RECORDING NEW BEEF PERFORMANCE MEASURES - EFFECTS ON THE ACCURACY OF SELECTION FOR PROFITABILITY

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SUMMARY

The effects of recording new measures of intramuscular fat %, mature cow weight and net or residual feed intake (NFI) on selection were examined for two breeding objectives and different levels of recording. These measures are the basis of new, and potentially new, BREEDPLAN EBVs. Recording scanned intramuscular fat % increased accuracy of selection by more than 30 % for an objective targeting production for the high-quality Japanese market. Relative to recording with other new measures included, recording NFI increased selection accuracy by up to a further 42 % for the Japanese objective and 14 % for an objective targeting the domestic market. There was little advantage in recording mature cow weight for cases studied. Trait relative economic values (REVs) showed that reducing NFI and cow weight traits together would usually be more important than increasing weights of young animals, especially for the Japanese objective.
Keywords: Beef cattle, selection, marbling, feed intake, maintenance

INTRODUCTION

Recent enhancements to BREEDPLAN have included new EBVs for intramuscular fat % and mature cow weight. Research at Trangie (Arthur *et al.* 1997) is examining a post-weaning feed intake test that could form the basis for an EBV for NFI. The NFI measure is the deviation of actual intake from that expected based on the animal's weight and growth over a test period. We consider how recording these new measures could impact on the accuracy of selection for beef profitability. This is examined for two breeding objectives, and in selection contexts where candidates, and their relatives, have differing amounts of recorded performance. We first consider the economic value (EV) of NFI traits, where these are part of the breeding objective.

METHODS

Breeding objective cases. Two breeding objectives were considered. One targeted production of 650 kg steers for high quality export markets that value marbling (Japanese), and the other 400 kg steers for domestic market segments where marbling is not valued (Domestic). Cases resembled Japanese and Domestic straight-breeding (SB) cases described by Barwick and Henzell (1997), except that in the Domestic case here weaning percentage (88 %) and cow weights (450 kg) were higher, and the percentage of heifers having calving difficulty was lower (15 %). The EV of marbling score in the Japanese case, on a per cow per year basis, was $42.34 per score. NFI traits of young animals (NFIy) and cows (NFIc) were added to the breeding objective, other traits being as described by Barwick and Henzell (1997). EVs for other traits took account of expected feed costs associated

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with weight and growth of young animals, and with weight, weight change, gestation and lactation of cows.

Economic values for residual feed intake traits. EVs considered the base cost of additional feed needed, assuming this could be purchased, the time spent on pasture and in the feedlot for young animals between weaning and sale, and the feed cost period for replacements and cows over the year. A period of two months, in the Japanese case, and three months, in the Domestic case, was assumed where feed requirement increase at pasture does not add to costs. Units of NFI were kg d^{-1} for 10 MJkgDM $^{-1}$ feed. EVs were calculated in \$ per kg d^{-1}, discounted to present value (McArthur and del Bosque Gonzalez 1990), and expressed per cow joined in the herd per year.

Example. In the Japanese case, on a per cow basis, 0.662 of a sale animal and 0.205 of a replacement were assumed to incur 10 MJkgDM $^{-1}$ feed costs at a base rate of \$105 $tonne^{-1}$ for 240d and 305d at pasture, respectively. The 0.662 of a sale animal also incurs costs at \$210 $tonne^{-1}$ for 210d in the feedlot. This yields a weighted cost of young animal feed of \$145 $tonne^{-1}$. Summing components over the number of days each is incurred, the feed cost for young animals is (0.662 x 240 x 0.105) + (0.205 x 305 x 0.105) + (0.662 x 210 x 0.210) = \$52.44, which after discounting, at 7 % over a 20 year horizon, is \$39.45. If cows incur feed costs at a base rate of \$100 $tonne^{-1}$ for 305d of the year, the analogous feed cost for cows is 1.0 x .100 x 305 = \$30.50, or \$15.83 after discounting. The EVs for NFIy and NFIc in the Japanese case were consequently \$ -39.45 and \$ -15.83. Corresponding values in the Domestic case were \$ -17.12 and \$ -15.94. Trait relative economic values (ie. EVs x σ_g) for NFIy and NFIc were also compared with REVs for growth traits over a range of base feed costs.

Performance measures available. Performance measures considered were young animal growth measures (G): birth weight (BW), liveweights at 200, 400 and 600 d (200, 400, 600); ultrasonically scanned carcass measures (S): fat depth at the p8 and 12/13 rib sites (p8, rib), eye muscle area (EMA); fertility measures (F): days to calving (DC), scrotal size (SS); new measures of mature cow weight (MCW) and scanned intramuscular fat % (IMF %), and NFI measured post-weaning (Arthur *et al.* 1997). NFI records available were assumed to be either a record on the sire, giving an EBV accuracy of .35, or this and an own record for NFI (EBV accuracy of .69).

Table 1. Accuracies of EBVs for performance measures under different levels of recording

EBV:	BW	200	400	600	DC	SS	p8	rib	EMA	IMF %	MCW
Level 1[1]	0.72	0.63	0.65	0.69	0.24	0.71	0.65	0.60	0.63	0.49	0.55
Level 2[2]	0.88	0.80	0.83	0.85	0.28	0.88	0.83	0.80	0.82	0.70	0.67
Level 3[3]	0.94	0.89	0.91	0.93	0.73	0.94	0.92	0.90	0.91	0.83	0.94

[1]Own, sire and 20 paternal half-sib records for young growth measures, scrotal size, and scan carcass measures on young bulls; and dam records for young growth measures, days to calving, mature cow weight and scan carcase measures
[2]Level 1 records plus 20 progeny records for young growth measures, scrotal size, and scan carcass measures on young bulls
[3]Own, sire, 30 paternal half-sib and 60 progeny records for young growth measures, scrotal size, and scan carcass measures on young bulls; dam records for young growth measures, days to calving, mature cow weight and scan carcass measures; and 60 progeny records for days to calving and mature cow weight.

Assumed levels of recording. Levels of recording assumed, for performance measures other than NFI, loosely correspond to accuracy levels of EBVs commonly encountered in selection (Table 1). Level 1 approximates young bulls by sires with progeny recorded for early-life traits. Levels 2 and 3 approximate AI sires with progeny recorded for early-life traits, or for both early and later-life traits.

Genetic parameters. Genetic and phenotypic parameters used were from BREEDPLAN and the literature (eg. Koots *et al.* 1994), with average opinions used when no other information was available. Matrices satisfied usual permissibility criteria. Based on a Trangie estimate in young animals, genetic variances for NFIy and NFIc were each assumed to be 0.15 kg^2 d^{-2}. Genetic correlations of the NFI measure with NFIy and NFIc were 0.75 and 0.50 respectively. Other genetic correlations with NFI were assumed zero, except for a value of 0.20 with fat depth measures and with fat depth in the breeding objective. Cow weight genetic variance was 900 kg^2.

Index calculations. The Index program of N. Kunzi was used to derive selection indexes for bulls. The relative accuracy of indexes, for a common objective, was assessed as σ_I/σ_I^{ξ}, the ratio of the standard deviations of the indexes compared, and expressed as a percentage.

RESULTS AND DISCUSSION

Figure 1 illustrates how base feed cost affects the importance of growth and NFI traits in each breeding objective. Absolute values of REVs are shown. In both cases, REVs for NFI and cow weight traits were negative and that for sale weight was positive. In total, the importance of reducing the NFI traits and cow weight exceeded the importance of sale weight in the Japanese case at all likely levels of feed cost. In the Domestic case, the situation was less dominated by feed cost.

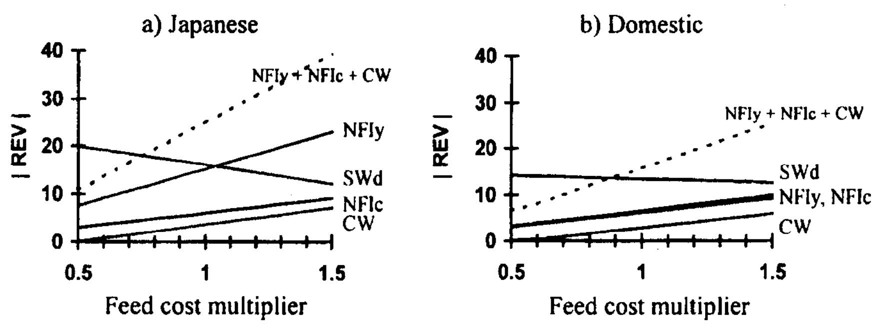

Figure 1. Effect of varying the assumed base feed cost on trait REVs (shown as absolute values) for NFI in young animals (NFIy) and cows (NFIc), sale weight (direct) in young animals (SWd), and cow weight (CW) in Japanese and Domestic market breeding objectives.

Table 2 shows recording scanned intramuscular fat % increased selection accuracy for the Japanese objective by over 30 %. Recording mature cow weight had little effect. Recording mature cow weight should help overcome the expected antagonism between young animal growth and cow size. For the cases here, this economic antagonism was not great. The standard deviation of the breeding objective for Japanese and Domestic cases was \$ 32.2 and \$ 18.5, respectively. The greater index accuracy in the Domestic case is a consequence of fewer traits being important to the breeding objective in that case. Genetic gain in each case will differ for the levels of recording considered, through differences in selection intensity and generation interval as well as accuracy. The results suggest a record of NFI on sires would add 7 to 19, or 3 to 5 % to selection accuracy, for Japanese and Domestic objectives respectively, over that possible with the other new measures recorded. With records on all individuals, these gains could be as much as 42 and 14 %. Ultimately, the benefits from these gains have to be compared against measurement cost (Graser *et al.* 1994). Archer *et al* (1999) provide a first analysis of the cost-effectiveness of the NFI measure. Our results show recording scanned intramuscular fat % and NFI each will be very important to the accuracy of selection for profitability, and that the magnitude of the importance will differ with the production system and market that underlies the breeding objective.

Table 2. Effect of the performance measures recorded, and level of recording, on accuracy[1] of selection for profitability for Japanese and Domestic market breeding objectives

	Japanese			Domestic		
Measures available	Level 1	Level 2	Level 3	Level 1	Level 2	Level 3
G	31	30	26	78	78	78
G + S	97	97	86	100	100	99
G + S + F	100	100	100	100	100	100
r_{IH} : accuracy for G + S + F	0.16	0.21	0.27	0.40	0.50	0.55
G + S + F + MCW	101	100	102	100	100	100
G + S + F + IMF %	132	137	134	100	100	100
G + S + F + MCW + IMF %	133	138	138	100	100	100
G + S + F + MCW + IMF % + RFI (sire)[2]	119	111	107	105	103	103
G + S + F + MCW + IMF %+RFI (sire,own)[2]		142	127		114	111

[1]Accuracy as a %, relative to that for G + S + F unless indicated; see text for abbreviations
[2]Relative to G + S + F + MCW + IMF %

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