Proc. Assoc. Advmt. Anim. Breed. Genet. 20:479-482

THE ECONOMIC VALUE OF BODY CONDITION SCORE IN NEW ZEALAND SEASONAL DAIRYING SYSTEMS

T.J. Byrne[1], B. Santos[1], P.R. Amer[1], and J.R. Bryant[2]

[1]AbacusBio Limited, P O Box 5585, Dunedin 9058, New Zealand
[2]DairyNZ, Private Bag 3221, Hamilton 3240, New Zealand

SUMMARY

The body condition score (BCS) of a dairy cow will fluctuate according to her physiological state. Where pasture availability is variable through the seasons, these fluctuations will have an economic cost if body condition is lost when feed costs are low and replaced when feed costs are high. Differences in efficiency of BCS mobilisation and replenishment, seasonal differences in cost of feed, the value of additional milk solids production at the end of lactation (by milking longer to utilise body condition) or drying off with conservation of body condition were the basis of the calculations presented in the economic value (EV) of one unit of BCS in dairy cows.

INTRODUCTION

The body condition score (BCS) of an adult dairy cow will fluctuate according to her physiological state (Nicol and Brookes 2007). In farming systems where pasture availability varies throughout the year, these fluctuations have implications for the cost of feed and farm management. Body condition score at the end of spring (120 days from planned start of calving) is very important since it defines the feeding management required to return the cow to adequate pre-calving BCS targets which will support good production and fertility in the following lactation.

Currently, BCS is used as a correlated predictor in the genetic evaluation of dairy cow fertility in the New Zealand dairy industry. This paper describes the calculation of an EV for the trait ‘autumn body condition score’ in seasonal dairy production systems. The New Zealand dairy industry is currently considering a proposal to include ‘autumn body condition score’ as a trait with a direct economic weight in its national breeding objective.

RATIONALE

The economic impact of genetic differences in ability to maintain body condition can be assessed by balancing the cost of extra feeding to maintain milk production in cows that retain body condition in spring rather than converting it to milk against the costs of three alternative management strategies as follows:

1) Excess body condition present in late lactation can be converted directly into higher milk solids revenue by milking slightly longer without providing additional feed;

2) More body condition at dry off can lead to savings in autumn/winter feed costs as less BCS gain is needed to meet pre-calving BCS targets for the following season;

3) Cows with high BCS could have an extended lactation with additional feeding to support milk production because low BCS cows need to be dried off early.

The approach used followed the standard practice of treating one unit of BCS change as equivalent to 6.58% of live weight when considering energy requirements (Anonymous, 2010) since this allowed the associated energy requirements to be scaled for breed differences in mature live weight. Calculations were also based on the assumption that cows would have recovered their pre-calving body condition scores by the end of the lactation i.e. that there would be no future cost associated with reduced production or effects on subsequent fertility. Further assumptions were that a gain of 1 kg of live weight in late lactation requires 50 MJME, a loss of 1 kg live weight saves 37 MJME for milk production in lactating cows, and 72 MJME is required per 1 kg of live weight gain in dry cows (Anonymous 2010). These assumptions, along with seasonal differences in feed costs (Chapman *et al.* 2012), and the value of extra milk solids production late in the lactation season whether through fat mobilisation or later dry off, formed the basis of the calculation of the EV per unit of BCS in dairy cows.

METHODOLOGY

Quantifying the extra feed costs on the milking platform from retaining BCS in spring. It was assumed that a cow that is one BCS unit higher than her herd-mates at the end of the spring period has achieved this by mobilising less body condition during early lactation. On a herd basis, it was also assumed that 30% of this extra body condition came from condition retained in early spring, while 70% came from condition retained in late spring. Early spring is a period of relatively high feed costs where supplementation is often required, whereas late spring is a time of pasture surplus and relatively low feed costs. Because of the typical timing and spread of calving, the majority of overall herd body condition mobilisation is expected to occur in late spring.

Cows with genetic propensity to retain body condition mobilise less energy, and so need more feed (37 MJME) to produce an equivalent amount of milk than cows with a genetic propensity to lose body condition. The following equation predicts an aggregated feed cost over the lactation to supply energy for BCS retention during lactation (i.e. BCS retention in early and late spring associated with a one unit increase in BCS in lactating cows, FC_b^{ABCS}).

$$FC_b^{BCS} = \sum_{s=1}^{2}\left[LW_b \times 0.0658 \times EC \times P_s \times Pf_s\right], \qquad (1)$$

where for cow breed b, LW is the cow mature live weight, EC is the energy change associated with the BCS retention (37 MJME/BCS unit/kg live weight) and for season s (s = early spring or late spring), P is the proportion of the condition score gain captured through associated BCS retention (30% in early spring and 70% in late spring), and Pf is the price of feed per MJME (Chapman *et al.*, 2012).

Quantifying the gain in milk solids revenue resulting from higher BCS through lactation leading to later drying off without additional feed inputs. The benefits of higher BCS throughout lactation can be captured as the value of feed used directly for milk production instead of BCS gain. The energy value saved through not having to gain body condition score (50 MJME per kg of live weight gain in lactating cows) was assumed to be converted to extra milk production in later lactation. The following calculation predicts the milk solid equivalent of one unit of BCS captured through later dry off in lactating cows, without any extra feed being supplied to the lactating cow.

$$MSV_b^{BCS} = \left(\frac{LW_b \times 0.0658 \times ES}{MS_b}\right) \times Pm, \qquad (2)$$

where for cow breed b, LW is the cow mature live weight, ES is the energy saved per kg live weight from not having to gain BCS, which can be used for milk production (50 MJME), MS is the MJME required per kg MS production, and Pm is the milk solids price.

Quantifying the savings in autumn or winter (May) feed costs through less need for supplementary feeding to gain BCS in late lactation. A cow that is one BCS unit lower than her herd-mates at the end of spring was assumed to have to recover that condition by additional feeding in late lactation. It was also decided that this additional feeding would be undertaken in the month of May, irrespective of the region of New Zealand. This assumption is not completely correct since in the North Island, May is counted as a winter feed cost, whereas in the South Island it is counted as an autumn feed cost. The decision was necessary however to provide some standardisation. The following calculation describes the savings in May feed costs associated with carrying forward an additional BCS unit.

$$WFC_b^{BCS} = LW_b \times 0.0658 \times EC \times Pf_{May}, \qquad (3)$$

where for cow breed b, LW is the cow mature live weight, and for season s (s = winter), EC is the energy saved from not having to achieve BCS gain (50 MJME per kg of live weight gain in late lactation cows) and Pf_{May} is the price of feed per MJME for the region in May.

Quantifying the profit resulting from prolonging lactation and providing additional feed to support milk production. Some farms capture the benefits of less mobilisation of condition during early lactation by milking cows longer while continuing to provide additional feed inputs. This alternative rationale reflects the opportunity to utilise retained BCS to ensure a longer lactation. This later drying off aspect of high BCS animals is not captured by breeding values for milk production traits.

The ability to milk cows with more condition for longer depends on the rate of decline in BCS that occurs in late lactation. The farm model currently used to derive the National Breeding Objective, assumes a lactation length of 270 days and a winter period of 61 days (Amer 2013). This leaves the balance of 34 days available. Under the assumption that cows have returned to pre-calving condition before the winter period (meaning they only need energy for maintenance and foetal growth during winter) a cow going into late lactation with one BCS unit more than her herd-mates could be milked for an additional 34 days provided additional feed was available on the milking platform to support her total feed requirements over and above the feed costs of a dried off cow that needs to recover body condition score prior to the beginning of winter. End of lactation daily milk production in kg MS, after accounting for the proportions of early-, mid-, and late-season calving cows, was incorporated for each breed. The following calculation describes the revenue component (MSP) associated with prolonged lactation, with additional feeding to prolong milk production.

$$MSP_b^{BCS} = 34 \times MP_b \times Pm, \ (4)$$

where for cow breed b, over 34 days MP is the daily milk production in kg MS at the end of lactation and Pm is the milk solids price ($/ kg MS).

In order to incorporate the marginal cost of extended lactation, feed costs to support milking are calculated for a cow over and above those required for herd-mates which are one BCS unit lower, have been dried off, and are being fed to recover condition. The following calculation describes feed energy costs to support that milk production ($MSFC$) associated with prolonged lactation, with additional feeding to prolong milk production.

$$MSFC_b^{BCS} = 34 \times MP_b \times MS_b \times Pf_a - LW_b \times 0.0658 \times ER \times Pf_a \qquad (5)$$

where for cow breed b, over 34 days, MP is the daily milk production in kg of milk solids at the end of lactation, MS is the MJME required per kg MS production, Pf_a is the price of feed per MJME in autumn, LW is the cow mature live weight, and ER is the energy change per kg live weight from gaining BCS in dry cows (72 MJME). Feed costs for maintenance are the same for the high and low BCS cows and so have been omitted from equation (5).

The following calculation describes variable costs (electricity and labour) to support the additional milk production ($MSVC$) associated with prolonged lactation.

$$MSVC_r^{BCS} = \sum_{d=1}^{34}\left[\frac{(VCL_r + VCE_r)}{LL_r}\right] \qquad (6)$$

where for region r, VCL is variable cost associated with labour per lactation , VCE is variable cost associated with electricity per lactation, and LL is the lactation length.

Economic value calculation. The EV of BCS in dairy cows can be assessed by balancing the extra feed costs on the milking platform from retaining BCS in spring against the three alternative strategies for farmers to extract value from higher BCS going in to autumn as follows.

- Extra feed costs on the milking platform from retaining BCS in spring (equation 1) against extra milk production in late lactation (equation 2):

$$EV_b^{BCS\_MS} = MSV_b^{BCS} - FC_b^{BCS}$$

- Extra feed costs on the milking platform from retaining BCS in spring (equation 1) against feed cost savings in May (equation 3):

$$EV_b^{BCS\_WF} = WFC_b^{BCS} - FC_b^{BCS}$$

- Extra feed costs on the milking platform from retaining BCS in spring (equation 1) against extra milk production in prolonged lactation (equation 4) after accounting for the extra cost of feed energy to support milk production over and above the feed required to recover body condition in a dry low BCS cow (equation 5), and the additional variable costs (electricity and labour) of prolonged lactation milk production (equation 6):

$$EV_b^{BCS\_PL} = MSP_b^{BCS} - MSFC_b^{BCS} - MSVC_r^{BCS} - FC_b^{BCS}$$

Assuming a fixed supply of feed on the milking platform, changes in the amount of feed required per cow with a trait change resulted in corresponding changes in carrying capacity. This had consequences for farm profitability on a per cow basis after all costs, including feed, had been accounted for (Amer, 2013). After accounting for the proportion of cows by breed in each region of New Zealand, and constraining feed supply on the milking platform, the EVs, per body condition score unit, were \$83.23 (extra milk production in late lactation), \$23.16 (feed cost savings in May), and \$128.60 (extra milk production in prolonged lactation).

CONCLUSION

The incorporation of BCS into the genetic improvement programme for the New Zealand dairy industry represents an economic opportunity for New Zealand dairy farmers. Differences in efficiency of body condition mobilisation, seasonal differences in cost of feed, and the value of extra milk solids production (through fat mobilisation or later dry off) form the basis of calculations of the economic value of one unit of BCS in dairy cows. The final EV for BCS will need to also take into account the proportion of dairy farms that capture the value of increases in BCS by saving feed rather than additional milk production. The incorporation of these proportions and development of the final EV calculation is on-going.

REFERENCES

Amer P. R., Byrne T. J., Santos B. F. S., Bryant J., 2013 *Proc. Assoc. Advmt. Anim. Genet.* (this journal)

Anonymous, 2010. Facts and Figures for New Zealand Dairy Farmers. DairyNZ.

Chapman, D.F., Bryant, J.R., McMillan, W.H., Khaembah, E.N., 2012. New Zealand Grasslands Association.74 209.

Nicol, A.M., Brookes, I.M., 2007. New Zealand Society of Animal Production, pp. 151-172