PRODUCTION (AND) OR PROFIT? FOCUSING OUR BREEDING OBJECTIVES BY SELECTING FOR PROFITABLE GENETICS ,NOT NECESSARILY HIGH PRODUCTION GENETICS

Matt Spangler

University of Nebraska-Lincoln

Introduction

Steep increasing genetic trends for growth traits (weaning and yearling) and mature cow weight can be seen in many breeds but perhaps more alarming are those producers that have dramatically increased the genetic potential for milk production in their cow herds. Conditional on the assumption that the Beef Cattle Industry is a For Profit organization, then it would seem logical that profit (Revenue – Expense) should drive our selection decisions. In order to actually do this, knowledge of environmental constraints, genetic antagonisms, and the selection tools that have the potential to measure profit are critical.

Environmental Constraints

The development of an obtainable breeding objective begins by clearly identifying environmental constraints and marketing goals. Table 1 illustrates levels of production that are suited for differing production environments.

Table 1. Matching genetic potential for different traits to production environments[1]

Production Environment		Traits					
Feed Availability	**Stress[2]**	**Milk**	**Mature Size**	**Ability to store energy[3]**	**Resistance to stress[4]**	**Calving ease**	**Lean yield**
High	Low	M to H[5]	M to H	L to M	M	M to H	H
	High	M	L to H	L to H	H	H	M to H
Medium	Low	M to H	M	M to H	M	M to H	M to H
	High	L to M	M	M to H	H	H	H
Low	Low	L to M	L to M	H	M	M to H	M
	High	L to M	L to M	H	H	H	L to M

[1] Adapted from Gosey, 1994.
[2] Heat, cold, parasites, disease, mud, altitude, etc.
[3] Ability to store fat and regulate energy requirements with changing (seasonal) availability of feed.
[4] Physiological tolerance to heat, cold, internal and external parasites, disease, mud, and other factors.
[5] L = Low; M = Medium; H = High.

If feed resources are limited in a stressful environment then selection for increased extreme output (high growth, milk, and red meat yield) could have negative impacts on the ability of cows to be successful breeders without the need for large quantities of harvested forage. The beginning of a profitable breeding objective is identifying what the environment will allow you to produce, at least until we have tools to apply direction selection to traits of adaptation.

Crossbreeding

At a BIF meeting in 2010, it hardly seems fit to even mention crossbreeding. Commercial producers who have not yet adopted it are a burden to the beef industry. However, it is an excellent example of selection for profitability. We know that the two primary benefits of crossbreeding are complementing the strengths of two or more breeds and heterosis, neither of which create trait maximums. If we think about it simplistically, crossbreeding for a trait like weaning weight leaves us with a calf crop that is better than the average of the parental lines, not better than both parental lines. Crossbreeding, if done correctly, seeks to optimize many traits through complementing breed strengths and produce animals that are better than the average of the parental lines that created them. The best tool that the commercial cattleman ever had is based on optimization, not the production of extremes. So, it would stand to reason that within breed selection should have the same goal, optimums and not maximums.

Genetic Correlations

Unfortunately, all traits that might be included in a breeding objective are not independent of each other. Sometimes this is beneficial as we see a favorable correlated response, and other times these genetic correlations pit revenue against cost. A good example of this comes from the suite of weight traits. Depending on the targeted marketing endpoint either weaning weight (WW), yearling weight (YW) or carcass weight (CW) become a source of revenue and all are related to a major factor influencing the cost of production, mature cow weight (MW). Table 2 illustrates the genetic correlations between MW and WW, YW, and CW, respectively.

Table 2. Genetic correlations between mature cow weight (MW) and weaning weight (WW), yearling weight (YW), and carcass weight (CW).

	WW[1]	YW[1]	CW[2]
MW	0.62	0.45	0.81

[1] Estimates from Northcutt and Wilson, 1993.
[2] Estimate from Nephawe et al., 2004.

Although it is not intuitive, literature results show that of the immature traits, WW has the highest genetic correlation with mature cow weight. Other similar estimates have been shown in the literature ranging from 0.65 to 0.82 in Red Angus field data (Williams et al., 2009). The same authors estimated the genetic correlation between postweaning gain and

MW to range between 0.48 and 0.59. This is particularly relevant in the context of producers that sell some portion of calves but also keep back their own replacement females. Care should be given not to focus solely on the revenue portion, sale weight, but rather optimizing input costs associated with mature weight and revenue sources from calf sale weight. The mature sale weight, CW, shows a strong and positive relationship with MW and again care should be taken to optimize selection between the two.

Selection For Decreased Input

Traditionally, there have been few EPDs that could be used to directly select against input costs. However there has been one for some time, milk. Research has shown that cows with the genetic propensity to milk heavily require more energy for lactation and maintenance. The National Research Council (NRC) data shows that a cow who produces 25 lbs. of milk at peak lactation requires 10% more feed energy than a cow producing 15 lbs. of milk at peak lactation. To see a 10% difference in feed energy with regards to mature weight it would require moving from a 1,000 lb. cow to a 1,200 lb. cow, or a change of 200 lbs. of body weight. Moderating mature cow size and selecting for an optimal window of milk production is beneficial when it comes to cutting costs regardless of your production environment given that milk production has been estimated to explain 23% of the variation in maintenance requirements (Montano-Bermudez et al., 1990). However, in limited feed environments females with high maintenance energy requirements may also have difficulty maintaining an acceptable body condition score and rebreeding. Nugent et al. (1993) determined that with limited nutrient availability, breeds with a high genetic potential for milk production had longer anestrous periods which lead to lower conception rates during a fixed breeding season. Other researchers have concluded that selection for increased milk production past an adequate threshold is not economically or biologically efficient if the marketing endpoint was at either weaning or slaughter (van Oijen et al., 1993). While the lactation requirements may be intuitive, cows with a higher milk yield also tend to have increased visceral organ mass this increasing energy requirements even when the cow is not lactating (Solis et al., 1988).

Other selection tools exist for decreasing input costs including mature weight EPDs and more recently the Maintenance Energy EPD published by the Red Angus Association of America (Evans, 2001; Williams et al., 2009). The study by Williams and others clearly depicts that selection for immature weights is occurring thus increasing MW. Furthermore, the study illustrates that without accounting for this prior selection in the development of ME predictions, and inherent bias is created.

Most of the described tools focus on the cow-herd and not in the finishing phase. The American Gelbvieh Association publishes a Days-to-Finish (DtF) EPD designed to select for animals that reach slaughter earlier, as measured by a constant fat thickness of 0.4 inches. For producers that are rewarded for feedlot performance DtF can be an effective way to decrease input costs derived from a greater number of days on feed or feeding cattle past an optimal fat thickness. Brigham at al., (2006) estimated the genetic correlation between Dtf and WW to be -0.29, suggesting that larger weaning weights tend to be moderately associated with few days on feed.

Bio-economic Index Values

In order to mitigate genetic antagonisms in an effort to select for profit economic index values become the tool of choice. A bio-economic index (H) is simply a collection of EPDs that are relevant to a particular breeding objective, whereby each EPD is multiplied by an associated economic weight (a). For example, the economic index value H can be written

H = EPD1a1 + EPD2a2 + EPD3a3 + ...

where EPDs 1, 2, and 3 are multiplied by their corresponding economic weight and summed. Consequently, a high index value does not necessarily mean that an animal excels in all EPD categories given that superiority in trait can compensate for inferiority in other traits depending on how the EPDs are weighted in the index. A high index value should be thought of as excelling in the ability to meet a breeding objective. These index values do not have a measure of accuracy directly associated with them because each EPD is weighted differently in the index and it is not statistically possible to weight the accuracy values. Like EPDs, they can easily change overtime with the addition of new information (i.e. progeny records) as the component EPDs change. It is important to note, however, that before proper use of an index can be ensured, a breeding objective must be clearly identified. For example, the use of an index such as the American Angus Association's Dollar Beef ($B) in an enterprise that retains replacement heifers can lead to adverse effects, given that sire selection pressure has been placed on terminal traits via $B.

The majority of economic index values are rigid (i.e. not catered to individual enterprises). A much more desirable method would use individualized index values where the bull with the highest index value may differ from one herd to the next, depending on how the animal fits the specific needs of each enterprise. While this would lead to more accurate identification of parents for the next generation, it becomes a challenging metric to use for advertisement purposes in the seedstock industry, which probably explains why this more desirable method of multiple-trait selection has not been exploited by the majority of breed associations. For example, it is possible to advertise that a bull is in the top 1% of the breed for $B, but if an index parameters are partially defined by the prospective bull buyer or semen user the most desirable bull for that producer may not be the best for other producers. One example to the contrary would be the interactive Terminal Sire index produced by the International Charolais Association.

New and Improved Tools

Genomic tools hold the potential to provide predictions for hard to measure traits that focus on input costs such as feed intake. Ideally, genomic predictions for feed intake would be incorporated into an economic index as a key component of input cost. However, accurate genomic predictions will require phenotypes.

The improvement of existing phenotypic databases for traits is also needed. It is critical that seedstock producers routinely turn in mature cow weights along with body condition scores to further aid in selecting for optimal weights and the development of tools such as the American Angus Associations Cow Energy value index ($EN) and the Red Angus Associations Maintenance Energy (ME) EPD. This will require participation in Whole (or Total) Herd reporting, a very necessary process for complete data collection and the development and delivery of genetic prediction tools.

Summary

Trends are rarely flat, as an industry we have measured ourselves by steep lines in one direction or the other. From a seedstock perspective this may have been perceived as necessary in order to differentiate themselves (either as breeders or as breeds) from others in the market place. Clearly identifying your production environment and realistic production goals given that environment are critical. Profit lies in the optimization of expense and revenue and optimization is always more challenging than maximizing outputs or minimizing inputs. It will require more effort, detailed financial records, and a structured breeding objective that builds a cow herd based on optimum values and not extremes. One final thought, extremely low maintenance cows will push the lower threshold of what is biologically possible for weight and produce virtually no milk. High output cows will represent the other extreme, weigh more than most mature bulls and milk heavier than the best Holstein. Both excel in some measure of the profit equation (i.e. lowest cost or highest revenue) but neither promises to be profitable.

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