GENETIC ENHANCEMENT OF RESISTANCE TO GASTROINTESTINAL WORM INFECTION IN CROSSBRED MATERNAL GENOTYPES USED FOR MEAT SHEEP PRODUCTION IN AUSTRALIA

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SUMMARY

There is potential to genetically improve meat sheep for resistance to parasitic worms thereby improving both maternal ability and lamb performance. An experiment was conducted to assess the resistance of the offspring of genetically resistant rams or ewes crossbred with sheep which had not been selected for resistance. Data from 98 ewe lambs of resistant and unselected Merino rams crossed with Waridale ewes, and resistant and unselected Merino ewes crossed with Border Leicester rams, indicated that lambs born to a resistant parent carried fewer worms than those from unselected parents. This study will continue by assessing the reproductive performance of the ewe lambs until their second lambing.

Keywords: Crossbreeding, maternal genotypes, parasite resistance, meat sheep

INTRODUCTION

Parasite infection is a major constraint on sheep production and may become even more so with the worldwide emergence of drug-resistance in worms (Waller *et al.* 1996). Breeding for resistance is one approach being exploited (Gray and Gill 1993). Resistance measured by faecal worm egg count (FEC) is moderately heritable (Morris *et al.* 1995, Woolaston and Eady 1995), with high variation within host populations (Piper *et al.* 1978, Gray 1995, Eady *et al.* 1996, Zhang *et al.* 1997). Breeding for resistance in sheep in Australia (Eady *et al.* 1997) and New Zealand (Baker *et al.* 1991) has been based largely on a single breed: Merinos or Romneys. Meat sheep production in Australia is characterised by a crossbreeding system which involves production of crossbred maternal genotypes (eg Border Leicester x Merino), the use of terminal sires (eg Texel and Poll Dorset) over these crossbred ewes, and intensive management in high rainfall areas. Enhancing resistance of meat sheep to gastrointestinal worm infections could provide economic advantages arising from production improvements in both dam and lamb, reducing the frequency of anthelmintic use and its associated costs, and delaying drug resistance of worms. This paper reports a study aimed at enhancing resistance to worms in prime lamb dams by means of crossbreeding and nutritional manipulation, preliminary results being given for the performance of the crossbred ewes as lambs.

MATERIALS AND METHODS

Animals and experimental designs. This experiment was conducted at the University of New England (UNE) Kirby Farm, Armidale, New South Wales. The 98 ewe lambs used were the

progeny of two random Border Leicester (BL) sires mated with Merino ewes which were either selectively bred for resistance to nematodes (rM) or random bred (M), and from 5 rM and 5 M sires joined to Waridale ewes (W), the latter being a dual-purpose composite breed. Subsequently there were four genotypes of lambs: BLxrM, BLxM, rMxW and MxW. The BLxrM and rMxW genotypes were expected to exhibit more resistance than the BLxM and MxW genotypes. The rM and M sheep were derived from the UNE "Golden Ram" flock (Albers *et al.* 1987). Lambing groups were formed on the basis of dam breed and sire (Sep 9 - Oct 14, 96). After marking at 2-7 weeks of age, lambs were combined into two groups according to dam breed. At weaning at 79 days of age, all ewe lambs were drenched, combined into a single management group and rotationally grazed for 3 months using two adjacent plots with similar grass conditions. On March 12, lambs were divided into two feeding groups, viz supplement group (S) and no supplement group (NS), stratified according to body weight and genotype. The two feeding groups were maintained separately but were rotationally grazed through four adjacent plots to retain similar pasture contamination of worms. All lambs were trained to eat lupins in the last week of April. Those in group S were then supplemented at 115g of lupins per head per day (g/hd) while the group NS received no supplement for four weeks. The ration for group S was further increased to 230 g/hd till June 11 when all ewe lambs were drenched. FEC was recorded for individual ewe lambs from weaning and continued fortnightly from Jan 8, using the modified McMaster method at the minimum rate of 100 worm eggs per gram faeces (epg). Larval cultures indicated animals were naturally infected by multiple nematode species, predominantly by *Trichostrongylus spp.*

Statistics. FEC was transformed using cubic roots (FECcr) and both FEC and FECcr were subjected to a preliminary analysis using PROC UNIVARIATE in SAS (1996). Analysis of variance of FECcr was conducted using PROC GLM. The model used for data collected until March 12 included genotype and type of birth as fixed effects. From April 2 the fixed effects were genotype, type of birth, feeding group and genotype x feeding group.

RESULTS

In the first three months after the first drench at weaning, the accumulation of worm eggs in lambs was very slow. The distribution of untransformed FECs was skewed (skewness, 0.85-6.5). The correlation between mean and variance of FEC was 0.88. The ratios of variance to mean were in a range of 186-737. The normal probabilities of FEC widely varied from 27 to 92 per cent. Cube root transformation substantially reduced the ratio of variance to mean and normalised FECs. At mean FECs above 400 epg, normal probabilities were around 90%, the ratio of variance to mean declined to 1.28, and the correlation between variance and mean weakened to 0.44. Average FECs over time in the four lamb genotypes are shown in Figure 1. At weaning FEC of all lambs reached 340 epg. The resistant weaners had the lowest FEC at weaning: 245 vs 330 for BLxrM vs BLxM, 230 vs 370 for rMxW vs MxW, but these contrasts using FECcr were not significant ($P>0.05$). Subsequently, after the drench at weaning and after FEC of all ewe lambs exceeded 400 epg, mean FEC of BLxrM was lower than BLxM and the rMxW was lower than MxW, the differences being 290 and 110 epg, respectively.

The effect of genotype on FEC was significant only on Feb 19 ($P<0.01$) and March 12 ($P<0.05$). Once FEC exceeded 700 epg (from May 14 onwards), a consistent and significant effect of genotype was observed ($P<0.05$). The feeding group effect was significant on April 30 only. The interactions of genotype and feeding group and effect of the type of birth were not significant ($P>0.05$).

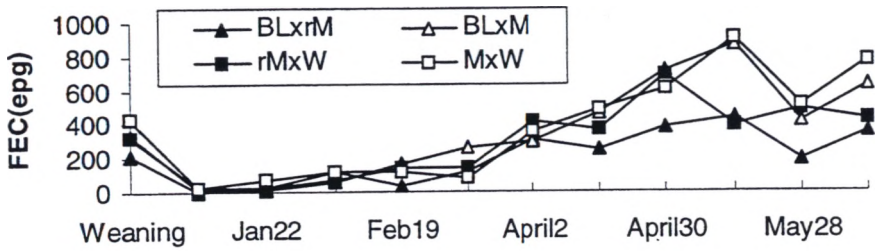

Figure 1. Mean FEC of the four genotypes.

DISCUSSION

These preliminary results indicate that the use of resistant Merino genotypes has an impact on the resistance of lambs after crossbreeding of Merinos with other breeds. Use of resistant Merino genotypes is one way to introduce resistance genes to the Australian meat sheep industry. 85% of lambs slaughtered in Australia have Merino genes either from both sire and dam (purebred Merino), dam alone (eg BLxM) or from granddam (eg TexelxBLM). These Merino genes therefore can have an impact on both lamb performance and on maternal performance and both of these aspects are being considered as this study progresses. The other major ways by which resistance genes can contribute to the maternal and lamb genotype are by using BL rams selected for resistance or, for the lamb genotype alone, by using terminal sires selected for resistance. This could be done by incorporating parasite resistance as a trait measured in sire evaluation schemes.

Breeding sheep for resistance to internal parasites has focussed on the selection of best sires or strains and crossbreeding for resistance in sheep to internal parasites has received relatively little attention. Piper *et al.* (1978) studied natural worm burdens of weaners in four breeds/strains (Dorset Horn, Corriedale and two Merino bloodlines) and their reciprocal crosses and indicated that, in most cases, the FEC of crossbred weaners was lower than that of corresponding pure breeds but in only one case (strongyles of Merino x Corridale) was the difference significant ($P<0.05$). More recently, McEwan *et al.* (1994) demonstrated that FECs of Texel x Romney lambs were significantly lower than pure Romney lambs for both *Nematodirus* ($P<0.05$) and strongyles ($P<0.001$). Watson *et al.* (1992) compared Romney, Perendale and Romney x Perendale weaners and reported that under natural mixed parasite infection, the cross exhibited significantly lower FEC than Romneys but higher than

Perendales. No heterosis of resistance was estimated in those studies. In crossbreeding programs, heterosis in resistance by utilising sheep selectively bred for resistance to internal parasites may be expected, increasing the potential for using resistant genotypes in meat sheep production.

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