GENETIC TRENDS IN A SELECTION LINE FOR LOW FAECAL WORM EGG COUNT

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SUMMARY

Selection for low FWEC in animals subjected to a natural challenge has resulted in the selection line diverging away from the control line in a desirable direction. The selected line had lower FWEC at weaning, and also in June at approximately 10 to 11 months of age compared to the control line. A genetic relationship between FWEC, faecal scores and dag scores were established. Results indicate that selection for a reduced FWEC at weaning might result in an undesirable correlated increase in scouring after the break of the season. There is clearly a need for further research into the response mechanisms involved in the low FWEC selection line. However, no other undesirable correlated responses were found between FWEC and production traits in this selection experiment.

INTRODUCTION

There is a growing awareness and acceptance that in terms of environmental, biological and economic aspects farming systems must aim towards long term sustainability. One of the biggest threats to sustainable sheep production in Western Australia is that the sheep nematode populations are becoming more and more resistant to the available anthelmintics. This poses a real threat as it indicates that current worm control practices with a high reliance on anthelmintics are not sustainable in the long term. There is an increasing body of scientific evidence that genetic variation exists between sheep breeds, and within breeds, for resistance to internal parasites, and this can be exploited to increase the level in resistance of sheep populations. This paper reports the results of the Rylington Merino breeding program (Karlsson et al, 1992) that aimed to breed Merino sheep with increased resistance to internal parasites, using selection for reduced faecal worm egg count (FWEC).

EXPERIMENTAL PROCEDURES

Flock and mating information
Rylington Merino is a collaborative project established in 1987 and was funded by the Wool Corporation from November 1987 until June 1994. Eight hundred mated ewe hoggets and 18 rams were donated to the project by a membership of 95 farmers and six agricultural research and training organisations. The initial ewe flock comprised 700 ewes for the selection line and 100 ewes for the unselected control line. Twenty rams were initially sampled from four different resistant flocks (Karlsson et al, 1992) and mated to ewes in the selected line. The numbers in the control line were kept constant whereas the selected line increased in size to reach 1100 ewes in 1994. The control line was syndicate mated with 20 randomly selected rams, whereas the selected line was mated in 16 single sire mating groups. This consisted of 14 new sires each year and two sires that were used the previous year for reference sires to generate genetic links between years. Rams with the lowest average FWEC over the 12 month sampling period were selected. No selection pressure was put on objective wool or body weight traits, but rams that had serious conformation faults or coloured wool were culled.
Mating took place in February each year and ewes lambed in July over a five week period. Full sire and dam pedigrees were collected in the selected line from 1989 but only dam pedigrees were collected for the control line.

Data
All progeny born from 1988 until 1990 were subjected to a natural challenge until 15 months of age. Ten to eleven FWEC's were taken on a monthly basis from weaning in October until September the following year. No samples were collected in October for 1988 and 1989 and no samples were collected in January. Lambs born in 1991 to 1993 were subjected to a natural challenge from birth until December. After sampling in December, the lambs were drenched and this procedure was repeated in March. The sheep were exposed to a second cycle of natural challenge following the break of the season and monthly FWEC were recorded until September when the sheep were approximately 15 months of age.

Body weights, faecal scores (FS) and dag scores (DS) were recorded at each faecal sampling. Faecal samples were given a FS of one to four. One for hard pellets down to four for fluid faeces. Animals with no dags were given a zero score and animals with heavy dags were given a score of four. Fleece data were based on midside samples collected at hogget shearing at approximately 15 months of age. Animals were not shorn as lambs.

Statistical analysis
Breeding values of FWEC at weaning (October) and after the break of the season (June) were estimated with an animal model using FEST (Groeneveld, 1990). The FWEC's were transformed to cubes (Woolaston, pers. comm.). Year of birth, sex of the lamb, birth status and age of the dam were included in the model as fixed effects and date of birth as a covariate. A heritability of 0.21 was used as a starting value for October and 0.22 for June (Greeff et al, this conference). The genetic trend was determined by averaging the estimated breeding values over birth years, and expressed as the back transformed values.

T-tests were conducted to determine whether traits differ significantly between the selection and the control line for lambs born in 1993 (Snedecor and Cochran, 1967).

RESULTS

Genetic trends
The genetic trends for FWEC measured at weaning in October and after the break of season (June) at approximately 10 months of age are indicated in Figure 1.

As shown in Figure 1 appreciable genetic gains were made by selecting for decreased FWEC. The genetic trend of FWEC after the break of the season shows that the control line stayed relatively constant whereas the selection line moved away from the control line. A correlated downward trend was also detected at weaning.

Genetic changes due to selection
Differences between the control and selection lines for the 1993 born progeny are indicated in Table 1. The selection line had a significantly (P<0.01) lower FWEC at weaning than the control line, but no significant differences were found after the break of the season in this year. Significant differences (P<0.10) were found in the response pattern of FS in the two lines. In October the control line had the highest FS, however, after the break of the season the order was reversed with the selected line having a significantly (P<0.10) higher FS than the control line, despite having a lower FWEC for this month. The
untransformed DS didn’t differ significantly between the lines, however, the cubed DS was significantly (P<0.10) higher in the selected line.

No significant differences were found between the two lines for body weight at weaning, at 10 months or at 12 months of age. Clean fleece weight was not significantly different between the two lines, but fibre diameter in the selection line was significantly (P < 0.01) lower than in the control line.

![Graphs showing genetic trend of FWEC for the control and selection lines measured at weaning in October and after the break of the season at approximately 10 months of age.]

**Year of birth**

Figure 1. Genetic trend of FWEC for the control and selection lines measured at weaning in October and after the break of the season at approximately 10 months of age.

Table 1. Differences between the selection and control line for FWEC, FS, DS, wool and body weight traits.

<table>
<thead>
<tr>
<th>Trait</th>
<th>Selection</th>
<th>Control</th>
<th>SE of difference</th>
<th>t-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>FWEC: October</td>
<td>272</td>
<td>433</td>
<td>61.9</td>
<td>2.59***</td>
</tr>
<tr>
<td>FWEC: June</td>
<td>533</td>
<td>606</td>
<td>72.9</td>
<td>0.99</td>
</tr>
<tr>
<td>FS: October</td>
<td>1.8</td>
<td>2.1</td>
<td>0.1</td>
<td>2.34**</td>
</tr>
<tr>
<td>FS: June</td>
<td>2.4</td>
<td>2.1</td>
<td>0.1</td>
<td>1.62*</td>
</tr>
<tr>
<td>DS:crutching</td>
<td>2.3</td>
<td>1.9</td>
<td>0.2</td>
<td>1.49</td>
</tr>
<tr>
<td>DS:crutching (cubes)*a</td>
<td>1.2</td>
<td>1.2</td>
<td>0.0</td>
<td>1.71*</td>
</tr>
<tr>
<td>Clean Fleece Weight (kg)</td>
<td>1.7</td>
<td>1.7</td>
<td>0.1</td>
<td>0.05</td>
</tr>
<tr>
<td>Fibre diameter (µm)</td>
<td>16.7</td>
<td>17.4</td>
<td>0.2</td>
<td>3.63***</td>
</tr>
<tr>
<td>Weight: October (kg)</td>
<td>16.6</td>
<td>17.3</td>
<td>0.6</td>
<td>1.09</td>
</tr>
<tr>
<td>Weight: June (kg)</td>
<td>23.8</td>
<td>24.2</td>
<td>0.5</td>
<td>0.75</td>
</tr>
<tr>
<td>15 mth Hogget weight (kg)</td>
<td>28.2</td>
<td>28.2</td>
<td>0.7</td>
<td>0.00</td>
</tr>
</tbody>
</table>

*** P<0.01; ** P<0.05, * P<0.10

*a Transformed values (cubes)
DISCUSSION

Selection for low FWEC in animals subjected to a natural challenge has resulted in the selection line diverging away from the control line in a desirable direction for this trait. Contrary to expectation, a good response was also achieved at weaning. This creates scope for early selection and/or culling. Karlsson and Greeff (unpublished) found a moderately high genetic correlation of 0.6 between FWEC at weaning and FWEC in June after the break of the season. However, the genetic correlation between FWEC at weaning and FS after the break of the season were negative and in an undesirable direction. This implies that selection for low FWEC at weaning may result in hyper-sensitivity and scouring later in life. This phenomenon was confirmed in the comparison between the selected and control line lambs born in 1993. From a practical point of view this suggests that selection pressure must be applied to a low FWEC and a low faecal consistency or dag score. There is clearly a need for further research into the response mechanisms involved in the low FWEC selection line. However, no other undesirable correlated responses were found between FWEC and production traits in this selection experiment.

ACKNOWLEDGEMENTS

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REFERENCES