Maintenance Energy Requirements

The Technical Details Explained

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In previous articles, we have discussed the merits of selecting for economically relevant traits, ERTs (see pages 22 and 34 of the February 2001 ARA). Basically, ERTs are traits that directly affect a revenue or expense. The RAAA's goal for producing genetic predictions is to publish EPDs only on traits of economic relevance.

Breed associations have published EPDs on many traits directly or indirectly related to sources of revenue. However, beginning in Spring 2004, RAAA will publish an EPD that predicts differences in maintenance energy requirements between animals. Differences in energy requirements can translate easily into differences in feed required to maintain body weight, which can be directly related to the biggest cost of production: feed costs. This article will outline the more technical details of the RAAA Mature Cow Maintenance Energy Requirements (ME) EPD. For more basic information on this new EPD, please see the article on page 28 of the January 2004.

There are two main components to the development of the ME EPD. First and foremost is a genetic prediction of mature weight. Mature weight is not an ERT, but is a component of the equation to estimate energy requirements. The first section of this article will describe the process of estimating mature weight genetic prediction.

The second component is milk yield. The RAAA has published a milk EPD for many years, but that EPD is expressed in pounds of weaning weight, not pounds of milk. With the appropriate conversions, our milk EPD can be combined with the mature weight genetic predictions to derive mature cow maintenance energy requirements.

Mature Weight Genetic Prediction

The RAAA mature weight genetic prediction was prototyped by Dr. John Evans (Evans, 2001), and was subsequently modified to follow nutritional and animal breeding procedures as outlined in this document. Mature weight (MWT) was analyzed as metabolic body weight (MWT0.75; pre-adjusted for condition score) using a random regression tool (Evans, 2001). Solutions from the metabolic body weight genetic prediction were adjusted to a five year old cow equivalent before they were incorporated into the maintenance energy genetic prediction.

The number of records sent to CSU from the RAAA was 517,750. This data set included 147,093 unique cows, 83,821 weight observations and 47,883 body condition observations. However, only 24,361 observations included both a weight and a condition score. Because some cows had more than one weight recorded, only 13,638 unique cows had both weight and body condition observations.

All weight observations were adjusted to a constant body condition score of 5. As a result, each weight observation was required to have an accompanying body condition score. The condition score adjustments taken from Tennant et al., 2002, are shown below:

	Body Condition Score						
	2	3	4	5	6	7	8
Adjustment	205	146	33	0	-55	-104	-148

The adjustments above were calculated using body condition scores from Angus females over a 14 year period from 1981 to 1994 by Tennant et al., 2002 and are expressed in pounds.

These condition score adjustments represent the weight an animal would either need to gain or lose to have the condition representative of a body condition score of 5.

The final data file after all exclusions for missing mature weights, condition scores, and contemporary groups lacking any variation included 16,145 records. That file included a total of 10,384 unique cows: 6,719 cows with 1 observation (i.e. weight and condition score); 2,232 cows with 2 observations; 910 cows with 3 observations; 404 cows with 4 observations; 98 cows with 5 observations; and 21 cows with 6 observations. Adjusted Mature weight observations were then raised to the ¾ power to obtain metabolic body weight, for use in the mature cow maintenance energy prediction. Once the final data file had been constructed, a 3 generation pedigree was built off of the cows remaining in the data file.

A total of 34,475 animals received metabolic weight breeding value estimates. Cow metabolic weight progeny difference genetic prediction summary statistics are shown in the table below. A sire with a metabolic weight EPD of 10 will on average have offspring with 10 $kg^{0.75}$ more metabolic weight at 5 years of age than a sire whose metabolic weight EPD is 0.

	Mean	Std. Dev.	Minimum	Maximum	Heritability
Metabolic Weight	0.395	1.27	-5.9	9.6	0.65

Mature Cow Maintenance Energy

Evans (2001) developed an equation for calculating mature cow maintenance energy breeding values for the RAAA as part of the same project in which the mature weight prediction was developed. The equation was developed using both the NRC (1996) equations for metabolizable energy for maintenance and a modified Wood's lactation function (Wood, 1969; Wood, 1979). The Wood's lactation function was modified (MacNeil and Mott, 2000) so an animal's genetic prediction for mature weight and milk could be used to predict its maintenance energy requirements. The base maintenance energy equation developed by Evans (2001) is as follows:

$$MEm_i = MEm\left(MW_i\right) + .10*MEp_i$$

Where MEm_i = an animal's EBV for metabolizable energy requirements at maintenance, MEm (MW_i) = the metabolic weight EBV at 5 years of age plus the population mean for mature weight for individual i adjusted to a constant condition score of 5, and MEp_i = the energy required for lactation for individual i derived from the individual's genetic prediction for weaning weight maternal obtained from the RAAA national cattle evaluation. The prediction is divided by 2 to be reported as a progeny difference, and is expressed in Mega-calories per month.

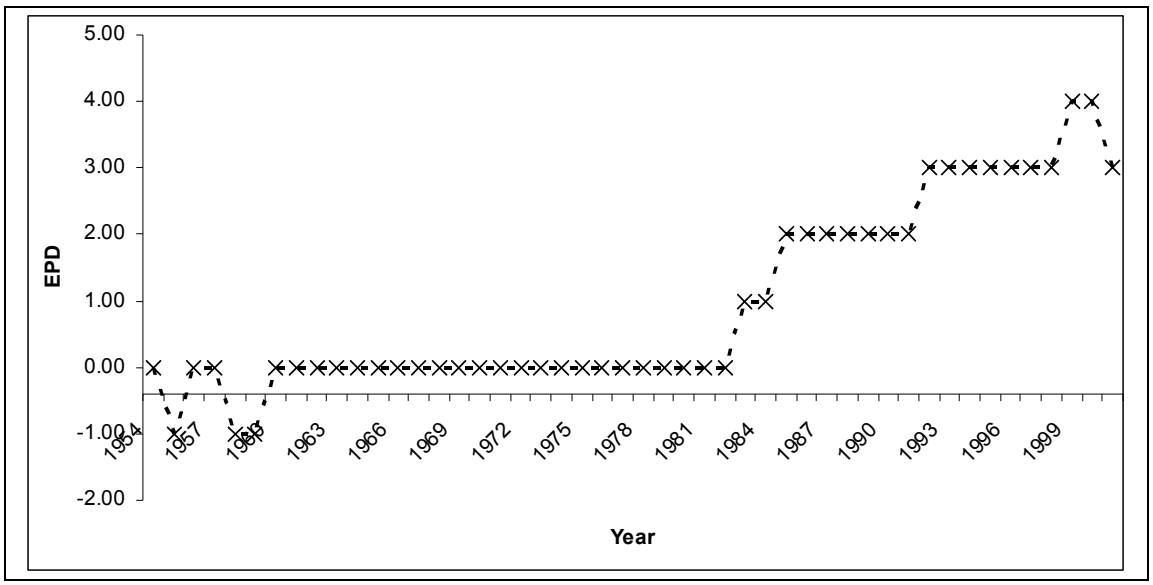
Unlike the manner in which traditional breeding values are calculated, mature cow maintenance energy is similar to that of an index or a combination of an animal's genetic prediction for mature weight and weaning weight maternal.

Summary statistics for the mature cow maintenance energy genetic prediction on bulls in the RAAA 2004 Spring Sire Summary (EPD and ACC) can be found below. The analysis resulted in a total of 34,475 animals with a maintenance energy genetic prediction.

	Average	Std. Dev	Minimum	Maximum
MEM EPD	5	5.7	-15	26
MEM ACC	0.71	0.060	0.55	0.83

A sire with a mature cow maintenance energy EPD of +20 will on average produce offspring that require an additional 20 Mcal of energy for maintenance per month than would a sire with an EPD of 0.

The genetic trend for mature cow maintenance energy can be found below. The average genetic merit for maintenance energy requirements has increased in a similar fashion to the average genetic merit for weaning and yearling weights. These trends are similar because of the relationship between animal size and maintenance requirements. However, the ME EPD trend appears to have leveled in the last few years. This is possibly a response to downward selection for birth weight.



The current mature cow maintenance energy equation is expressed in Mega-calories per month. Through simple conversions, these values can be expressed in many other units such as pounds of DM, TDN requirements, hay equivalents, etc. For example, the energy content for average quality range forage is approximately 0.86 Mcal/lb DM. If a sire has a mature cow maintenance energy EPD of +20 Mcal/month, his offspring will require approximately 23 lbs (20/0.86) more DM over a month's time than offspring of a sire with an EPD of 0.

Genetic selection should be a tool that can be used to increase profitability, not just revenues. We have seen the development of many revenue-side EPDs in the past 15 or so years, but profitability in the beef industry (any industry) relies on more than increased revenues. With the release of a cost-side EPD, the RAAA provides is members and their customers the ability to make profitable selection decisions. All RAAA EPDs, their averages and related information are available on-line at http://www.redangus.org/genpred/EPDPage.html. Alternatively, you can order a complementary 2004 RAAA Spring Sire Summary and Membership Directory by calling the national office at 940.387.3502

References

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