OPTIMUM LENGTH OF TEST FOR FEED EFFICIENCY IN CATTLE

J.A. Archer¹, P.F. Arthur¹, R.M. Herd¹, J.H. Wright¹ and K.C.P. Dibley¹

¹ NSW Agriculture, Agricultural Research Centre, Trangie, NSW 2823
² CRC for the Cattle and Beef Industry, University of New England, Armidale, NSW 2351

SUMMARY

The optimum length of test for measurement of net feed conversion efficiency (Net FCE) was examined. The results indicated that a 70 day test with cattle weighed fortnightly is optimal for measurement of Net FCE in British breed cattle. A 70 day test will reduce the cost of testing considerably compared to the current 120 day test and increase the rate of adoption by producers. Information on which selection decisions are based will be available earlier and problems with animals depositing excessive quantities of fat during the later stages of a longer test will be avoided.

Keywords: Cattle, feed efficiency, feed intake, central testing

INTRODUCTION

Recent results from the Meat Research Corporation funded project at Trangie investigating genetic variation in feed efficiency of beef cattle indicate that considerable variation in Net FCE exists and that this variation is moderately heritable (Arthur et al. 1997). Inclusion of feed intake information in selection decisions may facilitate genetic improvement of efficiency and profitability of beef cattle production. With current technology available it appears likely that the measurement of efficiency on candidates for selection will be performed in central test stations with appropriate facilities.

Centralised testing of elite animals is expensive and so, to minimise the cost of testing, the test should be optimised in terms of the length of the test and the amount of data collected without compromising the accuracy of the test. This paper presents an analysis to determine the optimum length of test for measurement of Net FCE, measured as net (residual) feed intake.

MATERIALS AND METHODS

Animals and data. Data on 760 cattle by 78 sires from the first four groups of animals tested for efficiency at the Agricultural Research Centre, Trangie were used. Approximately half of the animals tested were bulls and heifers from the Angus herd at the Agricultural Research Centre sired by industry bulls. These animals were born in the spring of 1993 and 1994 and were tested for efficiency after weaning in March of the following year. The other half of the animals consisted of Angus, Hereford, Poll Hereford and Shorthorn heifers purchased from 17 autumn calving industry herds and brought to Trangie after weaning and tested for efficiency in October of 1994 and 1995.
The test was conducted using an automated feeding system. An adjustment period of at least 21 days was allowed for animals to adapt to the feeding system and diet, followed by a 119 day test. Animals were given *ad libitum* access to a pelleted ration consisting of 70% lucerne hay and 30% grain, with approximately 10.5 MJ/kg dry matter of metabolisable energy and 16% crude protein, and feed intake was recorded. Approximately 0.5 kg of oaten straw per animal was also offered in open troughs each day to maintain rumen function. All animals were weighed weekly during the test.

**Derivation of Net FCE.** Growth of individual cattle during the test was modelled by linear regression of weight data against time (SAS 1989). The regression coefficients were used to calculate the average daily gain and midweight (mean of start and end weights) of each individual during the test. Daily feed intake was calculated by adding the energy intake of straw (0.34 MJ/day) to the recorded intake of the pelleted ration and standardised to an energy content of 10 MJ/kg. Net FCE was measured as net feed intake (sometimes called residual feed intake) and was calculated as the residuals of the regression of average daily feed intake on average daily gain and midweight $^{0.73}$, using separate models for each test-sex group (SAS 1989).

**Analyses.** Variance and covariance components were estimated using DFREML (Meyer 1993) operated using a front-end program (Swan 1994). The animal model used included test group, sex, breed and herd of origin as fixed effects, age at the start of the test as a covariate and a random term for the direct additive genetic effect in addition to the error term. Univariate analyses were used to estimate variances, while covariances between traits were estimated from bivariate analyses.

To assess the optimum length of test, net feed intake was calculated for tests which varied in length from 7 to 119 days in weekly increments. The effect of frequency of weighing was also investigated using a 70 day test (arising from the previous analysis) with weight data restricted so that weights collected at intervals of 1, 2, 5 and 10 weeks were used to calculate net feed intake.

Criteria were chosen against which the accuracy of each test were assessed. Estimates for additive genetic and environmental variance components were used to determine whether extra data reduced the amount of unexplained environmental variation in the trait. Phenotypic and genetic correlations of the trait measured in a shortened test with the trait measured over 119 days were also calculated. The efficiency of selection was calculated as the correlated response in net feed intake measured over 119 days to selection on a shortened test, compared to direct selection for net feed intake measured over 119 days. It was assumed that the intensity of selection was the same for the shortened test and the 119 day test, and so the terms for selection intensity cancel out in the formula given below.

$$\frac{CR_Y}{R_Y} = r_g \frac{i_X}{i_Y} \frac{h_X}{h_Y}$$

where $CR_Y =$ correlated response in trait Y to selection on trait X; $R_Y =$ direct response to selection on trait Y; $i_X$, $i_Y =$ intensity of selection on traits X and Y respectively; $h_X$, $h_Y =$ square
RESULTS AND DISCUSSION

The effect of test length on the accuracy of the test is shown in Figure 1. The environmental variance in net feed intake decreased as the length of test was increased, up to 70 days. Beyond 70 days there was little decrease in environmental variance, suggesting that the extra data did not increase the accuracy of the test, and consequently the heritability of net feed intake reached its maximum after 70 days. Genetic correlations between shortened tests and the 119 day test increased quicker than the corresponding phenotypic correlations, and after 70 days were 0.98 and 0.91 respectively, indicating that a 70 day test measures the same genetic trait as the 119 day test and that ranking of individuals is similar. The efficiency of selection increased as the test was lengthened to 70 days and was 0.99 after 70 days. Further increases in test length beyond 70 days had little effect on selection efficiency. Consequently it would appear that a 70 day test is sufficient for measurement of net feed intake with little decrease in accuracy when compared to a 119 day test.

Table 1. Effect of frequency of weight data collection during a 70 day test for net feed intake on heritability, phenotypic and genetic correlations with the full 119 day test and efficiency of selection

<table>
<thead>
<tr>
<th>Frequency</th>
<th>Heritability (+ s.e.)</th>
<th>Phenotypic correlation</th>
<th>Genetic correlation</th>
<th>Efficiency of selection</th>
</tr>
</thead>
<tbody>
<tr>
<td>Weekly</td>
<td>0.62 ± 0.14</td>
<td>0.91</td>
<td>0.98</td>
<td>0.99</td>
</tr>
<tr>
<td>Fortnightly</td>
<td>0.60 ± 0.14</td>
<td>0.90</td>
<td>0.98</td>
<td>0.98</td>
</tr>
<tr>
<td>5 weekly</td>
<td>0.53 ± 0.13</td>
<td>0.88</td>
<td>0.99</td>
<td>0.93</td>
</tr>
<tr>
<td>10 weekly</td>
<td>0.53 ± 0.13</td>
<td>0.87</td>
<td>0.98</td>
<td>0.93</td>
</tr>
</tbody>
</table>

The effect of frequency of weighing on the accuracy of a 70 day test is shown in Table 1. The genetic correlations indicate that the same genetic trait is measured regardless of the frequency of weighing, and there is little loss in selection efficiency when weights are collected fortnightly rather than weekly. However, where weights are collected less frequently there is a reduction in the accuracy of the test, as reflected by the heritability and the efficiency of selection. As the collection of weight information is inexpensive compared to the total cost of testing animals for net feed intake, fortnightly weighing of cattle during the test should be recommended.

There appear to be no reports in the scientific literature describing optimal tests for net feed intake with which the current results can be compared. The interpretation of the results presented here has been conservative and it may be possible to reduce the length of the test further. However it should be borne in mind that the data used in this study were collected in a research environment.
ACKNOWLEDGMENTS
This work was funded by the Meat Research Corporation and NSW Agriculture. The capable assistance of T. Snelgar, T. Patterson, D. Mula and S. George and the inputs of S. Exton, E. Richardson and the staff at the Trangie Agricultural Research Centre are gratefully acknowledged.
REFERENCES


