Are high genetic merit cows really more efficient?

Liam Sinclair

Holstein Journal – November 2001, p68

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Research & Development Manager Lucy Andrews invites Dr. Liam Sinclair, Senior Lecturer in Dairying, Harper Adams University College, to discuss the merits of the high genetic merit cow.

The use of higher genetic merit dairy cows in the UK has recently been questioned by a number of people on the grounds of economics, nutrition, poor welfare and fertility and their being unsuitable to the varied number of systems of milk production in the UK. It is therefore appropriate to consider what we mean by 'high genetic merit' and what these animals actually do to produce more milk. A deeper understanding of this should assist, not only in terms of setting breeding goals but also how we manage our cows to improve their welfare and profitability. High genetic merit can mean different things to different people and what we consider as high merit can change with time. However, the general perception, and the focus of this article, is that high genetic merit cows are those that have been selected for increased milk production and yield of butterfat and protein (kg).

Work conducted at the Scottish Agricultural College's herd at Langhill on their genotype and system evaluation has consistently shown that high merit cows are more profitable whichever system they are managed under (Table 1). Taking these figures to a 100 cow situation, then high merit cows under a high concentrate system can result in an increase in margin over average genetic merit cows of some £46,900 per annum whilst the difference under a low input system is some £50,400. Whilst these values are based on 1997/98 prices, even at today's milk price considerable financial benefits are available.

However, whilst these animals are more profitable in terms of margins, it is important to consider what they are doing to produce this extra milk and how our management should be adapted to meet these greater nutrient requirements.

Table 1. Genotype and nutrition effects on milk production and profitability

	High concentrates		Low concentrates	
	Control	Selected	Control	Selected
Milk yield	10,355	7,300	7,120	9090
Milk from forage	780	2520	3410	5040
Financial performance				
MOC (p/l)	15.2	15.7	16.2	16.6
MOPF (£/cow)	984	1453	1003	1507

Langhill management summary for 1997/98.

Caution should be exercised in interpreting the results as the groups were not balanced for cow age

The main areas of interest include dry matter intake, digestibility of nutrients, partitioning of nutrients once absorbed and the animal's requirements for maintenance etc.

Firstly, if we consider dry matter intake. Higher genetic merit cows do consume a greater dry matter intake than their lower merit counterparts, as can be seen in Table 2. It is therefore very important that we present these animals with sufficient quantities of high quality feeds, whether we are producing milk in a high input/output system or a low input/output system. It is also important to know the quality of all the feeds that we use, including any straights. For example, the ME content of wheat can range from 12.3-14.7MJ/kg DM and providing 5kg DM of wheat of an unknown ME can result in a difference of around 2 litres per day. Under a high forage system, the quality of the forage becomes increasingly important as the genetic merit of the cows increases. Anything that limits their intake, such as lack of trough space, poor intake characteristics of the forage, perhaps due to poor aerobic spoilage at the clamp or in the trough, can all be important factors. Grazing high merit animals presents a particular problem, as cows can realistically only consume sufficient grass to maintain a yield of up to 27-28 l/day. Management practices such as presenting a taller, denser sward, moving the electric fence in the afternoon when soluble carbohydrate levels are highest or the use of higher soluble carbohydrate grass varieties have all been demonstrated as means to increase intakes.

However, milk yields much above 28 l/day will require some form of supplementation. Work at SAC has shown that buffer feeding with maize silage, if available, is preferable to grass silage. Alternatively, supplement with concentrates, with recommended levels of up to 8 kg/day for cows producing 40 kg/day, even in the early grazing season. The other aspect to consider in your nutritional management is that the heifers are the highest genetic merit cows in the herd yet are the lowest in the social ranking and are

also attempting to grow during lactation. They in particular face a major physiological challenge in early lactation and grouping separately should be considered if at all possible.

In terms of digestibility of the diet, then work conducted at Hillsborough in Northern Ireland has revealed that, when fed the same diet, high merit cows have a similar digestibility to lower merit animals (Table 2). High merit cows therefore produce more milk by consuming more feed but also by partitioning more of the nutrients that they consume towards milk production. As we are therefore aware, higher merit cows have a lower body condition score than lower merit animals. If we look at data in Figure 1, again from Langhill and using heifers, we can see that high genetic merit animals not only mobilise more body condition but also will be at a lower condition in late lactation and at drying off. To avoid metabolic problems in successive lactations, management during late lactation and the dry period will become increasingly important. Work at CEDAR at Reading has shown that high yielding cows in early lactation can be mobilising an amount of energy equivalent to between 2-2.5 kg of body tissue per day. Even by week 20 of lactation, the cows were mobilising between 1-1.5 kg per day. These levels of body tissue mobilisation, unless managed appropriately, can have a knock-on effect on other aspects of performance, such as fertility.

Work conducted at the Hannah Research Institute has investigated the physiological differences between high and average merit cows (Table 3). Perhaps not surprisingly, high merit cows have larger udders, although milk output (ml/g tissue) was similar for both lines. However, larger udders do have implications in terms of weight bearing and locomotion and this should be taken into consideration in future breeding. It would also appear that high merit cows have similar levels of stress to low merit animals, at least in terms of heartbeats per minute. Other work has shown that the immune response of dairy cows of different genetic merit is also similar, with the forage to concentrate ratio having a greater effect. However, the area of genetic merit and metabolic stress in high merit cows will become increasingly important, particularly through the identification of key molecular markers, and future breeding goals may have to be altered to take these into consideration

Table 2. Effect of cow genetic merit on diet digestibility

	Milk yield (kg/d)	Digestibility
High merit	37	0.77
Average merit	31	0.77
Low merit	29	0.78

Gordon *et al.* (1995)

Table 3. Physiological differences between average and high genetic merit cows

	Average merit	High merit
Milk yield (kg/d)	29	37
Udder volume (l)	14	18
Growth hormone (ng/ml)	1.2	2.8
Weight (kg)	589	590
Condition score	2.6	1.8
Heart beat/minute	87	90

From Sorensen *et al.* (1998).

Figure 1:

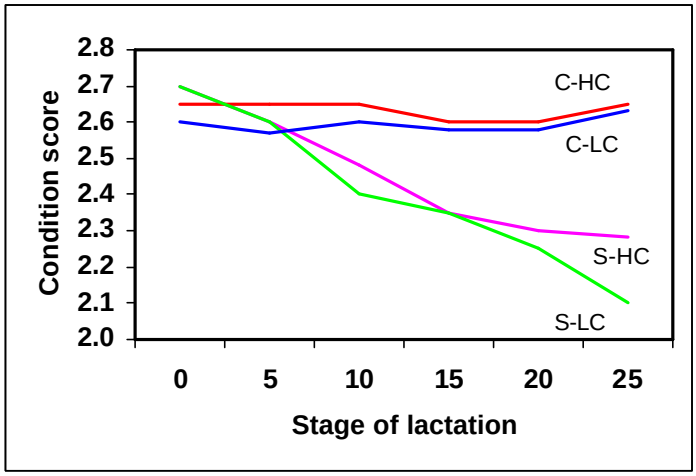

Fig 1. Body condition score change in heifers selected to be of high genetic merit under a high concentrate regime (S-HC), high merit under a low concentrate regime (S-LC), average merit under a high concentrate system (C-HC) or average merit cows under a low concentrate system (C-LC). (Keonen and Veekamp (1997)).

In summary, high genetic merit cows are more profitable but they do this by working hard. Whilst the cows may look like they are content and restful, from a metabolic perspective they are working very hard. We need to appreciate this in the way that we manage these animals. In particular, it would appear to be high genetic merit cows at grass that have the greatest challenge. By selective breeding and the use of genetic indices for clearly defined goals, we have improved the output and profitability of these

cows considerably over the past 20 years and, arguably, the way we have managed these cows has not kept pace with this. In the future, our breeding aims may have to change to reflect the greater awareness of the effects of longevity, fertility and factors influencing the welfare of our cows. A structured breeding system with clearly defined goals and incorporating the use of new techniques, such as molecular biology, will be fundamental in achieving this. However, we must be aware that we should always select cows that return a greater profit.