Harlan Ritchie	MI	2000

J. DAVID NICHOLS RECEIVES BEEF IMPROVEMENT FEDERATION PIONEER AWARD

Wichita, Kansas- The Beef Improvement Federation (BIF) honored J. David (Dave) Nichols with the Pioneer Award at the 32nd Annual Convention on July 14, 2000 in Wichita, Kansas. The purpose of this award is to recognize individuals who have made lasting contributions to the genetic improvement of beef cattle.

In 1939 the marriage of Merrill and Gladys Nichols started a family partnership. In 1953 they included their sons, Dave and Lee. In 1978 Nichols Farm, Ltd. in Bridgewater, Iowa was formed with Dave as managing partner. Dave and his wife, Phyllis, have two children, Fletcher and Jennifer.

Nichols Farms has grown from a modest beginning into one of the largest seedstock operations in the U. S. Their cow herd numbers 1100 head of purebred Angus, Simmental, Salers and two unique composite lines. Each year they sell over 400 bulls. They have exported semen, embryos and live cattle to 30 countries.

Nichols has been a leader and pioneer in many aspects of beef cattle production. In beef cattle technology Dave Nichols has been a step ahead of the crowd. In 1986 Dave started the Nichols Newsletter which now has a circulation of 7000 cattlemen. At one time he had one of the six fax machines in Iowa. In 1984 he put the entire operation on computer and by 1985 had four computers networked. In 1993 he put up the Nichols Farm web site only a month after Internet service became available in the area.

Nichols has been as much a leader in adoption and promotion of beef performance programs as he has in adoption of technology. Dave Nichols is truly one of BIF's pioneers. He was involved in the formation of the Beef Improvement Federation and served on the first board of directors. In 1974 he was elected President of BIF. In 1975 Nichols received BIF's Continuing Service Award and in 1993 he was named BIF's Seedstock Producer of the Year.

As a member of the Iowa Cattlemen Association for 40 years, Nichols has served on numerous committees. Nichols has served on the National Beef Board and the NCBA Board of directors. Nichols was recently awarded the Iowa State University Animal Science Hall of Fame Award. Nichols Farms hosts over 20 cattlemen and college tours each year and Dave Nichols continues to be a popular guest speaker at cattlemen conventions across the county.

BIF is pleased and honored to recognize the many contributions of J. David Nichols by presenting him with the BIF Pioneer Award.

ROBERT R. SCHALLES RECEIVES BEEF IMPROVEMENT FEDERATION PIONEER AWARD

Wichita, Kansas- The Beef Improvement Federation (BIF) honored Dr. Robert R. Schalles with the Pioneer Award at the 32nd Annual Convention on July 14, 2000 in Wichita, Kansas. The purpose of this award is to recognize individuals who have made lasting contributions to the genetic improvement of beef cattle.

Dr. Robert Schalles was born in Durango, Colorado. He married Betty Sewell in 1956 and has four children: Philip, Larry, Karen and Glen. Betty passed away in 1998. In January of this year he married Daisy Fielder and resides in Manhattan, Kansas.

After four years in the U.S. Navy Pacific Submarine Fleet Schalles received his B.S. in Agriculture Education from Colorado State University in 1963. He received his M.S. in 1965 and his Ph.D. in Animal Science in 1966 from Virginia Polytechnic Institute. In 1966 he joined the staff of the Animal Science Department at Kansas State University.

During his 32 years of service with the Animal Sciences and Industry Department at Kansas State University his expertise in genetics and beef cattle management contributed significantly to the animal breed research and teaching program. Dr. Schalles taught animal breeding at the undergraduate and graduate level and contributed to numerous research projects. Dr. Schalles retired in 1998 and is now Professor Emeritus at Kansas State.

Dr. Schalles has been a pioneer in several areas of beef cattle breeding. He is well known for his work with single gene inheritance and is often consulted on matters dealing with traits like coat color, the dilution gene, "rat tail" and deleterious recessive genes. Through his years of service to the industry Dr. Schalles has conducted research in many areas that have had a direct impact on performance programs. He did pioneer work in estimation of genetic parameters for ultrasound carcass data, was involved in some of the early work on scrotal circumference measurement and played a key role in the development of the Simmental carcass evaluation program.

Dr. Schalles has played an active role in the Beef Improvement Federation, serving on awards committees, the sire evaluation committee, the live animal committee and the purebred committee. He has served on various Kansas Livestock Association committees and has been chairman of the board of directors of the American Simmental Association.

BIF is pleased and honored to recognize the many contributions of Dr. Robert Schalles by presenting him with the BIF Pioneer Award.

HARLAN RITCHIE RECEIVES BEEF IMPROVEMENT FEDERATION PIONEER AWARD

Wichita, Kansas- The Beef Improvement Federation (BIF) honored Dr. Harlan D. Ritchie with the Pioneer Award at the 32nd Annual Convention on July 14, 2000 in Wichita, Kansas. The purpose of this award is to recognize individuals who have made lasting contributions to the genetic improvement of beef cattle.

Harlan Ritchie was born August 3, 1935 in Albert City, Iowa and grew up on a general livestock farm. He attended Iowa State University and received his B.S. in Animal Science in 1957. After receiving his Ph.D. from Michigan State University in 1964, he joined the Animal Science faculty at Michigan State University. In addition to his research responsibilities he served as coordinator of the department's undergraduate curriculum. In 1973 his appointment was changed from teaching and research to extension and research.

Dr. Ritchie was an influential pioneer in changing beef cattle type from fat, small-framed early maturing animals to leaner, faster-growing cattle that better met the needs of the commercial cattle feeding industry in the late 1960's and early 1970's.

Dr. Ritchie is well known for his work in beef production efficiency, beef cattle dystocia, retained ownership, beef quality, food safety and trends in the beef industry. He played a major role in development of the National Beef Cow Efficiency Forum in 1984 and is author of the BIF fact sheet "Calving Difficulty in Beef Cattle".

Dr. Ritchie's greatest contribution to the beef industry has been his perception of problems as they arise, his ability to bring people together to study the problem and his development of educational programs to communicate solutions.

Dr. Ritchie has received numerous awards including BIF's Continuing Service Award, the American Society of Animal Science Extension Award and Animal Industry Service Award, and Michigan State's Distinguished Faculty Award. The Saddle and Sirloin Club hanged Harlan Ritchie's portrait in 1994.

BIF is pleased and honored to recognize the many contributions of Dr. Harlan Ritchie by presenting him with the BIF Pioneer Award.

CONTINUING SERVICE AWARD RECIPIENTS

Clarence Burch	OK	1972
F. R. Carpenter	CO	1973
E. J. Warwick	DC	1973
Robert DeBaca	IA	1973
Frank H. Baker	OK	1974
D. D. Bennett	OR	1974
Richard Willham	IA	1974
Larry V. Cundiff	NE	1975
Dixon D. Hubbard	DC	1975
J. David Nichols	IA	1975
A. L. Eller, Jr.	VA	1976
Ray Meyer	SD	1976
Don Vaniman	MT	1977
Lloyd Schmitt	MT	1977
Martin Jorgensen	SD	1978
James S. Brinks	CO	1978
Paul D. Miller	WI	1978
C. K. Allen	MO	1979
William Durfey	NAAB	1979
Glenn Butts	PRI	1980
Jim Gosey	NE	1980
Mark Keffeler	SD	1981
J. D. Mankin	ID	1982
Art Linton	MT	1983
James Bennett	VA	1984
M. K. Cook	GA	1984
Craig Ludwig	MO	1984
Jim Glenn	IBIA	1985
Dick Spader	MO	1985
Roy Wallace	OH	1985
Larry Benyshek	GA	1986
Ken W. Ellis	CA	1986
Earl Peterson	MT	1986
Bill Borror	CA	1987
Daryl Strohbehn	IA	1987
Jim Gibb	MO	1987
Bruce Howard	CAN	1988
Roger McCraw	NC	1989
Robert Dickinson	KS	1990
John Crouch	MO	1991
Jack Chase	WY	1992
Leonard Wulf	MN	1992
Henry W. Webster	SC	1993
Robert McGuire	AL	1993
Charles McPeake	GA	1993
Bruce E. Cunningham	MT	1994
Loren Jackson	TX	1994
Marvin D. Nichols	IA	1994
Steve Radakovich	IA	1994
Dr. Doyle Wilson	IA	1994
Paul Bennett	VA	1995
Pat Goggins	MT	1995
Brian Pogue	CAN	1995
Harlan D. Ritchie	MI	1996
Doug L. Hixon	WY	1996
Glenn Brinkman	TX	1997

Russell Danielson	ND	1997
Gene Rouse	IA	1997
Keith Bertrand	GA	1998
Richard Gilbert	TX	1998
Burke Healey	OK	1998
Bruce Golden	CO	1999
John Hough	GA	1999
Gary Johnson	KS	1999
Norman Vincil	VA	1999
Ron Bolze	KS	2000
Jed Dillard	FL	2000

JED DILLARD RECEIVES BIF CONTINUING SERVICE AWARD

Wichita, Kansas – The Beef Improvement Federation (BIF) honored Jed Dillard with the continuing Service Award at the 32nd Annual Meeting and Research Symposium in Wichita, Kansas on July 14, 2000.

Jed Dillard is a native of Oglethorpe County, Georgia where he grew up on a small beef cattle operation on the land his family settled four generations ago. He was an active member of 4-H and FFA and got his first opportunities to develop new skills, new ideas and new friends from those activities. His career has combined that love of "home" with the excitement of new people, places and ideas.

Jed received his B.S. in Animal Science from the University of Georgia and his M.S. in Animal Breeding and Genetics from Ohio State University. After graduation, Jed realized the dream of most OSU graduates; he moved to Florida.

He has been a part of Florida's agricultural and beef industry since his arrival in Jefferson County. After a brief day work stint, he began work with a family crop and cattle operation that had operated on the same land for five generations.

This time his outside influence was the Florida Beef Cattle Improvement Association (FBCIA) and the Florida Cattlemen's Association (FCA). Jed began a performance testing program on the herd begun from common cows and outside bulls. This was his first step off the ranch.

Since then, Jed has worked with the FCA Integrated Research Management/Standardized Performance Analysis Committee, the Beef Checkoff Referendum, the Florida Beef Council, Florida Extension Service activities, National Cattlemen's Beef Association and Beef Improvement Federation. Dillard served as a director of BIF from the eastern region and is past president of BIF. His exposure to many segments of the industry and areas of the country has shown him the needs of the industry and the wants of the consumer must be combined in one system and that each collaborative component of that system is critical to its success.

After selling his family's interest in Basic Beefmasters, Inc., Jed joined the faculty of Florida A&M University as an Assistant Professor. His responsibilities included recruitment of minority students for agricultural programs and teaching Beef Cattle Production.

Jed is married to Dr. Joan Hare, a member of the research faculty at Florida State University.

Says Dillard, "No matter what we do, there's somebody or something else that can help us see new approaches and perspectives. The trick is to see them when they show up."

RON BOLZE RECEIVES BIF CONTINUING SERVICE AWARD

Wichita, Kansas - The Beef Improvement Federation (BIF) honored Dr. Ronald P. Bolze with the Continuing Service Award at the 32nd Annual Meeting and Research Symposium in Wichita, Kansas on July 14, 2000.

Ron Bolze was born in 1954 and grew up on a dairy and general livestock farm in south central Pennsylvania. He received his B.S. in Animal Science in 1976 from Pennsylvania State University. Upon graduation he returned to the family farm and spent five years in developing a commercial beef cow/calf and feeding enterprise. Bolze's interest in beef catttle lead him to Kansas State University where he received his Ph. D. in reproductive physiology in 1985.

Dr. Bolze joined the staff of Ohio State University in 1985 as an extension beef cattle specialist. His extension efforts involved general cow/calf management and his research interests were in the area of estrous synchronization and intensive grazing management. For five years Dr. Bolze managed the Ohio Bull Test Program.

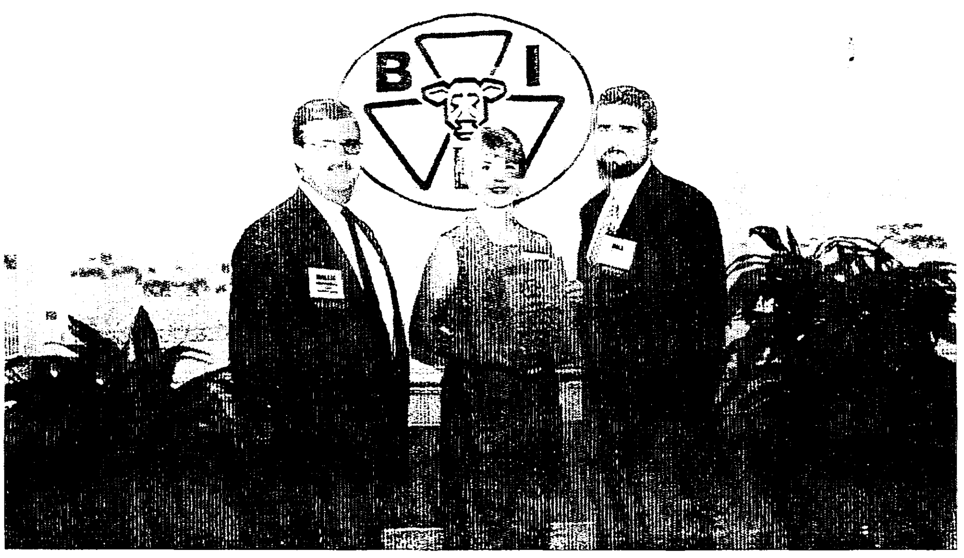
In 1991, Dr. Bolze accepted the position of Extension Specialist, Livestock Production with the Kansas State University Animal Science Department at the Northwest Research Extension Center in Colby, Kansas. Dr. Bolze's responsibility was implementing extension education programs in beef cattle production. He was involved in development of the HERD (Heifer Evaluation for Reproduction and Development) program. Through workshops and public meeting Dr. Bolze has reached thousands of ranchers and cattlemen with his extension programming.

In 1998 Bolze assumed the position of Director of Progeny Testing for Carcass Merit with Certified Angus Beef. Current efforts include application of DNA technologies for feedlot sorting and potential genetic selection of beef cattle.

Dr. Bolze has devoted years of service to the Beef Improvement Federation. In 1986 he joined BIF's board of directors as Eastern Region Secretary and served as chairman of the central test committee. He served as Executive Director of BIF from 1993 to 1998. During his term as Executive Director he played a major roll in the publication of the most recent edition of *Guidelines for Uniform Beef Improvement Programs*.

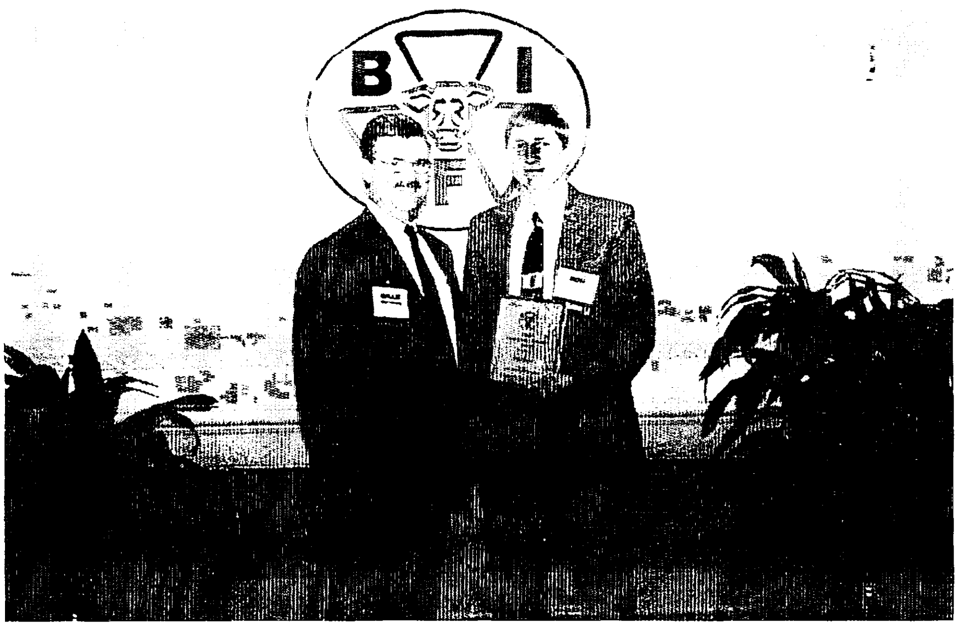
For his years of service to BIF the Beef Improvement Federation is pleased to recognize Ron Bolze with the Continuing Service Award.

Seedstock Producer of the Year
Left to Right:
Willie Altenburg, Lori, Megan and Galen Fink

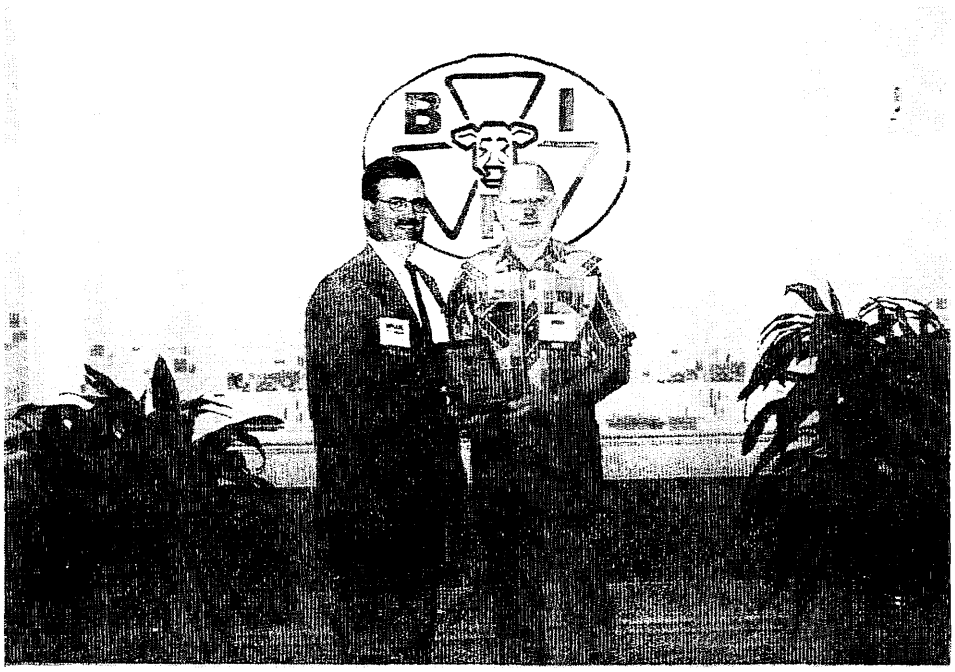


Commercial Producer of the Year
Left to Right:
Willie Altenburg, Claudia and Bill Tucker

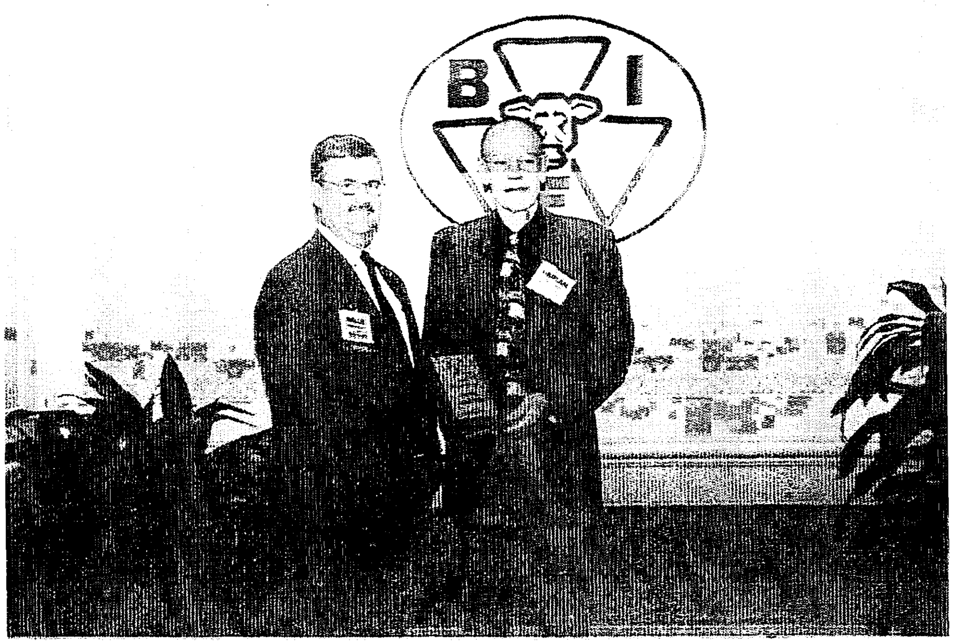
Frank Baker Memorial Scholarship Winners
Left to Right:
Willie Altenburg, Katherine A. Donoghue, Paul L. Charteris



Continuing Service Award Winner
Left to Right:
Willie Altenburg, and Ron Bolze



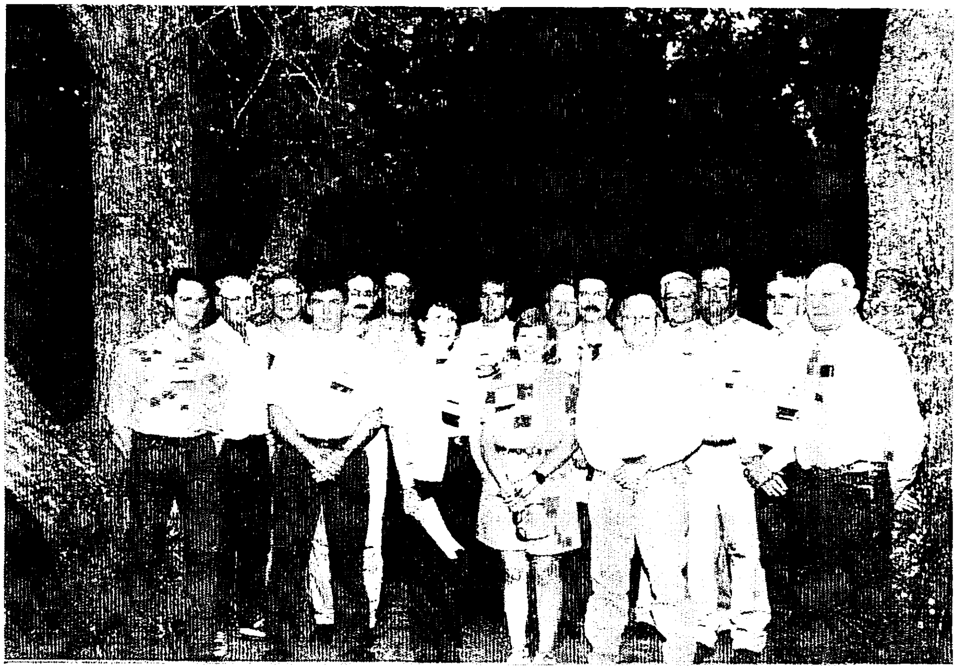
Pioneer Award Winner
Left to Right:
Willie Altenburg, and Bob Schalles



Pioneer Award Winner
Left to Right:
Willie Altenburg, and Harlan Ritchie

Continuing Service Award Winner
Left to Right:
Willie Altenburg and Jed Dillard

Ambassador Award Winner
Left to Right:
Willie Altenburg and Wes Ishmael



BIF Board of Directors
Left to Right:
Craig Huffins, Chris Christianson, SR Evans, Darrh Bullock, Ronnie Silcox, Terry O'Neil, Connee Quinn, Ronnie Green, Gini Chase, Robert Williams, Lynn Pelton, John Crouch, Larry Cundiff, Jimmy Holliman, Galen Fink, Richard McClung
Not Pictured:
Willie Altenburg, Sally Dolezal, Sherry Doubet, Robert Hough, Renee Lloyd, Herb McLane, Marty Ropp, Doug Frank, and Bob Weaber

BIF
32ND ANNUAL RESEARCH SYMPOSIUM AND ANNUAL MEETING
JULY 12-15, 2000
ATTENDEES

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