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UNUSUAL SUSCEPTIBILITY OF SHEEP SELECTED FOR RESISTANCE TO INTERNAL PARASITES

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SUMMARY

Two experiments were conducted to investigate the expression of genetic resistance to gastrointestinal nematodes infections of sheep. Merino lambs of parasite-resistant and random-bred genetic background were infected with nematodes of the genera *Trichostrongylus* and *Haemonchus*. In both experiments, and contrary to expectation, some groups of genetically resistant lambs had higher faecal egg counts than their random-bred counterparts . These unusual findings may be explained by the high levels of infection to which the lambs were exposed. Although these results are restricted to lambs in one family derived from a single highly resistant ram, we suggest that interactions between genotype and the level and nature of exposure to nematode infection require further investigation

INTRODUCTION

Breeding sheep with high levels of resistance to internal parasites is feasible and programs for the incorporation of resistance into industry breeding objectives are being developed (Woolaston 1994, these proceedings). However in some field situations, particularly when levels of infection are low, the repeatability of egg counts between months of sampling can be very low (Karlsson et al. 1991, Bisset et al. 1992) and in calves heritability can be highly variable between months (Gasbarre 1990). This has lead to speculation that resistant genotypes may not respond in a predictably resistant manner in all environments ,to all parasite species and to both artificially and naturally acquired infections. We (Gray, 1991)and others (for example Windon 1991 Baker et al. 1991) have reported widely on the positive (favourable) correlation between the responseof lambs to artificial experimental infections and infections acquired naturally under commercial conditions.

We have previously described reversal of the ranking of resisant and susceptible genotypes in an experimental flock based on a highly resistant family of Merinos (Albers et al. 1987) when lambs were maintained worm free before an artificial infection (Gill 1991). This was an unexpected result in the context of over 20 experiments (for example Gray et al. 1992) in which the genotypes responded to infection in a predictable manner. Here we present preliminary data from two experiments in which reversals occurred and conclude that if such effects can be shown to occur in outbred flocks or in commercial studs then the basis of this interaction needs to be investigated. It is emphasised that in our experimental program, such reversals are unusual, but as the data show, they can be quite convincing.

MATERIALS AND METHODS

Experiment 1 In two successive years (Years 1 and 2; 1991 and 1992) 5 rams designated resistant on the basis of their relationship to the founder, highly resistant ram (Albers et al. 1987) and 5 rams unrelated to the founder ram were mated to unrelated ewes. In Year 1, 18 resistant and 18 random-bred lambs from these matings, representing all sire groups, were infected artificially on separate occasions with 5,000 larvae of *Haemonchus contortus* or 10,000 larvae of *Trichostrongylus* sp. Throughout the experiment the lambs were at pasture and given no supplementary fed. The corresponding numbers of lambs in Year 2 were 15 and 22. Before and after each infection the lambs were drenched with an effective anthelmintic. Square-root transformed faecal egg counts were analysed

using a repeated-measures model which included sire of lamb, sex of lamb (female, castrated male), birth type of lamb (single, twin), genotype (resistant, random-bred) and day of measurement.

Experiment 2 Castrated male lambs of similar genetic background to those in experiment 1 were raised on pasture until weaning at 4 months of age and then maintained in an animal house on slatted floors with no access to fresh pasture for the remainder of the experiment. For 20 weeks they were infected three times per week with infective larvae of *Haemonchus contortus* at the rate equivalent to either 200 or 1000 larvae per day. At the end of 20 weeks the lambs were drenched with an effective anthlemintic and three weeks later infected with a single dose of 20,000 infective larvae of the same nematode species. Faecal egg counts were estimated at regular intervals. Square-root transformed faecal egg counts were analysed using a repeated-measures model which included genotype (resistant, random-bred) and day of measurement.

RESULTS

Experiment 1 Faecal egg counts are shown in Figure 1. In summary, the difference between the genotypes were highly significant in all infections except the infection with *Trichostrongylus* in Year 2.

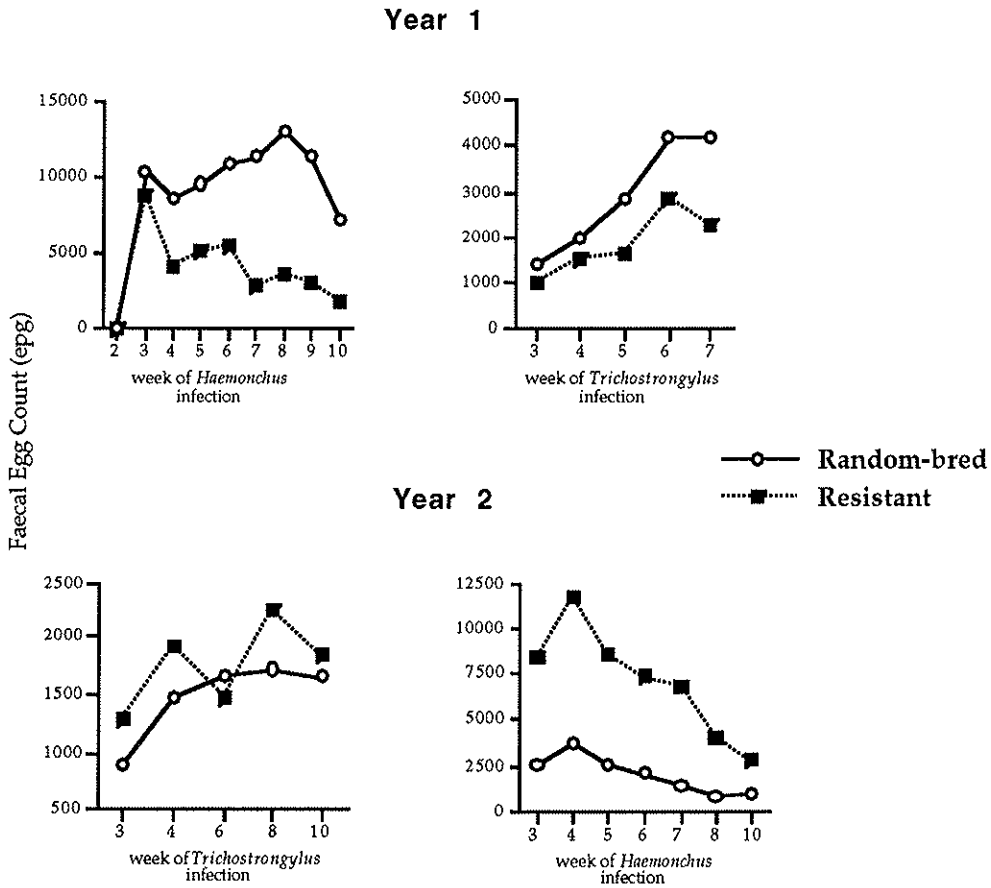

Figure 1 Mean faecal egg counts of two crops of lambs infected artificially with larvae of *Haemonchus contortus andTrichostrongylus* sp. Faecal samples were collected at about weekly intervals for the 7 to 10 weeks of infection. The experiments were conducted in each in a single paddock known to be infected with nematodes of the same genera.

Experiment 2 Faecal egg counts are shown in Figure 2. Differences between resistant and random-bred genotypes approached significance at both levels of previous infection but were opposite in sense. Lambs of resistant genetic background were more resistant than their random-bred counterparts at the low level of previous infection but more susceptible after exposure to the high level of previous infection.

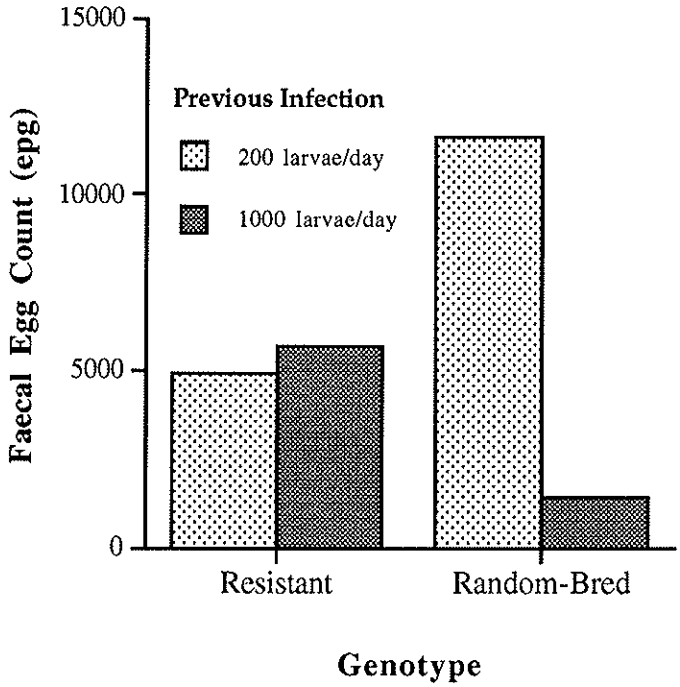

Figure 2 Mean faecal egg counts of young Merino lambs infected for 20 weeks at a rate of either 200 or 1000 infective larvae of *H. contortus* perday for 20 weeks before the challenge infection represented here. The lambs were of either genetically resistant or random-bred. The number of lambs in each group is shown above the column. In this challenge infection lambs were infected with a single dose of 10,000 infective larvae of *H. contortus* and faecal samples were collected after 21, 24, 27, 32, 35, 38 and 42 days. The height of each column is the least square mean estimated from a repeated measures analysis.

DISCUSSION

In the context of our experimental program and related experiments on Merinos in Australia these results are unusual but have been described in experimental rodents (Scott, 1991). Although the numbers of animals of animals in experiment 1 was small, and differences between group not significant there is a strong indication that there is an interaction between genetic background and level of previous exposure to infection. Taken together with the highly significant results of Gill (1991) there are adequate grounds for further testing this hypothesis. We have no evidence to show that the background levels of infection in the two years of Experiment 1 were different or that the lambs had received different levels of exposure to infection. It remains a possibility therefore that in this resistant genotype prior infection with *Trichostrongylus* results in modified expression of resistance to infection with *Haemonchus*. This is at odds however with our own results (Gray et al. 1992) and those from other Merino selection

lines (Woolaston et al. 1990). Our conclusion is lambs of this resistant family of Merinos may, in some experimental circumstances, have less resistance than their genetically non-resistant counterparts. Investigation of this interaction provides another tool for determining the genetic and immunological mechanisms which underly of expression of resistance.

ACKNOWLEDGMENTS

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