Effect of grazing management on minimising effects of parasitic nematodes on lamb production

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Abstract

An integrated management system involving cattle, ewes and lambs developed to minimise levels of parasitic nematode contamination of pasture was evaluated in a 2-year (1989-1991) study. Four experimental farmlets were managed as self-contained units over a May-May year. Over the two years, stocking rate averaged 15 su/ha and cattle:sheep ratio 35:65. Three treatments (lambs regularly drenched, ewes drenched post-lambing/lambs undrenched and undrenched ewes and lambs) were similarly managed (set-stocked, lambing to weaning, 7-day shifts post-weaning, a 77-day interval between consecutive lamb grazings and a strict rotation of lambs followed by ewes with cattle mid-way between the ewe and subsequent lamb grazing). A fourth treatment differed in each year: in year 1, lambs were set stocked over summer and in year 2 cattle followed lambs, and ewes were positioned mid-way in the rotation between lambs and cattle.

In both years, the management system developed to minimise nematode parasitism in lambs maintained low levels of infective larvae on pasture (<80 L3 larvae/kg pasture), and a faecal egg count in lambs of less than 1500 epg; clinical parasitism was not observed. However, regular anthelmintic drenching of lambs significantly ($P<0.01$) increased liveweight gain of lambs from weaning in November to May by an average 35% over the 2 years. In year two, grazing ewes ahead of lambs significantly increased ($P<0.01$) pasture larvae levels and lamb faecal egg counts and decreased liveweight gain compared with grazing cattle ahead. Drenching ewes to minimise effects of the post-parturient rise in faecal egg count had no influence on nematode levels in lambs or on lamb performance.

Keywords parasitic nematodes, grazing management, lamb growth

Introduction

The resistance of parasitic nematodes to all three available anthelmintic drench families is a serious problem in sheep and goat production in New Zealand. In addition consumer awareness of possible drench residues in foods is increasing (French 1989). Such concerns could have considerable impact on future farming practices, especially lamb production, in which anthelmintic drenches are used regularly.

Past research has clearly identified the life-cycle of parasitic nematodes in sheep (Vlassoff 1982) and the importance of integrated grazing with cattle to interrupt the cycle and reduce the level of infective larvae available to sheep (Brunsdon 1982). This information has not been applied successfully to practical farming (Davis *et al.* 1986), and the only effective control of parasitic nematodes in lambs is drenching 7-9 times/year.

Failure of the integrated grazing or "clean pasture" concept of lamb and cattle management may possibly have been due to a failure to understand fully the life-cycle of nematode larvae on pasture or to recognise the contribution of older sheep in contaminating pasture (Davis *et al.* 1986). The aim of this study was to develop an integrated nematode control programme that would either eliminate or drastically reduce the need for anthelmintic drenches in an intensive lamb production system.

Methods

A 2-year trial (1989-1991) was conducted at the MAF Tech Flock House Agricultural Centre on an area of 8 ha containing both Himatangi Sand and Puke Puke Sand soil types. Pastures were poor, with perennial ryegrass and clovers <30% of total pasture. The 16, 0.5 ha paddocks were divided into 2 blocks, each of 8 paddocks and within each block 2 paddocks were randomly allocated to one of 4 treatments.

Four criteria were considered important in treatment design:

1. The trial was stocked at a higher than average rate to ensure that the potential for parasitism was high.
2. Nematode eggs deposited in **faeces** develop into infective larvae under normal conditions in 15-21 days. However under ideal conditions **infective larvae** can develop **within** 7 days (Vlassoff 1982).
3. Under normal conditions larvae originating from eggs deposited in spring/early **summer do not** survive more than 40-60 days. Eighty percent of larvae originating from eggs deposited in late summer/autumn die within 60-90 days (Vlassoff 1982).
4. Ewes are a constant source of pasture contamination.

Treatments

Over the two years **1989/90** (year 1) and **1990/91** (year 2) treatments varied slightly.

- 1) Control: integrated control programme as described by **Brunsdon & Vlassoff (1982)**, with lambs drenched before shifts and integrated cattle and lamb grazing. The anthelmintic drenches Levamisole and Ivermectin were used in years 1 and 2 respectively.
- 2) Ewes drenched at docking and again at weaning; lambs received no drench and were managed the same as treatment 1.
- 3) No drench system. Lambs rotated on weekly breaks from weaning through to May, similar for treatments 1 and 2.
- 4) No drench system: Managed basically the same as treatment 3 but set stocked on two paddocks over summer (18 December - March 12).

In **1990/91** (year 2), treatments **1, 2** and 3 were the same as in **1989/90** (year 1) but management of treatment 4 was altered to investigate the importance of the ewe's position in a grazing rotation on larvae infestation.

From May to lambing (in mid-August) cattle grazed one block and ewes the other. Throughout the remainder of the year cattle, lambs and ewes alternated between the blocks to maintain lambs on "clean" pasture. In year 1 each treatment comprised 3 rising 2-year cattle, 18 ewes and 20 lambs. This equated to a stocking rate of 17 **su/ha** and a **cattle:sheep** ratio of approximately **40:60**. In year 2, stocking rate was reduced to 2 rising 1-year cattle, 15 ewes and 20 lambs. A stocking rate of 13 **su/ha** and a **cattle:sheep** ratio of **35:65**. This land class normally has an average carrying capacity of 10-12 stock **units (su)/ha**. Each year lambing was about 120-1 **30%**, and with only a few minor changes in lamb numbers, 20 lambs were able to remain on their respective treatments from birth through to May.

Measurements

Animals

In year 1 lambing began in early August and in year 2 in early September. Lambs were weighed at docking in September and again at weaning in October/November. From weaning, ewes and lambs were weighed monthly and faecal samples were taken monthly from lambs. In **year 1, 12 ewes/treatment were sampled only in October** (weaning) November and May. In year 2, ewes were faecal sampled monthly. For animal welfare reasons, lambs were drenched if average faecal egg count (FEC) of a treatment > 2500 epg.

Larvae on pasture

In year 1 infective L3 larvae were counted monthly by sampling pasture immediately before grazing by lambs. In year 2 a more intensive **programme** was adopted with pasture samples being collected weekly.

Pasture, mass and composition

Pastures were regularly monitored to ensure availability and quality of pasture was similar for all treatments. At monthly intervals each paddock was assessed for herbage mass using the pasture probe (Design Electronics), and **herbage** mass levels before and after grazing were measured weekly on lamb grazed pastures. Pastures to be grazed were sampled for botanical composition. In year 2 a portion of the pasture sample for botanical composition was analysed by Near infrared **Reflectance Spectroscopy** (Widham et al. 1989) for digestibility (DDM), protein and metabolisable energy content (ME).

Results

Climate

Climate from 1 November-1 May each year differed; **rain days** 70 v. 88, rainfall 475 v. 560 mm and average monthly temperatures 17.8 v 15.1 for the two years respectively.

Pasture herbage mass, composition, and quality

Average **herbage** mass varied markedly with season but never differed significantly between treatments.

Over the two years average composition of pasture was **20%, 40%, 10%, 7%, 23%** for ryegrass, other grasses, clovers, weeds, and dead matter, respectively. Pasture composition did not differ between treatments.

Quality of pasture offered to lambs in year 2 did not differ across the 4 treatments, with DDM, ME and protein averaging 68, 10.2 and 13.2, respectively.

Lamb growth

Over the 2 years the average interval between consecutive grazing by lambs of any particular area of the farmlet was 77 days. In year 1 from weaning to March the liveweight gain of drenched lambs (treatment 1) was significantly ($P<0.01$) greater than that of the other treatments (Table 1), most of this difference occurring from Oct to Dec. Liveweight gains on the other three treatments were similar.

In year 2 liveweight gain of lambs in treatment 1 (7 drenches) was significantly greater ($P<0.01$) than in the other three treatments; this difference did not occur until late in autumn (April/May). Liveweight gain of treatment 4 from weaning to May was significantly less than in treatment 3 and over the last period (April-May) liveweight gain of treatment 4 was significantly less than in the other three treatments.

Table 1 Liveweight gain (kg) of lambs while on respective grazing blocks and over the duration of the trial: weaning to May.

Treatment	1989/90			
	Oct-Dec	Dec-Mar	Mar-May	On-May
1	6.5	6.0	0.7	17.2
2	4.7	6.7	2.5	13.9
3	5.3	6.0	1.0	12.3
4	5.5	6.0	1.6	13.1
LSD 0.05	1.6	1.3	NS	3.3
0.01	2.2	1.6		4.3

Treatment	1990/91			
	Nov-Jan	Jan-April	April-May	Nov-May
1	4.7	6.2	3.2	14.1
2	3.6	4.4	1.9	10.1
3	3.3	6.2	1.7	11.2
4	3.2	5.0	0.5	0.7
LSD 0.05	NS	NS	0.9	2.1
0.01			1.2	2.6

Parasitic nematodes

Infective larvae on pasture

Levels of infective larvae were low on pasture in both years (Figure 1) with no significant differences between treatments in year 1. In year 2 in late Feb/March number of larvae on pasture in treatment 4 rose to 2650 L3/kg pasture then declined in late April.

Figure 1 Seasonal and treatment variations of infective larvae on pasture (total L3/kg pasture).

Faecal egg counts - lambs

Regular drenching of lambs (treatment 1) significantly reduced FEC in both years (Table 2), the degree of reduction being more marked in the second year than in the first. Over both years FEC of lambs in treatment 2 (drench suppression of the post-parturient rise in ewes) was not significantly different to that in treatment 3 (no drenches). In year 1 over late autumn FEC of lambs in treatment 4 was significantly higher than in treatment 3.

As a result of FEC exceeding the maximum limit allowable for animal welfare (2500 ep_g), lambs in treatment 4 in year 2 were drenched twice: 18 February and 1 May. The Feb drench did not reduce FEC. By the end of the trial on 9 May FEC of lambs in treatment 4 were similar to those in treatment 2, significantly lower than in treatment 3 and significantly higher than in treatment 1, which had been last drenched on 12 April.

Table 2 Log and arithmetic means () of strongyloid eggs/g of faeces in lambs at the time of changing grazing blocks over the two year trial period.

1989/90					
Treatment	Oct (weaning)	Dec	March	May	
1	1.5 (280)	0.8 (100)	2.5 (430)	2.3	(260)
2	2.2 (300)	1.5 (190)	2.3 (260)	2.8	(740)
3	2.0 (460)	2.0 (260)	2.0 (300)	2.5	(430)
4	2.3 (340)	2.5 (460)	2.4 (440)	3.0	(1120)
LSD	0.05	NS	0.9	NS	0.4
	0.01		1.23		0.6

1990/91					
Treatment	Nov (weaning)	Jan	April	May	
1	2.2 (200)	0.0 (0)	0.5 (30)	1.7	(270)
2	1.0 (250)	2.5 (510)	2.7 (660)	3.0	(1140)
3	2.1 (380)	2.8 (660)	3.1 (1470)	3.2	(1740)
4	2.0 (320)	3.1 (2500)	3.6 (5020)	1.3	(1000)
LSD	0.05	NS	0.4	0.5	0.8
	0.01		0.5	0.7	1.1

Faecal egg counts – ewes

Apart from ewes in treatment 2, no significant effects between treatments in ewe FEC over the two years were recorded (Table 3). For treatment 2 drenching ewes significantly reduced faecal egg counts (weaning to January) in both years.

Animal health

For treatments 1-3 no visual symptoms of internal parasitism were observed. The few deaths that occurred were attributed to pulpy kidney, pneumonia and facial

Table 3 Log and arithmetic means () of strongyloid eggs/g of faeces in ewes at strategic times over the two years.

1989/90					
Treatment	Sept	Oct (wean)	Nov	March	May
1	1.7 (300)	1.7 (260)	0.7 (110)	2.7 (830)	2.3 (300)
2	1.2 (260)	0.2 (9)	0.2 (9)	No sample	2.2 (150)
3	1.6 (200)	1.2 (70)	0.5 (70)	2.4 (340)	2.3 (220)
4	2.1 (390)	1.4 (230)	0.6 (60)	2.6 (590)	2.7 (1680)
LSD	0.05	NS	1.0	NS	NS
	0.01				

1990/91					
Treatment	Aug	Nov (wean)	Jan	March	May
1	2.5 (530)	1.4 (220)	1.5 (130)	0.0 (140)	1.8 (530)
2	2.7 (600)	0.7 (42)	0.0 (0)	1.0 (60)	1.1 (00)
3	2.3 (250)	0.5 (22)	0.2 (11)	0.8 (280)	0.7 (260)
4	2.6 (650)	1.4 (230)	0.9 (420)	1.3 (370)	1.3 (120)
LSD	0.05	NS	NS	1.0	NS
	0.01			1.3	

eczema. Lambs in treatment 4 in year 2 over late autumn exhibited breech soiling and ill thrift, indicating clinical parasitism.

Discussion

The results on larvae levels and FEC support the hypothesis of integrated grazing management developed from an understanding of nematode larvae ecology. The hypothesis was:

Maintain an interval between consecutive lamb grazings of greater than 8 weeks; shift lambs every 7-10 days onto “clean” pasture; graze ewes within 3 weeks behind the lambs; and grazecattle mid-way between ewes and lambs.

In year 1, for treatment 3 the level of infective larvae on pasture remained < 80 L3/kg pasture and FEC of lambs were < 500 epg. Only immediately post-weaning, October-December, was FEC in treatment 3 significantly higher than in treatment 1, although this difference was still small when it is considered that a FEC of 1500 epg indicates clinical parasitism (Brunsdon 1976; Brunsdon & Vlassoff 1982). It is calculated, assuming lambs consumed 0.9-1.3 kg of pasture DM/day and pasture contained 22% DM, that daily consumption of infective larvae in year 1 never exceeded 400 larvae/lamb. Coop *et al.* (1982) concluded that intakes of >1000 *Ostertagia circumcincta* larvae/day were necessary to reduce lamb growth. Steel *et al.* (1980) working with *T. colubriformis* found a significant reduction in lamb growth rate occurred at intakes of 140-430 larvae/day. These larvae intakes resulted in average faecal egg counts over the initial 12-week challenge period of 600 and 1500 epg, respectively.

Information from these reports suggests that to minimise production losses in lambs due to parasitism, a larvae level on pasture of no more than 50 L3 larvae/kg pasture and a faecal egg count of less than 1000 epg would be desirable. From this information the 40% increase in liveweight gain to drenching recorded in year 1 was surprising. A smaller liveweight gain (30%) to drenching was found in year 2 but differences in FEC between treatments 1 and 3 were much greater and FEC was more closely associated with liveweight gain. In year 1 the difference in liveweight gain between treatments 1 and 3 occurred at a time (Oct and Dec) when differences in FEC were small and, according to available information, unlikely to affect lamb growth rates.

Average ME values (11 MJ/kgDM) and protein content (13%) of pastures on all treatments were marginal for adequate lamb growth (NRC 1975). The

low quality at pasture most likely resulted from either the predominance of low fertility grasses or the long interval between grazings. Gibson (1963) suggests that the susceptibility of lambs to parasitic nematodes is enhanced when nutrition is poor. Quantitative information on level of nutrition and susceptibility of lambs to parasitism is unavailable but the information presented for both years (Tables 2 and 3) suggests that under poor nutrition small differences in parasitic nematode challenge can significantly affect lamb growth. Such a result may have a significant application to sheep farming, especially in the North Island, as the composition of pasture reported in this trial is very similar to pastures on much of North Island hill country (Granter *et al.* 1973).

Although lambing dates differed between the two years growth rate (kg liveweight gain/day) of lambs in the three treatments repeated over the two years were similar. Liveweight gains for treatments 1 to 3 were 84 v. 81, 68 v. 58, 60 v. 64 kg liveweight gain/day for years 1 and 2 respectively. The higher pasture larvae level and FEC recorded in year 2 was most likely the result of higher rainfall and more **raindays** creating a more favourable environment for nematode development. Local farmers described the summer/autumn of 1991 as very bad for worms and many of the Manawatu lamb finishing units drenched at 10-day intervals to maintain adequate lamb growth rates.

In year 2 the difference in management for treatment 4 **markedly increased infective larvae on pasture** (Figure 1) from February to April, and significantly ($P < 0.01$) increased FEC in lambs from January to April (Table 2), a result which supports the hypothesis presented by Familton (1991) that the ewe contributes to the level of parasitic larvae available to lambs. Over the period of high nematode infestation for treatment 4 the trigger level of 2500 epg, indicating clinical parasitism, was exceeded, and lambs in treatment 4 were drenched twice. Despite drenching, liveweight gain of lambs in treatment 4 over summer/autumn was significantly less than liveweight gain of lambs in treatment 3. Lack of a liveweight gain response to drenching when parasite challenge was high was also reported by Coop *et al.* (1982).

In both years drenching ewes at docking and weaning had little or no effect on pasture larvae levels, lamb FEC or lamb liveweight gain. This is contrary to the ideas presented by Brunsdon & Vlassoff (1985) who suggested that a reduction of the post-parturient rise of faecal egg counts in ewes reduces the requirement to drench lambs.

The results recorded by detailed monitoring of indicators of nematode parasitism (pasture larvae and FEC) and lamb performance in closed grazing systems

over two years has highlighted that grazing management can reduce larvae challenge and apparent clinical parasitism in lambs but not maintain liveweight gain in lambs at levels achieved by drenching integrated with grazing management to reduce nematode challenge.

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