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Progress on genetic studies of resilience to nematode parasites in sheep

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ABSTRACT

Recent studies on 3- to 7-month-old lambs have shown that there is genetic variation in the ability to withstand the effects of roundworm challenge and thus maintain acceptable performance (high growth, low dags) when left undrenched for extended periods. This trait is generally referred to as resilience. The heritability of resilience has proved to be low (three years' data, with 213 sire groups and two separate approaches to measuring resilience gave estimates of 0.10 ± 0.03 and 0.14 ± 0.03). Nevertheless progeny testing should successfully identify genetically resilient rams for use. Resistance to nematode infection, measured in terms of faecal egg count (FEC), is also known to be inherited in sheep, and studies of selection for low FEC have successfully improved resistance. However, resilience and resistance appear to be genetically independent. A selection experiment for high vs low resilience was initiated in 1994, and the first year's results are reported here. Four progeny-tested rams with high resilience (RL+) and four with low resilience (RL-) were inter se mated to outlier RL+ and RL- ewes. Progeny were grazed together on infective pasture, with minimal drench treatment. Relative to RL- progeny ($n=74$), RL+ progeny ($n=84$) had 2.0 kg greater weaning-to-autumn gains (+17%, $P<0.001$), 2.2 kg greater live weights in April (+7%, $P<0.01$), and a significant advantage in yearling weight ($P<0.05$). However, there was no significant difference in dag score, or in January or March FEC. There was a 0.24 kg increase in yearling fleece weight (+10%, $P<0.01$). The results show that selection for resilience is possible and that, provided care is taken to avoid sires with high FEC, improved resilience in lambs should lead to lower drenching requirements without jeopardising production.

Keywords: nematodes; faecal egg count; resistance; resilience; genetics; sheep.

INTRODUCTION

It is now widely recognised by ram breeders in New Zealand that resistance of sheep to nematode infection is inherited, and that selection for low faecal egg count (FEC) will improve resistance (Morris *et al.*, 1995). However, unless care is taken, there may be side effects due to unfavourable correlated responses. Results from Massey University (Howse *et al.*, 1992; Williamson *et al.*, 1995) and from Woodlands Research Station (McEwan *et al.*, 1992) showed that flocks selected for increased yearling fleece weight had an increased mean FEC, relative to unselected controls. Studies in two fleece-weight selection flocks (one related to Woodlands and one independent) and their controls at Tokanui have since confirmed these results for yearling fleece weight, although two out of three liveweight-selection flocks at Tokanui have shown no correlated change in FEC (Morris *et al.*, 1996). Improving FEC and production will therefore require that both traits are recorded, and selection will need to be based on an index of the two.

We have considered an alternative approach by studying genetic variation in the ability of an animal to withstand the effects of roundworm challenge, and maintain acceptable performance (high growth, low dags), when left undrenched for extended periods. This trait was referred to as "resilience" by Bisset *et al.* (1994). Three years of progeny testing with a total of 213 different sires (Bisset and Morris, 1996), have shown that the heritability of resilience is low (values for two measures of resilience being 0.10 ± 0.03 and 0.14 ± 0.03). Progeny-test selection for resilience is feasible, but resilience is not significantly correlated genetically with \log_e FEC.

This paper describes the first year of results from two Romney flocks established at Wallaceville in 1994 with selection for high (RL+) or low (RL-) resilience to parasites.

MATERIALS AND METHODS

Selection flocks

Four progeny-tested RL+ Romney rams and four progeny-tested RL- Romney rams were used for mating at Wallaceville in 1994 with Romney ewes which were respectively RL+ or RL-, based on data collected on them as lambs. Criteria for selecting foundation rams and ewes were their breeding values for weight gain as lambs from weaning to April, under minimal drenching (i.e. drench administered only when a flock average FEC of 1500 worm eggs/g faeces was reached). A total of 210 progeny was available at weaning in December. Male performance was recorded until April, whilst females were retained until approximately 12 months of age (September). The males were run as a single experimental group, where the treatment consisted of minimal drenching whilst grazing infective pastures. However, due to the fact that the females were involved in a second experiment they were balanced between a minimal-drench group like the males, and a group which received suppressive anthelmintic treatment via a series of slow-release anthelmintic boluses from weaning (every 100 days) [Albendazole; Nufarm, Auckland]. All females were grazed together. A total of 158 lambs (all the males and half of the females) was recorded until April, comprising 84 RL+ and 74 RL- lambs. Amongst the females, 54 minimal-drench and 52 suppressively treated animals were recorded in September (62 RL+ and 44 RL- animals).

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Lamb data recorded

The RL+ and RL- dams were run as one management group until weaning. Lambs were drenched with anthelmintic at weaning and then grazed together in single sex groups. Monitor animals were checked for FEC until a threshold of about 1500 eggs/g was reached, when all animals in a minimal-drench group were faecal-sampled for FEC and then drenched. The cycle was repeated, which provided FEC samples in January, March and April.

In addition to live weight and FEC which were recorded at faecal sampling time in summer and autumn, a dag score was also recorded (0 to 4 scale, where 0 = no dags), and yearling body weight and yearling fleece weight were recorded on females in September.

Data analyses

For minimally-treated animals least squares analyses (Genstat, 1990) were carried out on production traits from the two selection lines, fitting sex of lamb, age of dam, birth-rearing rank and a covariate for date of birth. The remaining traits (i.e. dag score and \log_e (FEC + 100)) were analysed using a restricted maximum likelihood model with the repeated records option (Johnson and Thompson, 1995).

For female lambs only, anti-parasite treatment effects were then considered by fitting a main effect (i.e. receiving a bolus or not), a selection flock effect and their interaction, in addition to the other fixed effects already described.

RESULTS

Table 1 shows the comparison of RL+ and RL- lines for all traits recorded on lambs receiving the minimal-drench treatment. Post-weaning gain for four months until April was significantly greater ($P<0.001$) and April weight was significantly greater ($P<0.01$) in RL+ than RL- animals. Although this was a sire selection trait, and a response was expected, the size of the advantage in April weight (2.2 kg or 7.0%) was notable. Dag score did not, however, differ between lines. FEC showed no correlated response to selection for weight gain (resilience); FEC was not one of the sire selection criteria.

TABLE 1. Comparison of 1994-born resilient (RL+) and non-resilient (RL-) lines for growth traits, dag scores, faecal egg counts (FEC), and yearling data (females only) on body weight and fleece weight

Trait	RL+	RL-	s.e.d.	Significance ^a
Weaning weight, kg	21.2	20.6	0.6	n.s.
Weight gain, weaning to April, kg	13.5	11.5	0.5	***
April weight, kg	33.8	31.6	0.7	**
Mean dag score ^b	1.7	1.7	0.2	n.s.
Mean \log_e (FEC+100) ^b	7.0	7.0	0.1	n.s.
Yearling body weight, kg ^c	42.8	37.8	1.3	***
Yearling fleece weight, kg ^c	2.64	2.40	0.10	**

^a ** = $P<0.01$; *** = $P<0.001$; n.s. = not significant

^b Data combined from January, March and April records, using a repeatability model

^c Only one-third of the animals were retained from April to October

At the yearling stage the RL+ females were 5.0 kg (13.2%) greater in body weight and 0.24 kg (10.0%) greater in fleece weight than their RL- counterparts ($P<0.01$). This was, however, based on only 54 animals. The regression of yearling weight on postweaning gain was 1.04 ± 0.21 kg/kg ($P<0.001$), which would lead to an alternative estimate of the yearling weight difference (based on 158 animals recorded to April) of $1.04 \times 2.0 = 2.1$ kg.

In the bolus-treated animals evaluated for production post-weaning, there were significant increases (>10%) in yearling body weight and fleece weight (to be reported elsewhere). However, there was no interaction between selection line and anti-parasitic treatment for either trait, indicating that genetic group and treatment were additive under the conditions evaluated.

DISCUSSION

The first generation of progeny in this resilience selection study has demonstrated that selection for weight gain under controlled levels of parasitic challenge is feasible. Assuming that responses in the two lines were symmetrical, then a 1.0 kg change in weight gain in each direction was achieved in one generation of screening and selection, equivalent to about 0.7 genetic standard deviations. There was a positively correlated change in yearling body weight.

More intensive studies of component traits for resilience are planned in future years, so that it should be possible to estimate the numbers of drenches saved in a selective drench regime for males (as described by Bisset *et al.*, 1994).

The fact that there was no difference in FEC between the two selection flocks was consistent with the results from our previous genetic studies of unselected paternal half-sib groups for resilience (Bisset *et al.*, 1994; Bisset and Morris, 1996). The absence of an interaction between selection flocks and anti-parasitic treatment for yearling weight shows that the RL+ animals performed with a similar production advantage over RL- animals with or without an anthelmintic bolus. Index selection for high resilience and low FEC should lower drenching requirements and reduce pasture contamination without jeopardising production.

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REFERENCES

- Bisset, S.A.; Morris, C.A.; Squire, D.R.; Hickey, S.M.; Wheeler, M. 1994. Genetics of resilience to nematode parasites in Romney sheep. *New Zealand Journal of Agricultural Research* 37: 521-534.
- Bisset, S.A.; Morris, C.A. 1996. Feasibility and implications of breeding sheep for resilience to nematode challenge. *International Journal for Parasitology* (in press).

- Genstat 1990. Statistical Package: Genstat 5, Release 2.2. *Lawes Agricultural Trust (Rothamsted Experimental Station, U.K.)*.
- Howse, S.W.; Blair, H.T.; Garrick, D.J.; Pomroy, W.E. 1992. A comparison of internal parasitism in fleeceweight-selected and control Romney sheep. *Proceedings of the New Zealand Society of Animal Production* **52**: 57-60.
- Johnson, D.L.; Thompson, R. 1995. Restricted maximum likelihood estimation of variance components for univariate animal models using sparse matrix techniques and average information. *Journal of Dairy Science* **78**: 449-456.
- McEwan, J.C.; Mason, P.; Baker, R.L.; Clarke, J.N.; Hickey, S.M.; Turner, K. 1992. Effect of selection for productive traits on internal parasite resistance in sheep. *Proceedings of the New Zealand Society of Animal Production* **52**: 53-56.
- Morris, C.A.; Clarke, J.N.; Watson, T.G.; Wrigglesworth, A.L.; Dobbie, J.L. 1996. Faecal egg count and food intake comparisons of Romney single-trait selection and control lines. *New Zealand Journal of Agricultural Research* (in preparation).
- Morris, C.A.; Watson, T.G.; Bisset, S.A.; Vlassoff, A.; Douch, P.G.C. 1995. Breeding sheep in New Zealand for resistance or resilience to nematode parasites. In: "Breeding for resistance to infectious diseases in small ruminants". Eds. Gray, G.D., Woolaston, R.R. and Eaton, B.T. Published by the Australian Centre for International Agricultural Research: 77-98.
- Williamson, J.F.; Blair, H.T.; Garrick, D.J.; Pomroy, W.E.; Douch, P.G.C.; Green, R.S.; Simpson, H.V. 1995. Parasitism and production in fleece-weight-selected and control sheep. *New Zealand Journal of Agricultural Research* **38**: 381-387.