Lamb weight gain and faecal egg count when grazing one of seven herbages and dosed with larvae for six weeks

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ABSTRACT

One hundred and forty Polled Dorset lambs were randomly allocated to graze one of seven herbages (n = 20/herbage) and either trickle dosed (n=12) with a total of 108,000 third stage gastrointestinal nematode larvae (50% *Trichostrongylus colubriformis* and 50% *Ostertagia circumcincta*) over 6 weeks, or undosed (n=8) and allowed to ingest any nematode larvae on pasture. After 28 days on the trial lambs dosed with larvae had higher ($P<0.001$) faecal egg counts (FEC's) than undosed lambs but after 42 days egg counts did not differ ($P>0.05$) between dosed and undosed groups. Dosing with larvae did not significantly alter the liveweight gain (LWG). Herbage species affected LWG, being highest on lotus (*Lotus pedunculatus* cv Maku) and lowest on ryegrass/white clover (*Lolium perenne*/*Trifolium repens*), with other treatments being intermediate.

Dosed lambs grazing chicory (*Chicorium intybus*) had more faecal dags than any other group of lambs. Those grazing G27 red clover (*Trifolium pratense*) were worst afflicted by a dermatitis type condition commonly referred to as trefoil dermatitis. Plasma pepsinogen levels differed significantly ($P<0.05$) only between dosed and undosed groups grazing pawera red clover, ryegrass/white clover and sulla (*Hedysarium coronarium*).

Worm counts were undertaken on ryegrass/white clover and sulla grazed lambs. Both dosed and undosed groups grazing ryegrass/white clover had higher ($P<0.05$) abomasal worm counts than sulla grazed lambs, Intestinal worm counts were highest in dosed lambs grazing ryegrass/white clover, intermediate in the dosed lambs grazing sulla and in undosed lambs grazing ryegrass/white clover, and lowest in the undosed lambs grazing sulla.

Keywords: lamb growth; internal parasites; dagginess; Trefoil dermatitis.

INTRODUCTION

Most grazing trials which have been undertaken to study the effects of internal parasites on lamb production have not reported the composition of the grazed sward species (Jagusch *et al.* 1980, Vlassoff and Brunsdon 1981). Indoor feeding trials have used ryegrass/white clover (Sykes *et al.* 1988) or pelleted feed, generally based on lucerne (Coop *et al.* 1982). While such experiments have elucidated many of the host response mechanisms to internal parasites, data on liveweight gains may have little relevance to outdoor grazing situations.

Previous studies have shown differences in parasite establishment (Niezen *et al.* 1994) and liveweight gain (Niezen *et al.* 1993b) in lambs fed forages containing different levels of condensed tannins (CT) and between different grass species (Niezen *et al.* 1993a). There has been little study of the role of the wide range of the forage crops presently available to farmers.

This paper reports on a 6 week grazing trial undertaken to evaluate the effects of 7 herbages on the growth of parasitised lambs, their faecal egg counts and lamb dagginess following natural or experimental challenge with gastrointestinal nematodes.

MATERIAL AND METHODS

Pastures

The seven forages used in this trial were, Maku lotus (*Lotus pedunculatus* cv Maku), Chicory (*Chicorium intybus* cv Puna), low oestrogen red clover (*Trifolium pratense* cv G27), high oestrogen red clover (*T. pratense* cv Pawera), lucerne (*Medicago sativa* cv Otaio), sulla (*Hedysarium coronarium*) and ryegrass/white clover (*Lolium perenne* cv Nui/*Trifolium repens* cv Huia). All the pastures had not been grazed by sheep for 6 months except for the ryegrass/white clover sward, which on one occasion was grazed by drenched wethers for two weeks during the winter months. Lotus had been grazed by cattle only in the previous 2 years. Thus it was presumed that all the forages had low numbers of infective sheep gastrointestinal nematode larvae.

Animals

One hundred and forty, four month old mixed sex Polled Dorset lambs were hand reared until weaning and then grazed on dairy farm pasture to minimise parasite exposure before the trial started. Lambs were drenched and then, based on sex and liveweight, randomly allocated into two treatment groups of

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12 and 8 lambs on each of the 7 herbages. After a 1 week acclimatization to the feed, one group (n=12) was "trickle dosed" 3 times per week with approximately 3000 *Ostertagia circumincta* and 3000 *Trichostrongylus colubriformis* infective larvae. Over the 6 week dosing period dosed lambs received a total of 108,000 larvae. The other group of lambs on each herbage species (n=8) picked up any natural infection over the duration of the trial. Lambs were weighed fortnightly and faecal egg counts taken on day 28 and 42. At the end of the trial, all lambs were dag scored on a scale of 1 to 5. Blood samples, for pepsinogen determinations, were taken by jugular venipuncture on day 0 and 42 from all lambs and just prior to slaughter from those lambs from which worm burdens were determined. Five dosed and five undosed lambs from ryegrass and sulla treatments then grazed worm-free pasture for a further 3 weeks, were slaughtered and abomasal and intestinal worm burdens determined.

Six lambs were removed for reasons unrelated to the trial.

Grazing Management

The grazing management was designed to ensure that lambs grazed only forage that had zero or low larval contamination. All lambs had a similar herbage allowance of 4kg DM/head/day and were shifted weekly.

Laboratory Methods

Plasma pepsinogen levels were determined by a modification of the method of Mylrea and Hotson (1969), and activity was expressed as milliunits (mu) of tyrosine, where 1 mu = 1 m.mol tyrosine/litre of plasma/minute at 37°C. Faecal egg counting was undertaken using a modified McMaster technique with 1 egg counted corresponding to 50 eggs per gram fresh faeces. Worm counts were undertaken in 10% aliquots.

Statistical Analysis

All data was analysed using SAS ® General Linear Models (GLM). Faecal egg counts were square root transformed and worm counts were $\log_{10}$ transformed to normalise data for analysis.

RESULTS

After 28 days, FEC's were highest in the dosed groups of lambs grazing the ryegrass/white clover and chicory swards and lowest in the sulla and lucerne treatment groups (P<0.05; Table 1) with the two red clover groups intermediate. Undosed lambs on all pasture types had low egg counts. By day 42 dosed lambs grazing ryegrass/white clover had significantly higher FEC's than all other treatments (P<0.05; Table 1). The FECs of the undosed lambs increased on all treatments except lotus, which remained at 0, such that the dosing effect was not significant for FEC at day 42 (Table 1).

Plasma pepsinogen levels at day 42 were affected by herbage in both the dosed and undosed groups. In the dosed group, levels were significantly (P<0.05) lower on the chicory than G27 red clover, lucerne, pawera red clover and ryegrass/white clover with sulla being intermediate. In the undosed group, lambs grazing lucerne had higher pepsinogen (P<0.05) levels than those grazing chicory, pawera red clover, ryegrass/white clover and sulla with G27 being intermediate. Dosed lambs grazing pawera red clover, ryegrass/white clover and sulla had higher (P<0.05) plasma pepsinogen levels than their undosed counterparts, which does not consistently reflect the faecal egg output in the latter treatment group.

Lamb liveweight gain over the 28 and 42 day period were highest on the lotus and lowest on the ryegrass/white clover, with all other species intermediate (P<0.05; Table 2). With the exception of the lucerne group, dosing with larvae did not significantly affect lamb growth.

Abomasal worm counts, which consisted solely of *Ostertagia circumcincta*, were higher (P<0.001) in the lambs grazing ryegrass/white clover than those grazing sulla (Table 3). Undosed lambs grazing ryegrass/white clover had heavier (P<0.05) abomasa at the end of the trial than their dosed counterparts, which did not differ from both groups grazing sulla (Table 3). Intestinal worm counts were lowest (P<0.05) in the undosed sulla lambs, followed by the undosed ryegrass/white clover lambs. Dosed lambs grazing ryegrass/white clover had the highest intestinal worm counts although these were not significantly higher than in the dosed lambs grazing sulla. There were

TABLE 1: Mean faecal egg counts (FEC) (eggs/g fresh faeces; backtransformed means of square root transformation) and plasma pepsinogen levels (milliunits tyrosine/litre plasma/minute) of dosed and undosed lambs grazing one of seven herbages for 6 weeks. Columns with differing superscripts indicate differences at the 5% level.

	Day 28			Day 42					
	FEC (eggs/gram)			FEC (eggs/gram)			Plasma Pepsinogen		
	Dosed	Undosed	Dosed vs Undosed	Dosed	Undosed	Dosed vs Undosed	Dosed	Undosed	Dosed vs Undosed
Chicory	1739^{b}	102^{a}	P<0.001	1798^{b}	3003^{a}	NS***	415^{a}	391^{a}	NS
G27 Red Clover	1362^{ab}	125^{a}	P<0.001	978^{b}	280^{b}	NS	527^{b}	479^{ab}	NS
Lotus	ND*	ND	ND	1158**	0**	P<0.001	ND	ND	ND
Lucerne	835^{a}	34^{a}	P<0.001	1345^{b}	895^{ab}	NS	526^{b}	496^{b}	NS
Pawera Red Clover	1657^{ab}	193^{a}	P<0.001	1691^{b}	240^{b}	NS	494^{b}	384^{a}	P<0.02
Ryegrass/White Clover	2247^{b}	137^{a}	P<0.001	10650^{a}	1852^{a}	P<0.001	497^{b}	375^{a}	P<0.01
Sulla	847^{a}	66^{a}	P<0.02	757^{b}	1971^{a}	NS	466^{ab}	335^{a}	P<0.01
Herbage Effect	P<0.03	NS		P<0.001	P<0.02	NS	P<0.001	P<0.001	

* Not done

** Not included in herbage effect analysis

*** Not significant

TABLE 2: Average daily gain (ADG) (gram liveweight/day) of dosed and undosed lambs grazing one of seven herbages for 6 weeks. Columns with differing superscripts indicate differences at the 5% level.

	Lamb ADG Day 0 - 28			Lamb ADG Day 0 - 42		
	Dosed	Undosed	Dosed vs Undosed	Dosed	Undosed	Dosed vs Undosed
Chicory	165.2^{ab}	133.9^{b}	NS**	166.7^{b}	168.2^{b}	NS
G27 Red Clover	227.3^{a}	209.8^{ab}	NS	178.6^{b}	193.5^{ab}	NS
Lotus	ND	ND	ND	285.7^{a}	285.7^{a}	NS
Lucerne	187.5^{ab}	285.7^{a}	NS	136.4^{bc}	261.9^{a}	P<0.03
Pawera Red Clover	183.0^{ab}	225.4^{ab}	NS	171.0^{b}	166.7^{b}	NS
Ryegrass/White Clover	55.1^{c}	113.8^{b}	NS	84.3^{c}	131.0^{b}	NS
Sulla	90.8^{bc}	147.3^{ab}	NS	140 9^{bc}	145 8^{b}	NS
Herbage Effect	P<0.001	P<0.001	NS	P<0.001	P<0.001	P=0.08
Pooled SEM	24.4	24.4		14.3	14.3	

* Not done
** Not significant

TABLE 3: Abomasa and intestine weights (g), worm burdens and plasma pepsinogen levels (milliunits tyrosine/litre plasma/minute) at time of slaughter of dosed and undosed lambs grazing ryegrass/white clover or sulla for 6 weeks. Columns with differing superscripts indicate differences at the 5% level.

	Abomasum		Intestine		Plasma Pepsinogen
	Weight(g)	Worm Count*	Weight(g)	Worm Count	(IU/l)
Dosed Lambs					
Ryegrass/White clover	194.1^{a}	549.5^{a}	916.3^{a}	2951.2^{a}	813.1^{a}
Sulla	198.9^{a}	58.9^{b}	854.1^{a}	1621.8^{ab}	662.4^{b}
Undosed Lambs					
Ryegrass/White clover	254.2^{b}	446.7^{a}	951.8^{a}	1071.5^{b}	704.3^{ab}
Sulla	188.5^{a}	57.5^{b}	813.2^{a}	275.4^{c}	474.5^{c}
Pooled SEM	10.4	NA**	47.0	NA**	34.3
Herbage Effect	NA****	P<0.001	NS	P<0.02	P<0.01
Dosing Effect	NA****	NS****	NS	P<0.001	P<0.01

* Worm counts are expressed as back transformed means of $\log_{10}$ transformed data.
** Not applicable due to transformation.
*** Not significant (P>0.05).
**** Not applicable due to a significant herbage X dosing interaction.

significant herbage and dosing effects. The nematodes consisted primarily of *Trichostrongylus colubriformis* although there were small numbers of *Nematodirus spathiger* (≈25/lamb) in both sulla groups. Weights of intestines did not differ between any of the treatment groups.

At the end of the trial there was a tendency for the dosed lambs to have more dags. The chicory treatment group were daggier than other groups, particularly the dosed lambs (Table 4).

A dermatitis, showing features of trefoil dermatitis was noted in some of the lambs and prevalence was associated with treatment. Severity of the clinical signs was graded on a scale of 1 to 5 on ear eczema, one being a clean ear and 5 being totally covered in eczema. Lambs grazing the G27 had the most severe eczema (Table 4).

TABLE 4: Dag and Trefoil dermatitis scores of dosed and undosed lambs grazing one of 7 herbages for 6 weeks.

Herbage and treatment	Dag Score				Trefoil dermatitis score**		
	1	2	3	4	1	2	3
Chicory - dosed	1	4	6	1	1	4	6
- undosed	1	5	2	0	1	3	3
G27 - dosed	7	4	0	0	0	2	4
Pawera - undosed	5	2	0	0	1	3	2

* Score 1 is a clean behind, score 4 is a wet daggy behind.
** Score 1 is a clean ear, score 5 is an ear totally affected by dermatitis.
*** Number of lambs in the treatment group with that score.

DISCUSSION

Although it is widely known that internal parasites can be one of the main impediments of lamb production, this trial has found that despite dosing with a large number of larvae, they had minimal impact on lamb liveweight gain over the 6 week duration of the trial. Only on lucerne was there a significant dosing response to lamb liveweight gain at 42 days. While this experiment was short term and differences may have manifested themselves if it had continued, this was compensated somewhat by the high dosage rates of larvae. The levels of liveweight gain attained on some of the herbages suggest that, if maintained for another 3-4 weeks, most of the lambs would have reached a 32kg liveweight.

On day 28, the FEC's exhibited the expected pattern with dosed lambs having far higher egg counts than the undosed lambs. However, by day 42 egg counts in all dosed treatments except ryegrass/white clover remained at about the same level while egg counts in the undosed groups increased. The high egg counts in the dosed vs undosed lambs grazing the ryegrass/white clover indicate substantial establishment of larvae resulting in high lamb FEC's. Worm

counts suggest that the *Trichostrongylus* establishment followed the expected pattern although overall establishment was low relative to published results (Sykes *et al.* 1988) while *Ostertagia* establishment was extremely low. Reasons for the low rate of establishment are either the viability of L_3 or the high plane of nutrition resulted in a low *Ostertagia* establishment. This strain of *Ostertagia* has been successfully used in previous and subsequent trials, suggesting that it was unlikely that poor viability of *Ostertagia* was the problem.

The low FEC's of lambs on herbages other than ryegrass/white clover and the observations that undosed lambs grazing chicory and sulla had FECs higher than the dosed lambs is difficult to explain. It may be related to the duration and level of challenge resulting in increased rejection of worms or a reduction in worm fecundity because of an improved immune response in the dosed groups whereas such an immune response is not seen in the undosed groups because of the initial low larval challenge. Such a potential complex rate-of-challenge/plane of nutrition/development of resistance interaction requires further study. The surprising high FECs in some of the undosed mobs is most likely caused by lambs ingesting overwintering larvae as the undosed lambs grazing lotus had no egg count and lotus was the only herbage which was not grazed by any lambs in the autumn. Wethers grazing the ryegrass during the winter should not have contributed any contamination as they were drenched prior to grazing and the egg hatch of any parasites that may have survived is poor in the winter (Leathwick *et al.* 1992).

Very little is known about the causes of dagginess in lambs but it can lead to increased flystrike (Leathwick unpublished) another major loss of production in lambs. Although it is generally associated with parasites, the genotypic and phenotypic relationships between FEC and dag score is low (McEwan *et al.* 1992). The increase in dagginess in lambs grazing chicory has been observed elsewhere (J Deaker pers comm). Thus far no studies have been undertaken to determine the cause, but it may be related to the high level of soluble carbohydrates or low DM levels found in chicory. Understanding the causes could be of high priority if chicory becomes a widespread lamb finishing or ewe flushing crop.

The condition commonly referred to as "trefoil dermatitis" was most severe in lambs grazing G27 red clover. Similar symptoms have been observed in lambs grazing *Lotus corniculatus* (K. Stafford unpublished). Very little is known about this condition (Bruère *et al.* 1990), yet the symptoms seen in lambs in this trial would cause serious concern.

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