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R. Mark Enns
Colorado State University, Mark.Enns@Colostate.edu

D. J. Garrick
Colorado State University, D.Garrick@massey.ac.nz

B. W. Brigham
Colorado State University

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USING NEW SELECTION TOOLS

R. Mark Enns, D.J. Garrick and B.W. Brigham
Colorado State University

The goal of most beef production systems is to increase or at least maintain profitability. Producers can attempt to increase profitability in a variety of ways that might include reducing feed costs, changing their marketing program, or perhaps by changing the performance of their herd through genetic improvement. Focusing on this latter option, there are two primary genetic tools available: selection and mating where selection refers to the selection of breeding animals and mating includes which females are mated to which bulls, for example, crossbreeding systems. This paper focuses on the former, the selection of the appropriate animals for a production system with the goal to improve profitability.

The best tool available for making selection decisions is expected progeny differences (EPD). Over the years the number of EPD available to guide producers in making selection decisions has grown from 5 to over 15 in most cases. Simply put, the amount of information that the breeder must sift through to try to make a good selection decision has become overwhelming. The producer must determine which EPD have the greatest influence on their income and their expenses, and by how much—a daunting task. Historically this task has depended on the "intuition" and experience of the breeder. For instance, they know that selection for heavier weaning weight will increase the weight of calves sold at weaning, but that blind selection for weaning weight will also increase calving difficulty and if replacements are kept, likely increase cow size and feed costs. Breeders have been performing a balancing act with little concrete information on how important each of those traits is to their profitability. Fortunately, there are several tools that have recently become available to ease the process of combining the costs and the revenues of beef production with EPD to make selection decisions that will produce progeny which are more profitable.

TRAIT CLASSIFICATION

The first and easiest tool available to help breeders focus their selection rather than wading through vast amounts of information is the concept of economically relevant traits versus indicator traits. EPD often exist for both but distinguishing between the two will reduce the number of EPD that need to be considered. Briefly the economically relevant traits (ERT) are the traits that are directly related to the costs or the revenues from production. If performance in these traits is changed one unit, there is a direct effect on either cost or income. The indicator traits, however, are not directly related to profitability. If performance in these traits is changed one unit, there may not be a change in cost or income. The indicator traits are genetically related to the economically relevant traits, and are measured to add accuracy to the calculation of EPD for the ERT. Once that data is used to calculate the EPD, however, the EPD for the indicator traits does not need to be considered. Two examples of this scenario are the consideration of birth weight and calving ease EPD, and scrotal circumference and heifer pregnancy EPD when making selection decisions. Birth weight and calving ease EPD are often both available, so which should

receive the primary focus when making selection decisions? Using the procedure outlined above, if birth weight decreases 1 lb is there a direct effect on costs or income? The answer is likely not, conversely, if calving ease is increased 1%, meaning 1% fewer heifers are assisted at calving, profitability is directly effected by increased number of calves for sale and decreased labor costs. In the second example, scrotal circumference in yearling bulls is related to age of puberty in their daughters, with bulls with larger scrotums having daughters that reach puberty at an earlier age. Again, using the system above, if scrotal size is increased 1 cm is the producer more profitable—likely not. But if heifer pregnancy rate is increased 1%, there is a direct effect on profitability through retention and development of fewer replacement females and a corresponding increase in the number of heifers then available for sale.

Using the concept of the ERT, the producer can limit the number of EPD that they need to consider when making a selection or a bull purchase decision. This is the first and easiest step to reducing the amount of information that needs to be considered and to begin to combine the economics of production with genetic improvement to increase profitability. However, just identifying the ERT for a specific production system does not objectively combine the costs and incomes from production to weight each EPD by impact on profitability.

SELECTION INDEXES

Since 1943, (Hazel) scientists have advocated a more objective method for combining EPDs with the economics of production. The original concept of selection indexes began with L.N. Hazel, but saw little use due to the complexities of implementation. In the recent past, increases in computer speed and development of software systems allowed breed associations and scientists to become more proactive in developing these indexes. Seedstock breeders and breed associations have realized the benefit of providing their customers with these indexes in order to simplify the process of selecting more profitable seedstock. There are now a number of associations that produce index values including but not limited to, the American Angus Association, the North American Limousin Foundation, American Charolais Association, the American Hereford Association, and the American Simmental Association. Additional associations have selection indexes in the development stage. Others are providing decision support tools that allow producers, both commercial and seedstock, to develop these specifically for their own production systems—a topic that will be discussed later.

All indexes currently released, weight EPD by their respective impact on profitability, this impact factor otherwise known as an economic weight (a) such as in the following:

$$I = a_1 x EPD_1 + a_2 x EPD_2 + \cdots + a_n x EPD_n$$

Each index includes the EPD that are related to profitability and the best indexes include EPD for all ERT. Using the above in a simple example, assume that a 1 lb increase in weaning weight was worth $.97 and a 1% increase in stayability was worth $1.92 for each calf produced and a bull's EPD for weaning weight was +25 and his EPD for stayability was

+8. That bull's index would then be ($.97*25) + ($1.92 * 8) or $40. This value could then be compared to another bull's index value. An example with two bulls is shown in table 1. Index values are interpreted exactly as are EPD. In the two scenarios in Table 1, Bull A's progeny would be $30 more profitable than Bull B's in a system where calves are sold at weaning and replacement heifers are retained. In a terminal system where all calves are sold, Bull B's progeny would be $35 more profitable than Bull A's.

Table 1. Comparison of index values for two bulls.

	Weaning Index	Terminal Index
Bull A	+$40	+$20
Bull B	+$10	+$55
Difference	$30	-$35

Table 1 introduces a key consideration to using indexes. Breeders should choose the index that most closely resembles their specific production and marketing system.

While a vast improvement in combining selection and the economics of production, indexes have several weaknesses that the producer should consider as they use those published dollar values. First, many associations report several index values and the index used for selection purposes should include those traits that are applicable to the production and marketing system of the producer using those values. For instance, if the producer were retaining replacement females and selling calves at weaning, it would not be appropriate for the producer to use a terminal index to make selection decisions. Second, the producer should realize that the index may not include all traits that are economically relevant to their production system. For instance, the weaning index may not include EPD representing longevity of the cow and would therefore put no selection pressure on that trait. The producer would have to consider longevity, or stayability, separately from the index value. Third, the producer should realize that all currently produced indexes are based on generalizations about the costs of production, the level of performance of the herd, and the prices received for animals. For instance, increases in maintenance feed requirements are likely more costly in harsh environments as opposed to environments where supplemental feed is readily and cheaply available. Fourth, in any index, traits may receive economic emphasis but may need little emphasis in any one specific operation. For instance, consider two producers, both of whom retain ownership and market their cattle on the same quality grid. One's calves consistently grade 85% choice while the other's grade 35% choice. Clearly, the latter producer would put more emphasis on improving marbling score than would the first producer.

Finally, generalizations about the costs of production and the incomes received from production should be monitored. Thankfully research has shown that even though the economic weights might not be exact for an individual production system, the indexes are relatively robust to changes in the costs of production or the prices received that are in turn used to calculate the economic weights (Smith, 1983; Weller, 1994).

While indexes have some weaknesses that require a producer to consider more than just the dollar value of the individual, they are a vast improvement over the "seat of the

pants" methods used previously. When chosen for the appropriate marketing program, indexes are relatively robust in helping to make good selection decisions. However, the best use of selection indexes allows them to be custom-designed for a producer's particular production and marketing system

DECISION SUPPORT SYSTEMS

Interactive decision support systems overcome the weaknesses associated with relatively generalized selection indexes in that they allow the producer to tailor the selection system specifically to their operation's production and marketing program, taking into account current production levels, costs of production, and marketing program.

As part of the National Beef Cattle Evaluation Consortium (NBCEC), Colorado State University is developing a web-based decision support tool to simplify the process of selecting breeding stock that produce more profitable offspring. The system is designed to be user friendly and require information that is readily available for each producer. Examples of the 4 components of a production system and the specific information required from a cow/calf producer are listed in Table 2.

Table 2. Information required for use of a decision support system for the cow/calf producer.

Production	Management	Economics	Cow Genetics
Herd size	Constant Input[a]	Non-feed cow costs	Cow breed
Cow calving rate	Replacements (bred or purchased)	Heifer value	Birth weight EPD
Heifer calving rate	Cows per bull	Cow value	Weaning weight EPD
Mature weight	Breeding system (maternal or terminal)	Bull value	Yearling weight EPD
Calf Survival Rate	Maximum cow age	Heifer, cow, calf prices	Milk EPD
Yearling weight		Incremental feed costs (cost of purchased feed)	Calving ease direct and total maternal EPD
Weaning weight		Discount rate	Heifer pregnancy EPD
Birth Weight			Stayability EPD
Heifer calving difficulty			Maintenance energy EPD

[a]Allows the producer to either reduce or expand their herd should per cow feed requirements change or purchase/sell in supplemental feed if requirements increase

The decision support system interacts with breed association databases containing EPD, combining that information with the producer-specific information to simulate animals performance and rank animals based on their overall impact on profitability in that specific production system. The current system is developed for use by the producer selling calves at weaning but research funded in part by the NBCEC is fast developing a post-weaning component to the system allowing producers to account for retained ownership and the impact selection decisions have on that sector of the industry. The final system will also account for implementation of crossbreeding systems and will consider genetic changes in all cow-calf and feedlot economically relevant traits simultaneously.

SUMMARY

Several tools are available for producers to compare selection of potential breeding animals and the impact those animal's offspring will have on the profitability of the operation. Tools range in complexity from identification of the economically relevant traits to interactive decision support systems that account for herd specific parameters all with the goal of improving the profitability of beef production.

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