

Cow maternal efficiency: "Giving the girls some credit"

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Abstract: The CRC for Beef Genetic Technologies (the "Beef CRC") has established the Maternal Efficiency Project to provide new knowledge to help better inform beef producers on the impacts estimated breeding values for carcase fatness/carcase muscularity and for feed efficiency have on maternal efficiency, especially under variable nutritional environments. The project is being conducted across southern Australia. It has an industry herd component and a research station component being run simultaneously. Early results from the research stations show that selection for traits affecting body composition holds across seasons and nutrition treatments, and that genetically leaner cows seem to be less fertile, especially under low nutrition. Results are peer-reviewed and compiled for industry dissemination in the *Maternal Journal* available through the Beef CRC website (www.beefcrc.com.au).

Keywords: beef, cow, productivity, efficiency, fat, ebv, climate change.

Introduction

The Australian cattle industry is concerned about the impact on breeding herd efficiency of adopting selection strategies influencing body composition, such as selection for improved feed efficiency or increased carcase yield. Forecast increased variability in climate may result in cows having to be productive under even more variable nutritional environments than experienced in the past.

Seedstock cattle breeders' perspectives on topics associated with maternal productivity were investigated through in-depth interviews (Lee et al. 2009). The vast majority of breeders had firm requirements about the need for females to calve at 24 months of age and subsequently calve on an annual cycle. However, there was considerable divergence in attitudes to female management concerning grazing management, body condition score fluctuation and the utilisation of body fat reserves.

Variation in these attitudes was associated with considerable divergence in perspectives on the importance of selecting for positive (>0) rib and rump fat depth estimated breeding values (EBVs) for female fertility, or selecting for neutral or negative fat EBVs to assist yield, particularly with regard to steer progeny. The survey demonstrated that even though the breeders had similar end market goals, there were substantial differences in selection and the way they interpreted and utilised fat EBVs.

To provide new knowledge to help the cattle industry to effectively balance these potentially conflicting requirements, the CRC for Beef Genetic Technologies (the "Beef CRC") has established the Maternal Efficiency Project now being conducted across southern Australia. The project has an industry herd component and a research station component being run simultaneously.

Industry herd

The industry herd component involves ongoing performance recording on approximately 7,000 Breedplan recorded heifers, comprising both Angus and Hereford breeds, from conception through to weaning of their second calf. The females have liveweight, hip height and body condition score measures as well as ultrasound scans for eye muscle area (EMA) and fatness (subcutaneous fat depth over the ribs (Rib) and rump (P8) and intramuscular fat% (IMF) recorded at pre-calving and at weaning during the first and second parities. This will enable the amount of body tissue accumulated or mobilised depending on feed supply (pasture through the year) and energy demand (pregnancy and lactation) to be quantified.

Data have been collected for four years and data collection is now 75% complete. It is apparent, to date, that cow weight and body composition traits are moderately heritable

and repeatable over time. The cows changed weight and composition substantially throughout the year but there are considerable differences in the size and direction of these changes between herds. However, change in weight over the annual production cycle has low heritability and more a result of management decisions than of selection (see Table 1).

Correlations between cow weight and IMF, and the cow's EBVs for these traits are moderate and positive; indicating that an increase in these EBVs is accompanied by an increase in the observed values for the traits (see Table 2). However, the correlations for rib and P8 rump fat and EMA with the EBVs for these traits were low, indicating that selection on what are effectively steer carcass EBVs may be ineffective in changing these body composition traits in cows.

Research station herds

The research station component is being carried out at the Vasse Research Station, near Busselton, WA, and at the Struan Research Station, near Naracoorte, SA. At both sites females that are genetically divergent in trial NFI EBV (net or residual feed intake; a measure of feed efficiency) or in rib fat EBV are run under either high or low nutritional regimes.

Feed intake is recorded as well as more detailed measures of reproductive performance. This will enable differences in maternal efficiency (weight gain of cow and calf per MJ energy consumed by cow and calf) to be calculated for the different genotypes under different management regimes. Data collection for the first and second parities is now complete.

High and low fat EBV cows

There was a significant difference between the fat lines in heifer conception rate (CR): the high-fat cows had a 94% CR whereas the low-fat cows had an 85% CR (see Table 3). The heifer CRs were evaluated before nutrition treatments had begun. Going into their second parity, on the high nutrition treatment, the low-fat cows were heavier than the high-fat cows, but there was no difference in cow weights on low nutrition. On both nutrition levels, the high and low-fat cows showed consistent differences in scanned rib-fat depth, with the low-fat cows being leaner by >3mm of fat. The difference in CRs between the high and low fat cows was again apparent, and most pronounced on the low nutrition treatment.

High and low NFI EBV cows

There was no significant difference between the high and low NFI lines in heifer CR. Going into their second parity, within each nutrition level, the high and low NFI cows did not differ in weight. Low NFI was associated with a reduction in fatness of the cows, and a trend towards a lower CR, on both nutrition treatments.

Conclusions

From the industry herd data, heritabilities for possible new traits like mobilisation of reserves and estimation of phenotypic and genetic correlations between cow traits (days to calving, milk production and culling records) and young body composition (fat and muscle) and structural assessment scores will be calculated.

Early results from the research stations show that selection for traits affecting body composition holds across seasons and nutrition treatments, and that genetically leaner cows seem to be less fertile, especially under low nutrition. The results will also be utilised to enable the simulation of 'what if' scenarios. This allows the effects of selection for different traits such as increased muscling, decreased feed intake and altered fat distribution on maternal productivity in varied environments to be determined.

Results are peer-reviewed and early results have been published by Donoghue and Parnell (2009) and Donoghue et al. (2010). As results become available they are compiled for industry dissemination in the Maternal Journal available through the Beef CRC website (www.beefcrc.com.au).

The maternal efficiency project will progressively deliver results that will inform beef producers on the impacts EBVs for carcase fatness/carcase muscularity and for feed efficiency have on maternal efficiency under variable nutritional environments.

References

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Appendix

Table 1. Cow weight change during 1st and 2nd parities (kg/day)

Trait	Parity 1	Between parities	Parity 2
	(1st lactation)	(Weaning – calving)	(2nd lactation)
Parity 1	0.16 (0.04)	-0.53 (0.02)	0.10 (0.03)
Between parities	-0.51 (0.23)	0.09 (0.04)	-0.43 (0.03)
Parity 2	0.62 (0.20)	-0.30 (0.27)	0.14 (0.05)

Heritabilities on diagonal; $r_{phenotypic}$ above; $r_{genetic}$ below; SE in parentheses.

Table 2. Correlations between EBVs and traits recorded on cows

	1st parity		2nd parity	
	Pre-calving	Weaning	Pre-calving	Weaning
EBV_{cowwt} : Cow weight	0.41	0.45	0.41	0.49
EBV_{IMF} : Cow IMF	0.45	0.50	0.38	0.47
EBV_{P8} : Cow P8 fat	0.17	0.14	0.09	0.19
EBV_{Rib} : Cow Rib fat	0.14	0.14	0.06	0.12
EBV_{EMA} : Cow EMA	0.22	0.18	0.26	0.13

Table 3. Pregnancy data for high and low rib-fat EBV cows during 1st and 2nd parities

Line	Nutrition	Weight (kg)	P8 fat (mm)	Conception rate (%)
1st parity				
High Fat		473	6.5	93.5
Low Fat		465	4.9	85.1
2nd parity				
High Fat	High	531	8.3	94.9
High Fat	Low	488	5.4	88.4
Low Fat	High	575	7.6	93.5
Low Fat	Low	491	4.2	85.7

