BEEF BREEDING FOR COW FERTILITY: WHEN IS IT IMPORTANT ?

S. A. BARWICK, A. L. HENZELL AND M.E. GODDARD

Animal Genetics and Breeding Unit,
University of New England,
Armidale, NSW 2351

SUMMARY

The importance of breeding for cow fertility (cow weaning rate) is examined by comparing its relative economic value with that for growth (sale weight direct) in the context of a profit breeding objective. A self-replacing commercial herd where seedstock are to be used is simulated. Cow fertility increases in importance when genetic changes in the herd are valued over a longer (20 year) time horizon and with a lower interest rate, and when the herd has lower fertility or sells animals of greater individual value for their age. Under some circumstances the importance of breeding for fertility is reduced when animals are sold at young ages.

INTRODUCTION

A common view, from a management perspective, is that improved herd fertility is more important in beef enterprises where sale animals are sold at younger ages. Taylor and Rudder (1986) found improving growth had a bigger effect on gross income than improving fertility when sale age was more than 42 months. The present study examines improvement in cow fertility from a breeding objective viewpoint. The context is within-breed improvement and the breeding objective is profit. The term 'fertility' is used loosely; the actual trait considered is the number of calves weaned per cow, as a trait of the cow, termed cow weaning rate. The study does not consider cow weaning rates which exceed 100%.

Establishing the breeding objective requires the breeder to have a vision of the way improved seedstock will be used in commercial herds, of what sort of product the herds will produce, and of how the herds will be structured and managed. Also needed is a view of the production environment, and of the performance levels expected in the herds under optimal management without genetic improvement. The vision needs to extend into the future by perhaps 2 to 4 generations (Fewson 1993).

In this study we examine the importance of breeding for cow fertility for a simulated self-replacing commercial herd in which improved seedstock are to be used. The impacts of several changes to herd and breeder variables are considered.

METHODS

A relevant breeding objective (H) can be written as

$$H = v_1 g_1 + v_2 g_2 + \sum_{i=3}^{n} v_i g_i$$

where the g's and v's are respectively breeding values and economic values for traits, traits 1 and 2 are respectively sale weight (direct) and cow weaning rate, and the other traits are sale weight (maternal), cow

weight, dressing percentage, saleable meat percentage, fat depth, bull mating capacity, calving ease (direct and maternal) and cow survival rate (ie. n = 11). This is the form of the objective used in the beef breeding objectives PC-package BREEDOBJECT (Barwick et al. 1992). By definition, the v's are values of a unit change in each trait while other traits are constant.

The importance of cow fertility to the breeding objective can be assessed, relative to growth, as

$$REV_{cwr/sw} = \frac{v_2 \sigma_{g2}}{v_1 \sigma_{g1}}$$

where $REV_{cwr/sw}$ is the relative economic value of cow weaning rate (cwr) in relation to sale weight direct (sw), and σ_{g2} and σ_{g1} are relevant genetic standard deviations for the two traits. As cow weight is a separate term in the breeding objective, increased sale weight is here valued at constant cow weight.

$REV_{cwr/sw}$ was assessed with BREEDOBJECT, initially for a breeding herd which sells steers of 390 kg liveweight at 16 months. Surplus heifers were assumed sold at the same age as steers and to weigh 335 kg. Base values used for prices received were 140 c/kg liveweight for steers and 125 c/kg for heifers. There were assumed to be eight age classes of cows in the breeding herd, deaths and culling were assumed constant between ages and cows were assumed to first calve at 2 years.

Values used for σ_g were 9.9 (h^2 =.20) at sale ages of 10 months or less, 16.0 (h^2 =.30) at ages in the range 11 to 16 months, and 20.0 (h^2 =.33) at ages of 17 to 20 months. At ages greater than 20 months, the value of σ_g used was such that it was a constant 4.2 percent of steer sale weight. The assumed value for σ_{g2} varied with the cow weaning rate level, p (base value 80 percent). Heritability for cow weaning rate was assumed to be a constant .05 and the phenotypic variance assessed as p(1-p).

The economic value for sale weight was assessed as the difference between the value of meat from an extra kg of sale animal and the cost of the extra feed needed to produce the extra kg. Feed was costed assuming that feed resources were fixed and that the additional feed needed was met by reducing cow numbers.

The economic value for cow weaning rate was the additional profit accruing from an extra one percent of calves, after accounting for additional feed costs and other costs, and from additional effects on profit that arose from changes in the age structure of the herd. The age structure is affected because fewer cows are culled because there are less dry cows.

The economic values were adjusted for time using the procedure described by McArthur and del Bosque Gonzalez (1990). Account was taken of the delay in realising the benefit of the genetic change in the commercial herd and of the way the change diffuses through the herd. The change was valued over a specified time horizon (base value 20 years) and its present value assessed. The present value lump sum was then converted to an equivalent annual value. The interest rate used (base value 8 percent) is assumed to be real interest rate, or market rate minus inflation.

Effects of changes in single herd variables and in time horizon x interest rate, cow weaning rate x time horizon and sale weight at fixed age x price were examined while holding other herd parameters at base values. To examine sale age x time horizon, sale weights were varied with sale age so that average daily gain to sale age remained equivalent to that of the base case.

RESULTS AND DISCUSSION

Results are shown in Figure 1. Benefits from increased fertility are slow to accumulate (because they rely on commercial herds purchasing improved bulls which then breed daughters of higher fertility) and depend heavily on the time horizon over which they are valued (Figure 1a). At base herd values, $REV_{cwr/sw}$ ranged from 0.6 to 1.4 over a horizon of 10 to 20 years and was 1.0 (fertility of equivalent importance to growth) at a time horizon of 13 years. The time horizon effect varied with the interest rate used (Figure 1a). Though not presented, variation in the number of cow age classes in the herd and in the age at which cows first calve can modify these effects.

Figure 1.[1] Effect of time horizon x interest rate, cow weaning rate x time horizon, steer sale weight at fixed age x price and steer sale weight and age x time horizon on the relative economic value (REV) of genetic change in cow weaning rate (cwr) and sale weight direct (sw)

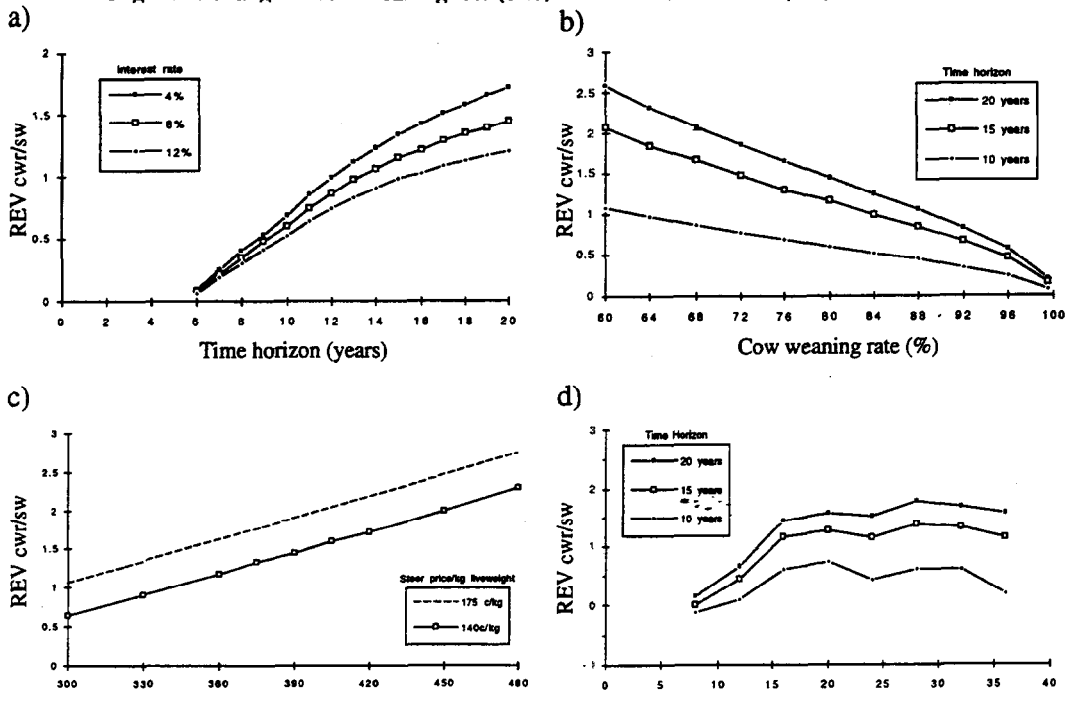

Figure 1b shows the importance of breeding for fertility increases at lower herd cow weaning rates, with the increase being substantially more for a 20, than for a 10 year horizon. Over 10, 15 and 20 year horizons, fertility was at least of equivalent importance to growth at or below cow weaning rates of 63, 84 and 89 percent, respectively, when other parameters were unchanged.

Increasing sale weight at fixed age increases $REV_{cwr/sw}$ (Figure 1c). This is partly because σ_g for sale weight was assumed to be constant at a fixed age. The result supports that of Taylor and Rudder (1986), where a large change in sale weight at fixed age substantially increased the value of improving fertility. Figure 1c further shows that a change in sale weight of σ_p (eg. from 375 to 405kg at 16 months) has only a small effect on the importance of fertility. This contrasts with the much larger effect that a similar change

in cow weaning rate (σ_p of 40 percent) has (Figure 1b). Varying the price/kg liveweight received has no effect on the nature of the increase in $REV_{cwt/sw}$ which occurs with increase in sale weight (Figure 1c).

At fixed average growth rate to sale, $REV_{cwt/sw}$ was approximately constant for sale ages (and corresponding weights) above 16 months, for each time horizon (Figure 1d). The importance of fertility decreased to zero when calves were sold at 8 months. This occured because as fertility increases more calves and less dry cows are sold. However sale of dry cows was more profitable than sale of 8 month old calves in this example, so there was no increase in profit. Alternative management strategies not investigated here (eg. selling pregnant cows) might make better use of the increased herd fertility.

The results shown in Figure 1d assume a constant price/kg across sale ages. Price/kg might be increased at very young ages and decreased at old ages. Increasing price/kg by 25 percent at sale ages of 8 and 12 months increased $REV_{cwt/sw}$ to .79 and 1.06, respectively, for a 20 year horizon. Decreasing price/kg by 25 percent at ages of 32 and 36 months, similarly, decreased $REV_{cwt/sw}$ to 1.26 and 1.13 respectively. We also assumed a constant growth rate so 8 month old steer calves were assumed sold at only 212kg. If they were heavier, $REV_{cwt/sw}$ would increase.

The above variables have all been considered for a situation where improved seedstock are to be used in a self-replacing commercial herd. Some more obvious influences also should be mentioned. When the improved seedstock are used as terminal sires, cow fertility is not part of the objective. When the use is as sires to breed a specialised maternal line for crossing, the improved seedstock are responsible for the genes for cow fertility but only for half of those for growth. In such a maternal case, all values for $REV_{cwt/sw}$ are approximately twice those shown in Figure 1. Our results also depend on the relative amounts of genetic variability assumed. The heritability of cow weaning rate, especially, might differ from .05 in certain breeds and environments. At heritabilities of .03 and .10, the values shown for $REV_{cwt/sw}$ are respectively reduced and increased by 23 and 41 percent when other base parameters are unchanged.

These results show that substantial emphasis is often justified on cow fertility in breeding, but that its precise importance changes with the perception of the future commercial herd, production system and breeding role in which improved seedstock are to be used. This perception is the domain of the individual breeder. It follows that the relevant importance to give to fertility is best decided on a case by case basis.

ACKNOWLEDGEMENTS

The work was supported by funds from the Meat Research Corporation. Other AGBU colleagues provided helpful comment.

REFERENCES

BARWICK, S.A., FUCHS, W., DAVIS, G.P. and HAMMOND, K. (1992) *Proc. Aust. Assoc. Anim. Breed. Genet.* **10**:565

FEWSON, D. (1993) In *Design of Livestock Breeding Programs*, Chapter 6, Fewson, D., James, J.W., Nitter, G., Kinghorn, B.P., Barwick, S.A., Graser, H.-U. and J. Savicky, AGBU, UNE, Armidale

McARTHUR, A.T.G. and DEL BOSQUE GONZALEZ, A.S. (1990) *Proc. Aust. Assoc. Anim. Breed. Genet.* **8**:103

TAYLOR, W.J. and RUDDER, T.H. (1986) *Proc. Aust. Soc. Anim. Prod.* **16**:379