ENVIRONMENTAL EFFECTS ON THE REPEATABILITY OF RESISTANCE TO WORMS IN SHEEP

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SUMMARY

Repeatability of faecal worm egg counts (FEC) was estimated in groups of Merino ewes infected naturally with sheep nematodes while grazing pastures on a commercial property on the Northern Tablelands of NSW. 253 ewes were allocated to four groups from which an initial FEC was estimated. Groups of ewes were then introduced to supplementary feeding of lupins at weekly intervals such that when a second FEC was estimated 4 weeks later, groups of ewes had been exposed to feed for either 1, 2 or 3 weeks. The fourth control group were not fed. Feeding did not affect the mean concentrations of worm eggs, nor the extent of variation about the mean. Repeatabilities of FEC (correlations between the first and second FEC) were 0.62 in the control group and 0.63, 0.53 and 0.42 in the groups fed for 3 weeks, 2 weeks and 1 week respectively. Offering the supplement included moving sheep between paddocks and nutritional effects cannot be distinguished in this experiment from stresses from other sources. Nevertheless it is suggested that use of FEC measurements for ranking animals (for selection in breeding programs, for example) should be treated with caution if animals have recently been exposed to stress of any kind.

INTRODUCTION

Resistance to anthelmintics is increasing. In 1991 resistance to at least one anthelmintic drench was found on 85% of farms and resistance to multiple drenches was found to occur on 34% of farms tested in high rainfall areas of Australia (Overend et al. 1994). Hence there is a need to explore alternative methods for controlling internal parasites, such as breeding for increased resistance. Increasing the ability of sheep to resist internal parasites may be used to reduce reliance on chemicals for the control of internal parasites. Research on breeding sheep for resistance to internal parasites has reached a point where implementation of these technologies into the Australian sheep industry is possible (WRDC 1991).

Repeatability of FEC in a number of studies has been shown to be highly variable: from zero (Karlsson et al. 1991) to 0.86 (Baker et al. 1991) under field conditions. This is of importance to the industry as the repeatability has a profound impact on the response to selection and the number of measurements required for optimal genetic progress. In this study the repeatability of FEC was investigated with the introduction of supplementary feeding between two faecal samples taken one month apart.

MATERIALS AND METHODS

Two hundred and fifty three Merino ewes run on the property "Little Plain" 30 km east of Guyra, in the Northern Tablelands of New South Wales were used in the experiment. The ewes were around 18 months of age and had been drenched five times from birth up to the start of the experiment. Following the last drench in December 1993 the ewes were moved to a paddock which had not contained any sheep in the previous four months. Body weight of the sheep was 31.7±4.6kg (mean ± standard deviation) at the start of the trial. Three paddocks were used in the experiment: one paddock held all animals receiving the
supplement of lupin grains, another held animals not receiving supplement, and a small holding paddock was used during feeding to increase the opportunity for contact with grain. Feed was dropped on the ground from a vehicle. The supplement was given on Wednesdays and Saturdays with 400gm per head being offered on each day. Supplementary feeding of group 3 commenced on 26/3/94. Twelve experienced Border Leicester cross Merinos ewes were run with the feed group to encourage the trial ewes to consume the supplementary feed. Faecal worm egg counts egg count were measured using a modified McMaster technique.

Table 1 Experimental Design

<table>
<thead>
<tr>
<th>Group</th>
<th>24/3</th>
<th>26/3</th>
<th>30/3</th>
<th>2/4</th>
<th>6/4</th>
<th>9/4</th>
<th>13/4</th>
<th>18/4</th>
</tr>
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<tbody>
<tr>
<td>Control</td>
<td>FEC</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>FEC</td>
</tr>
<tr>
<td>3</td>
<td>FEC</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>FEC</td>
</tr>
<tr>
<td>2</td>
<td>FEC</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>FEC</td>
</tr>
<tr>
<td>1</td>
<td>FEC</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>FEC</td>
</tr>
</tbody>
</table>

FEC: Faecal worm egg count performed. Shaded boxes indicate that supplementary feed was offered.

Pearson correlation coefficients were calculated using a model which included initial body weight, person who counted the worm eggs and counting tray number, none of which had a significant effect on FEC. A number of different transformations were tested as well as rank correlation. These resulted in similar trends in the data with the most appropriate transformation, in terms of variance and skewness, being the cube root. Means were obtained using a generalised linear model (GLM) procedure and coefficients of variation (CV) estimated as the ratio of the standard deviation to the mean of the transformed data. The significance of differences between repeatability (r) values were calculated using the technique described by Snedecor and Cochran (1969). In this method r values are converted to z values to remove the problem of r values being skewed which reduces the accuracy of determining differences between r values.

RESULTS

Untransformed mean FECs for all animals were 1217 and 1276 for the first and second samples. There was no significant difference between the means obtained within each sampling date. Counts on the same faecal sample prepared and counted twice on the same day were highly correlated (correlation coefficients: 0.85 and 0.77 for FEC1 and FEC2, respectively). No significant difference in means was detected within or between the groups. Coefficients of variation were similar among the groups using both transformed and untransformed data (Table 2). Repeatability of FEC was highest in the control group and fell with declining interval between introduction of feeding and the second FEC (Figure 1). The repeatability of 0.45 for group 1 was significantly less than for group 3 and the control group (P<0.01).
Table 2 Mean faecal worm egg counts and their coefficients of variation (CV) estimated on both untransformed and cube-root transformed faecal egg counts made 4 weeks apart (FEC1 and FEC2). Repeatabilities between the two counts were estimated on cube-root transformed data.

<table>
<thead>
<tr>
<th>Group</th>
<th>No.</th>
<th>FEC1 Untransformed Mean</th>
<th>CV (%)</th>
<th>FEC1 Transformed Mean</th>
<th>CV (%)</th>
<th>FEC2 Untransformed Mean</th>
<th>CV (%)</th>
<th>FEC2 Transformed Mean</th>
<th>CV (%)</th>
<th>Repeatability</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control</td>
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<td>1161</td>
<td>99</td>
<td>9.40</td>
<td>37</td>
<td>1156</td>
<td>111</td>
<td>9.40</td>
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<td>0.62</td>
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<td>9.79</td>
<td>30</td>
<td>1461</td>
<td>87</td>
<td>9.79</td>
<td>35</td>
<td>0.63</td>
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<td>117</td>
<td>10.24</td>
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<td>1322</td>
<td>96</td>
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<td>0.53</td>
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<td>28</td>
<td>1163</td>
<td>109</td>
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<tr>
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<td>100</td>
<td>9.64</td>
<td>32</td>
<td>1276</td>
<td>100</td>
<td>9.79</td>
<td>33</td>
<td>-</td>
</tr>
</tbody>
</table>

Figure 1 Repeatability of FEC estimated 4 weeks apart with the introduction of supplementary feeding 3 weeks, 2 weeks and one week before the second measurement, expressed in three different ways: r: the between-sample correlations, r/r1: the ratio of r in the treatment groups to r in the control group, r1, and r/rS: the ratio of r to the correlation (rS) between repeated measurements on the same faecal sample.
DISCUSSION

Nutrition, stress, climate and physiological state can affect the interaction between worms and sheep (Bundy and Golden 1987). This experiment has shown that the introduction of supplementary feed has had little or no effect on the level of worm burden, as indicated by mean FEC, or variation in FEC - coefficients of variation before and after feeding did not change. Correlations between FECs were lowered by the feeding when the second egg count was taken soon after the introduction of the feeding regime. Whether this was caused by the feed itself, or other stresses induced by feeding or movement between paddocks, has not been resolved.

Naive sheep take approximately 3-4 weeks to accept a grain ration (Chapple and Lynch 1986). Over these three weeks the number of sheep eating the supplement will slowly increase until most are eating the supplement after the fourth week. Increased levels of nutrition usually increase the ability of mammals to mount an immune response at cellular and molecular levels (Bundy and Golden 1987; Roberts and Adams 1990). Roberts and Adams (1990) and Abbott et al. (1988) found that supplemented ewes had a lower FEC than unsupplemented controls. The lymphocyte response to L3 larval antigen may be important in acquired resistance and this develops more quickly in animals receiving high levels of protein (Kambara et al. 1993).

Lupins contain approximately 30% crude protein (Hume 1974) but their impact on physiological function may be attributed to the increased energy intake of supplemented sheep (Teleni et al. 1989). The extra protein per se in the gastrointestinal tract and in the bloodstream may directly affect the reproduction rate of the parasite (Bundy and Golden 1987). Although the present study shows that concentration of worm eggs did not change throughout supplementation the possibility cannot be ruled out that total faecal output had either increased or decreased, masking changes in total worm egg output.

The reduction in repeatability in our experiments emphasises the sensitivity of the interaction of internal parasites and their ruminant hosts, and suggests caution in using FEC for ranking sheep when recent management changes may have placed stress on the sheep. We suggest that sheep should be allowed to adjust to supplementary feed for at least two weeks before sampling.

ACKNOWLEDGMENTS

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REFERENCES