PERFORMANCE OF PROGENY OF ROMNEY RAMS SELECTED FOR PRODUCTIVITY UNDER NEMATODE CHALLENGE – GROWTH AND FAECAL EGG COUNTS UNDER CONVENTIONAL AND ANTHELMINTIC-FREE MANAGEMENT SYSTEMS

K. Betteridge[1], A. D. Mackay[1] and S.A. Bisset[2]

[1]AgResearch, Grasslands, Private Bag 1108, Palmerston North, New Zealand
[2]AgResearch, Animal Health, P.O. Box 40 063, Upper Hutt, New Zealand

SUMMARY

The performance of lambs, two tooths and mixed age ewes, sired either by rams selected for productivity under high nematode challenge (PC) or by commercially-bred rams selected for productivity under minimal challenge (PM), was compared under conventional and anthelmintic-free management regimens. This work was part of a larger systems comparison run over five years to examine the risks and constraints of a chemical-free (CF) approach to livestock farming in relation to a conventional (C) system. Parasite challenge encountered by sheep on the CF system was consistently higher than for those on the C system. Presumably, as a result of this factor, conventionally managed sheep were on average heavier than CF sheep until 24 months of age. Progeny of PC sires out-performed progeny of PM sires in the CF system at 8 months and in the C system at 20 months. Except at 3 months, when PM progeny had higher faecal egg counts (FEC) than PC progeny, there was no significant difference in FEC between the two progeny types.
Keywords: Sheep, chemical-free, nematode parasites, liveweight, productivity under challenge.

INTRODUCTION

Interest in reducing agri-chemical use has been stimulated by: the problem of resistance of weeds to herbicides (Bourdôt 1996) and parasites to insecticides and anthelmintics (McKenna 1991, 1994; Leathwick 1995); the possibility of non-tariff barriers based on more vigorous residue testing; the increasing withholding periods placed on livestock following chemical treatment for ecto- and endoparasites; and the expanding world-wide markets for low-residue and organic produce. As part of a larger farm systems comparison to examine the risks and constraints of a chemical-free approach to livestock production, we evaluated the potential benefits of utilising progeny of rams selected for above average productivity in the presence of high nematode parasite challenge - a trait sometimes referred to as resilience (Bisset *et al.* 1994) but perhaps more clearly as productivity under nematode challenge (PC). The results of that work are presented here.

MATERIALS AND METHODS

Animals and experimental design. PC rams were derived from experimental Romney flocks run at Wallaceville Animal Research Centre. Although not line-bred specifically for production under challenge, progeny tests had indicated that their progeny were able to maintain above average productivity in the presence of high nematode parasite challenge, while receiving minimal

anthelmintic drench treatment. Commercial (PM) Romney rams were obtained from breeders who had selected for body weight and fleece weight within a drenching regime.

Progeny of PC and PM sires were compared in unreplicated conventional (C) and chemical-free (CF) self-contained, 25 ha farmlets (Farm type) at AgResearch's Hill Country Research Station in the southern North Island. Details of the design of this trial have been reported previously (Mackay *et al.* 1996) and are described only briefly here. Each farmlet wintered 110 MA ewes, 40 two tooth ewes (2ths), 48 ewe lamb replacements; 10 breeding cows, 8 one year cattle and 4 two year cattle from 1995. Stocking rate was 10.5 su/ha in 1991, but increased to 12.0 su/ha in 1995, and the sheep:cattle ratio was 63:37 (sheep equivalents). Sheep were set-stocked through lambing (September) but rotationally grazed for the rest of the year. Cattle were rotationally grazed at all times. Each year 15 kg P as rock phosphate and 12 kg elemental sulphur/ha was applied.

In the C system, lambs received a 5-in-1 vaccine at docking (October) and 5-6 anthelmintic drenches from weaning in December through May. All C sheep were dipped in April for control of external parasites. In the CF system, anthelmintic use was restricted to maintenance of animal ethical standards only. Any lambs treated were quarantined for three times the withholding period of the product used. CF sheep were neither dipped nor vaccinated.

In both systems, a grazing interchange system was used to minimise exposure to nematode parasite larvae on pastures. Young sheep and cattle were grazed for several months, from weaning, on pastures previously grazed by animals of the opposite species. The C and CF ewes and 2ths were run together for 6 weeks at mating (from 14 April). Half were run with PM rams and half with PC rams which were supplied from Wallaceville's experimental flocks. Animals were weighed monthly and a random sample of 10 ewes; 10 2ths; and 10 lambs/hoggets within each Sire type class, were selected to provide faeces for faecal egg counting.

Data analyses. Liveweights and faecal egg counts (FEC) in December (pre-weaned lambs only), April (lambs, 2th, ewes) and August (hoggets, 2ths, ewes) from each Farm type, Sire type and year were used in the analyses. These times were chosen to represent periods of high and low challenge from gastro-intestinal parasites. Data for analyses were available from four, three and two years for lambs, 2ths and ewes respectively, as only progeny bred on the trial were used in the analyses. All analyses were conducted on a within-age group, within-month basis. The SAS general linear model was used, in which Farm type and Sire type were the main effects. As Farm types were unreplicated, no interpretation of this main effect was attempted and the reason for any Farm type x Sire type effect could not be determined. Sires were not used in the analyses as different sires were used each year. FEC data were $\log_{10}(FEC+100)$ transformed before analyses.

RESULTS AND DISCUSSION

Liveweight.

Farm type. Conventionally managed sheep were nearly always heavier than CF sheep (Table 1). This difference was greatest at 12 months of age and declined thereafter. Because of the lack of replication, the difference cannot be attributed solely to the high parasite challenge (as expressed by

FEC) faced by undrenched sheep in the CF system in their first year. Compensatory growth occurred in the CF sheep from 12 to 20 months.

Sire type. PC progeny were heavier than PM progeny at 3 months of age, but the difference was small. At 8 months, PC sheep were heavier than PM sheep on the CF farmlet, but there was no difference on the C farmlet where all lambs had been regularly drenched. At 20 months a different pattern was seen, with PC progeny being heavier than PM progeny on the C farmlet, while there was no difference on the CF farmlet. Older PC ewes were again heavier than PM ewes. Based on condition and liveweight, or whether CF lambs had been drenched, a total of 16 PM and 8 PC hoggets were culled, over the last three years, from the CF farmlet; this compares with 12 PM and 14 PC hoggets culled from the C farmlet.

As indicated earlier, the PM sires were bought from commercial ram breeders and had thus been bred for high performance under normal farming conditions. In contrast, the PC sires were derived from experimental flocks at Wallaceville and had not been selected for commercial characteristics for some years. They therefore might have been expected to have poorer growth than the PM rams. It remains unknown whether the performance of the PC progeny might have been better had both sire types been selected from within the same flocks.

Table 1. Least square mean liveweights and faecal egg counts of chemical-free (CF) and conventionally (C) farmed sheep sired by rams which were selected for productivity under either nematode challenge (PC) or minimum challenge (PM)[1]

	Liveweight (kg)						Faecal egg count (epg)					
					Mean						Mean	
Farm	Age	Sire type x Farm type			Sire type		Age	Sire type x Farm type			Sire type	
type	(mth)	PC	PM	Mean	PC	PM	PC	PM	Mean	PC	PM	
CF	3	21	19	20 Q	22 A	20 B	3	320 c	590 b	460 Q	470 B	620 A
	8	29 b	27 c	28 Q	31 A	30 B	8	3550	2860	3200 P	1870	1550
	12	32	31	30 Q	35	34	12	570	370	470 P	450	250
	20	52 b	52 b	52 Q	53	53	20	380	520	450	450	460
	24	53	55	55	54	54	24+	870	350	610	480	360
	32	56	56	56	57	57						
	36+	58	56	57 Q	60 a	57 b						
C	3	22	21	21 P			3	630 a	660 a	640 P		
	8	33 a	32 a	33 P			8	200	180	180 Q		
	12	37	37	38 P			12	325	130	230 Q		
	20	55 a	53 b	54 P			20	530	400	460		
	24	54	53	54			24+	90	360	230		
	32	58	58	58								
	36+	62	58	60 P								

[1] Means within age groups (rows) (A,B $P<0.01$; a,b,c $P<0.05$) or within columns (P,Q $P<0.01$;) with different letters are significantly different.

Faecal egg count.

Farm type. At weaning and the time of the first drench of C lambs (3 months), the C lambs had a higher FEC than CF lambs (Table 1). By 8 and 12 months of age however, FEC in the CF sheep was substantially higher than in the C sheep. This was probably largely because CF sheep remained undrenched during the period of high challenge, but due to the lack of replication of the farm type effect, it is unknown whether other factors contributed to this difference. As a result of high FEC and loss of weight, it was necessary to treat from 0-21% of CF lambs during the last 3 years. Two thirds were PM lambs.

Sire type. At 3 months of age, PC progeny had a lower mean FEC than PM progeny on the CF farmlet. In later life, including the period of higher parasite challenge, there was no significant difference in FEC between the breeding groups. This is consistent with the results of Bisset *et al.* (1994) and Bisset *et al.* (1996) which showed no correlation between 'resilience' to nematode challenge and FEC in sheep.

CONCLUSION

Progeny of PC sires grew to heavier weights than their PM counterparts in the presence of high parasite challenge, with this characteristic being more pronounced on the CF farmlet at 8 months and the C farmlet at 20 months. By 24 months of age, and following culling for replacement ewes at 12 months of age, the liveweight difference between C and CF sheep had disappeared as a result of compensatory growth by the CF sheep.

While we found resilience to nematode challenge to be beneficial to sheep in a chemical-free environment, through better growth and less need for recovery drenching, PC lambs were not able to compensate for the production advantage given by drenches during periods of high nematode larval challenge. However, it should be recognised that the PC rams used had simply been identified through progeny testing rather than selective breeding for the trait. Lines of Romney sheep selectively bred for growth under challenge have recently been established at Wallaceville for experimental purposes and in the future these may provide strains showing much greater resilience (Morris *et al.* 1996).

REFERENCES

Bisset, S.A., Morris, C.A., Squire, D.R. Hickey, S.M. and Wheeler, M. (1994) *NZ. J. Agric. Res.* **35**: 51.

Bisset, S.A., Morris, C.A., Squire, D.R. and Hickey, S.M. (1996) *NZ. J. Agric. Res.* **39**: 314.

Bourdôt, G.W. (1996) In "Pesticide resistance - Prevention and Management", p 81, editors G.W. Bourdôt and D.M. Suckling, NZ. Plant Protection Soc.

Leathwick, D.M. (1995) *Vet. Rec.* **136** : 443.

Mackay, A.D., Betteridge, K., Gray, D.I., Devantier, B.P.. Budding, P.J. and Hutching, S.M. (1996) Proceedings of the Central Districts Sheep & Beef Cattle Farmers' Conference: p 49.

McKenna, P.B. (1991) *NZ. Vet. J.* **39** : 154.

McKenna, P.B. (1994) *NZ. Vet. J.* **42** : 151.

Morris, C.A. and Bisset, S.A. (1996) *Proc. NZ. Soc. Anim. Prod.* **56**: 91.