ESTIMATE OF THE GENETIC CORRELATION BETWEEN CALVING SUCCESS AND DAYS TO CALVING IN ANGUS FEMALES

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SUMMARY

Female fertility records from 16,350 maiden heifers from Australian Angus herds were used to estimate the genetic correlation between calving success and days to calving using a new analytical procedure that accounted for the categorical nature of calving success. Both calving success and days to calving were lowly heritable, 4 and 12 %, respectively with a –0.66 genetic correlation between the two traits. The results indicate that days to calving is likely to be the better trait in a selection program because of its higher heritability, its ease of modelling and also its favourable correlation with calving success.

Keywords: Beef cattle, heritability, fertility, genetics.

INTRODUCTION

Selection for improved reproductive performance is important in self replacing beef herds. The female fertility trait days to calving has been included in BREEDPLAN since 1993. Recent studies have shown several other measures of female fertility to be heritable. Mialon et al. (2000) reported a heritability of 12% for calving to first oestrus interval in Charolais cattle. Morris et al. (2000) reported a 9% heritability estimate for calving date (which is equivalent to days to calving) in an Angus selection line.

Calving success has also been used as a measure of female fertility. However, traits exhibiting a discontinuous distribution are best analysed by postulating an underlying continuous distribution (Gianola 1982). With recent improvements in computer power and developments in algorithms for analysing categorical traits, it is now possible to estimate variance components for threshold type traits from larger field datasets. The objective of this study was to estimate the heritability of calving success and secondly, to estimate the relationship between calving success and days to calving.

MATERIALS AND METHODS

Days to calving (DC) records from 16,350 Angus maiden heifers were used from the Angus Society’s NBRS database which is a total female inventory recording system. For a complete description of the traits see Johnston and Bunter (1995). In brief, DC is the number of days between when a cow is first exposed to a bull (under natural joining) until she subsequently calves. All non-calvers are included in the genetic analysis by assigning a predicted (penalty) DC record. Calving success (CS) was simply generated from the DC records as a binary trait: calvers=1 and non-calvers=0. For this study, only records from maiden heifers, aged between 270 and 625 days at the commencement of joining, were used. Calving success records were only used from joining management groups where variation

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existed. That is, CS records were removed for all animals in joining management groups where all cows calved.

A Gibbs sampler was used to estimate variance components. In this procedure the categorical data (CS) were augmented with latent data using the method of Albert and Chib (1992). The residual variance of the underlying distribution was set to 1. Non-informative priors were used for all effects in the model. After a burn-in period, the last 3000 samples were used to estimate all parameters. A bivariate analysis was performed for DC and CS. Included in the model for each trait was a fixed joining management group and age at the commencement of joining as a linear covariate. Three generations of pedigree were used to construct the relationship matrix. A total of 4,944 sires had daughters with a DC record and the total number of animals included in the analysis was 40,357.

Estimated breeding values (EBVs), on the underlying scale, were generated from the last 3000 samples of the Gibbs sampler for all animals. The EBVs were converted to a probability of increased calving success on the observed scale, assuming a threshold of 0.73. A simple linear regression of CS EBV on DC EBV for all animals was performed. Further, EBVs from sires with more than 20 daughters with a DC record were examined.

RESULTS AND DISCUSSION

Genetic parameters are presented in Table 1. A total of 16,350 heifer DC records from 4,944 sires in 845 joining management groups were used. The mean DC was 313 days (std = 28.9). The heritability estimate for DC in maiden heifers was 12% and this is similar to the earlier result of Johnston and Bunter (1995). Calving success was modelled taking into account the categorical nature of this trait. A total of 9,235 heifer CS records from 4,944 sires in 432 joining management groups were used. The heritability estimate of CS, calculated on the underlying scale, was 4%. Morris et al. (2000) reported heritabilities of 9% for calving date (equivalent to days to calving) averaged across ages, and yearling pregnancy rate of 8% in a New Zealand Angus selection line.

Table 1. Heritabilities (diagonals) and correlations (genetic above; phenotypic below) between days to calving and calving success (underlying scale) in maiden Angus

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<th>Days to Calving</th>
<th>Calving Success</th>
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<tr>
<td>Days to Calving</td>
<td>0.12</td>
<td>-0.66</td>
</tr>
<tr>
<td>Calving Success</td>
<td>-0.47</td>
<td>0.04</td>
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The genetic correlation between DC and CS was –0.66 and suggests selection for reduced DC will result in correlated increases in calving success. Although the magnitude of the correlation was not reported, Morris et al. (2000) also found that higher pregnancy rates were associated with earlier calving dates. This estimate would support the negative genetic correlation found in this study. Johnston and Bunter (1995) reported a correlation of –0.97 from a linear model. Phenotypically, DC and CS were negatively correlated reflecting both the negative genetic and residual correlations.

There were 178 sires with more than 20 daughters with DC records. The mean DC EBV was –1.16 days (std= 4.82) with a range from –16.2 to +12.0 days. The mean CS EBV of those sires was 0.98 %
(std = 2.91) with a range from –7.2 to +8.8%. The correlation between EBVs was –0.96. The negative sign reflects shorter DC is favourably associated with an increased probability of a successful calving. The regression coefficient for DC EBV was –0.6 percent success/day. Therefore, for each 5 days shorter DC EBV there is a 3% increase in CS EBV. This estimate is similar to the assumption made by Ponzoni and Newman (1989) when modelling these traits for breeding objective formulation.

CONCLUSIONS
The new estimation procedure has yielded similar estimates to other studies that used linear models. Further testing and development of the analytical software is continuing. From a selection viewpoint these results show that DC is a similar trait genetically to CS but is more heritable, suggesting additional genetic differences exist in those cows that calve. Therefore days to calving should continued to be used as a genetic measure of female fertility in BREEDPLAN.

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REFERENCES