Contributed paper

A NEW TOOL TO SELECT ANGUS BULLS TO BREED TO DAIRY COWS

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SUMMARY

Widespread use of sexed semen among other factors has resulted in a dramatic increase in dairy cows being mated to beef bulls. Economic selection indexes were developed to identify the best Angus bulls, a predominant breed in this market, to use on Holstein and Jersey cows. Through interviews and site visits with key participants in the dairy beef supply chain, production and economic parameters were sourced to inform the modification of the standard American Angus terminal sire index $Beef. $Angus-on-Holstein Value ($AxH) and $Angus-on-Jersey Value ($AxJ) were developed and although highly correlated to each other (0.96), were considered to rank bulls different enough, especially at the top end, that both were needed. Generally, the dairy indexes identify bulls with the best $Beef but avoid three particular traits that are problematic in the dairy industry, with non-linear emphasis. Calving ease had relatively lower emphasis with a similar penalty in both the $AxH and $AxJ indexes, where muscling was heavily weighted with greatest emphasis in $AxJ and a penalty for excessive yearling height EPD was implemented in $AxH in an effort to reduce excessively long carcasses in that cross. These new indexes provide dairy farmers and players in the supply chain through to slaughter a tool to select Angus bulls to produce calves that are better suited to the requirements of this unique sector.

INTRODUCTION

America's dairy cattle have always been one source in the beef supply chain. In recent years, this source of beef has been evolving due to a convergence of factors. Sexed semen has been revolutionary in dairy cattle, where breeders can target replacement heifers from their best cows and breed the remainder for beef production. Before sexed semen, the feeding of straight Holstein steers was common, and although this practice remains, there has been a movement towards less demand for these from processors, increasing incentives for breeding dairy cows to beef bulls. Jerseys are gaining market share in the USA but their straight Jersey male calves have very little value, making beef breedings even more attractive. Low milk prices and contraction in the dairy industry reduces the demand for surplus replacements, again pushing the incentive for more beef matings.

Angus has been the most common breed of sire for beef on dairy matings in the USA. $Angus-on-Holstein Value ($AxH) and $Angus-on-Jersey Value ($AxJ) were developed to help dairy farmers identify the most profitable Angus sires for those markets. Although these were the first indexes developed in the USA for beef bulls crossed on Dairy cattle, such indexes have been in place in other countries where beef from the dairy industry is significant such as in Ireland (Berry *et al*. 2019).

Described are the unique aspects that were considered in the development of the beef on dairy indexes. Differences in resulting selection choices and trait emphasis between $Values is described.

MATERIALS AND METHODS

The development of the Angus on dairy $Values released in 2020 built on the Angus $Value indexes, released in 2019 which were the result of a complete rebuild of the bio-economic model at the time and included an industry wide survey described in Santos *et. al*. (2019). Beef Value or $Beef is a terminal index related to profitability differences on a per carcass basis when all progeny are fed through to slaughter. Differences in post-weaning performance and carcass revenue are

considered. There is no emphasis on calving ease in $B as it is assumed that terminal matings involve mature cows only, which have a negligible dystocia incidence when bred to Angus bulls.

The biological models behind $Beef were adjusted to reflect differences in the production and performance of the Dairy cross calves. The dairy model considered the calves performance from birth, including calving ease and pre-weaning growth EPD. Differences in post-weaning performance, feed efficiency and mean carcass grading performance in Dairy cross calves were all considered. Information about the unique aspects and challenges, along with mean performance characteristics were obtained by visiting supply chain participants in the USA by way of in-person interviews and facility visits through the mid and Southwest. Included were dairy farms, calf raisers, feedlots and the processing sector. In addition to this production tour, interviews were also held with the USDA scientists behind dairy selection indexes (Drs. Paul VanRaden and John Cole pers comm). These interviews ascertained the importance of calving ease in the dairy production system as described in VanRaden *et al*. (2018).

The dairy cross calves were characterized with slower post-weaning growth and poorer feed conversion efficiency, lighter carcass weights, less back-fat but similar marbling compared to the straight beef animals as modelled in $Beef. Unique aspects of the dairy cross calves were also apparent, including problems with carcass length in the Holstein cross calves and lack of muscling in both Holstein and Jersey. Differences in mean growth and feed efficiency performance were relatively straight forward adjustments to the bio-economic model behind $B.

Lack of muscling in the dairy cross calves creates two problems. The term “sunken strips” was revealed through the packer interviews to describe the problem of some steak cuts, like strip loins, that are undesirable from a visual, “plate appeal” standpoint due primarily to shape. These poorly muscled animals also create a problem in the live animal as it is a way for the marketplace to visually distinguish animals from the dairy industry. To prevent discounts in the market, these beef animals resulting from the beef-on-dairy cross need to look like beef animals and not the stereotypical “narrow” dairy character.

Deficiencies due to muscling required the development of a genetic trait for use in the indexes, but is not reported. Standard American Angus carcass Expected Progeny Differences (EPD) are presented on an age constant basis (Miller *et al*. 2018). Muscling was determined via a genetic regression using the component traits of ultrasound rib-eye area in bulls adjusted for weight at time of ultrasound scanning (yearling age) using similar methodology employed for feed efficiency as described in MacNeil *et al*. (2011). To rank high for muscling an animal needs to have a large ribeye area relative to their weight.

The economic impact of deficient muscling was modelled in a similar manner to other carcass traits in the $B model, where different categories have different prices. With the thresholds where prices change being known, a new cumulative price can be determined based on a shift in the mean performance. Changes in the developed muscling trait was used to model the economic impact of a different proportion of animals being discounted for lack of muscling, which creates a non-linear relationship between muscling EPD and $Value, where increasing economic discounts are applied with decreasing muscling. Improved muscling was most important with the Jersey crosses.

The same approach was applied to yearling height EPD as a predictor of carcasses being out of specifications in $AxH with 20% of carcasses being over-length with 20 USD per 45.4 kg discount. This approach to modelling categorical traits resulting in a non-linear emphasis is described in Quinton *et al*. (2019).

Correlations were determined using Microsoft Excel between $Value indexes and related EPDs Sires in the analyses included 25,914 current sires with indexes reported for both $AxH and $AxJ.

RESULTS AND DISCUSSION

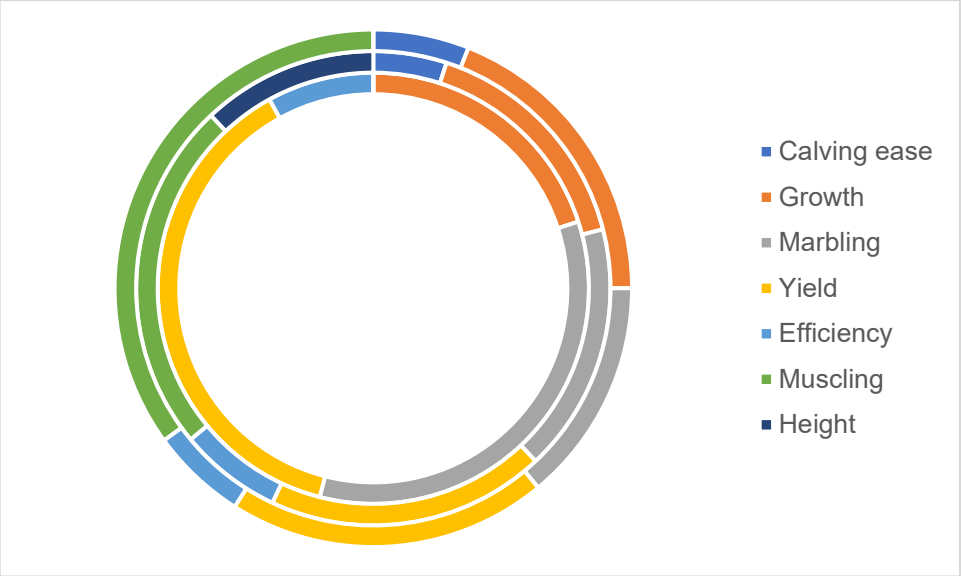

Figure 1. Relative emphasis on each trait segment in $B, $AxH and $AxJ (from center)

The dairy indexes are different in the traits that are added to $Beef and as a result, reduce emphasis on existing traits as illustrated in Figure 1. Although the emphasis on growth and efficiency remained similar, the additional traits of calving ease and muscling in both dairy indexes as well as yearling height in $AxH reduced the emphasis on marbling and yield compared to $Beef considerably. The heavy emphasis on muscling stands out as distinctly different with the greatest emphasis in $AxJ.

Table 1. Correlations between $Value Indexes[1] and some important trait EPD[2] related to Angus on Dairy Indexes

	$Beef	$AxH	$AxJ
Calving Ease	0.01	0.27	0.20
Post-Weaning Gain	0.75	0.53	0.63
Marbling	0.66	0.49	0.44
Yearling Height	0.54	0.09	0.28
Muscling	0.31	0.79	0.79
$Beef		0.72	0.78
$AxH			0.96

[1]$Value indexes are economic selection indexes developed for American Angus including a standard terminal index $Beef when Angus bulls are bred to Angus cows along with newly developed indexes when Angus bulls are mated to Holstein ($AxH) and Jersey ($AxJ) dairy cows. Expected Progeny Differences are the genetic evaluation estimates from the American Angus weekly genetic evaluation.

Resulting $AxH and $AxJ were considerably different to $Beef with correlations of 0.72 and 0.78, respectively (Table 1). As most dairy matings are via artificial insemination, considerable re-ranking among top bulls on the $AxH and $AxJ indexes justified both indexes in the market place despite their high correlation to each other (0.96).

The emphasis on calving ease in both $AxH and $AxJ resulted in a low to moderate correlation with calving ease direct EPD of 0.27 and 0.20, respectively. This is different to the near zero correlation observed between $Beef and calving ease EPD, which can be surprising considering $Beef is a terminal index with considerable weight on growth and weight traits with a 0.75 correlation with post-weaning gain EPD. Amongst the current sires analysed the correlation between calving ease EPD and post-weaning gain EPD was only -0.04 and this combined with a positive correlation of 0.22 between calving ease direct and marbling, a heavily weighted trait in $Beef, are contributing to this neutral correlation observed.

There was a positive correlation between EPDs for yearling height and weight (0.59) and since traits like post weaning gain and carcass weight are positively weighted in $Beef, a positive relationship between $B and Yearling height (YH) EPD (.53 correlation) exists. High yearling height EPD sires then come to the top of $Beef rankings, which are not desirable sires for Holstein cows due to the problem with carcass length. This was addressed in $AxH with downward non-linear emphasis on yearling height resulting in a very small (0.09) correlation between YH EPD and $AxH. It is interesting that although there is no direct emphasis on YH in the $AxJ indexes, there was reduced correlation with YH EPD (0.28) compared to $Beef (0.54). This is partly due to the negative correlation (-0.10) between muscling and yearling height where the increased emphasis on muscling in $AxJ is putting downward pressure on height. Also, as traits are added to the dairy indexes, compared to $Beef, proportional emphasis on traits like growth are also reduced, which could also be influencing the relationship with height.

The indexes developed addressed a need from dairy farmers and participants in the dairy beef supply chain that was not being met with current tools. The main differences between the indexes developed and the standard $Beef index was the relationship with calving ease and the elimination of bulls at the top of the index rankings that are best described as “tall and narrow”. Such genetics are not a favourable cross on dairy cattle as they tend to magnify the phenotype that buyers and processors identify as being less desirable. The resulting $AxH and $AxJ indexes were well received by semen companies, who are the primary marketers of genetics to dairy farmers.

CONCLUSIONS

The $AxH and $AxJ indexes developed to select Angus sires to breed Holstein and Jersey cows address important and unique aspects relevant to these dairy crosses that don’t exist in the straight beef supply chain, which the existing terminal index for American Angus, $Beef was designed for. The moderate correlation between $Beef with the $AxH and $AxJ indexes illustrates the major re-ranking that will exist with these new indexes compared to the standard terminal index for straight beef matings and hence their need in the marketplace.

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