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Effectiveness of drenching Saanen milking does

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ABSTRACT

Three mobs of mixed age Saanen milking does (n=15) were grazed separately on 3 suites of paddocks during the spring-summer lactation season between 1984 and 1985. Animals within mobs were drenched at 21 d intervals according to manufacturer's recommended dose rates with 1 of either ivermectin, oxfendazole or morantel. Ivermectin was given to all stock while not lactating.

Seasonal patterns in faecal nematode egg count (FEC) were similar across all 3 groups. FEC regain measured 7 d after drenching suggested that effectiveness of the drench depended on the type used. Faecal cultures indicated that *Ostertagia* spp. and *Trichostrongylus* spp. were the dominant nematode genera.

Pasture larval estimations were made during the 1984-85 season. *Ostertagia* spp. larvae were more prevalent during spring and autumn. *Trichostrongylus* spp. were dominant during the summer months.

Does with kids at foot were turned out for 76 d as *tracers* on the various suites at the end of the first trial. At slaughter, the dominant genus found was *Ostertagia* while appreciably fewer *Trichostrongylus* spp. were recovered. Significant differences in total worm burdens were detected between treatment groups.

Drenching programmes appeared to have little effect on parasite control on pasture grazed solely by Saanen does. This is attributable to contamination established on pasture as well as the relative ineffectiveness of these types of drenches in this breed of goat when used at rates recommended for sheep.

Keywords Saanen does, nematode parasites, anthelmintic treatments, ivermectin, oxfendazole, morantel citrate, egg counts, worm counts, infective larvae, seasonal patterns, effectiveness.

INTRODUCTION

Drenching strategies were originally developed for sheep to remove worm burdens from young, growing, susceptible stock during the times when challenges were at maxima (Brunsdon *et al.*, 1975; Vlassoff and Brunsdon, 1981). In consort with mature ewes which showed increased resistance to re-infection, lambs under a *preventive* drenching programme rotating across a farm could be expected to reduce the larval challenge gradually in preparation for subsequent lambing.

Farmers naturally applied these strategies to goat management using additional drenches when animals looked in poor condition. There were very little data and information on which to base this transfer of management practices from sheep to goats. Furthermore, anthelmintic manufacturers equated sheep and goats for the purposes of defining dose rates and predicted efficacies largely from work undertaken with sheep. Kettle *et al.* (1983) found, after surveying goat farmers, that dose rates and frequency of drenching were highly variable, apparently often without obvious success. The frequency of documentation of suspected *drench failures* rose rapidly with numbers of goat farms.

Only recently trials conducted in New Zealand compared efficacies of various modern broad spectrum anthelmintics in feral-type and Saanen kids (Elliot, 1987; McKenna and Watson, 1987). In both cases animals were experimentally infected with *cocktail* mixtures and dosed at rates recommended for sheep by the various manufacturers. In general, these authors concluded that effectiveness is dependent on both host and parasite species as well as the drench being given in the absence of drench resistant populations. These results provide some clues as to the apparent increasing occurrence of *drench failures* on goat farm properties (Kettle *et al.*, 1983; Watson, 1986a; Pearson *et al.* 1987). This experimental work must be regarded with a degree of caution since the animals were not grazing or fed grass during the trials. The present trial was designed to document seasonal patterns of faecal egg count in lactating Saanen does drenched with anthelmintics representative of the 3 modern broad spectrum families at rates recommended by the manufacturers for sheep (Barragry, 1984a, b).

MATERIALS AND METHODS

The present trial was run in its entirety on the Ruakura Dairy Goat Unit. The land used had been grazed with goats for the previous 3 to 4 years during which time stock has been given primarily oxfendazole and levamisole at irregular intervals.

Milking Doe Management

Mixed-age Saanen does (N=45) were randomised on the basis of age and previous milk yields into 3 treatment groups. All animals remained in these groups throughout the trial. Where necessary due to culling or mortality comparable does were introduced to maintain stocking rate. Mating occurred during March 1985.

Each treatment group grazed its own suite of 4 paddocks randomly assigned at the beginning of the trial.

During the trial milking stock were drenched at 21 d intervals. All animals from each group were drenched with ivermectin (IVM), oxfendazole (OXF), or morantel citrate (MOR) during lactation between August 1984 and February 1985. During mating all does received 2 treatments of OXF 21 d apart between 18 February and 3 April and grazed as 1 mob across the entire block. After the second OXF treatment all does were given IVM every 21 d and continued to graze together.

All does were faecal sampled at 21 d intervals immediately prior to drenching to estimate faecal nematode egg counts (FEC). Seven days after drenching 5 animals selected at random from each group were sampled to determine drench efficacy by reducing FEC. This defined the faecal egg count depressions (FECD).

Nematode Infective Larvae Estimations

Total infective larval challenge as well as species compositions were estimated once or twice monthly for each pasture suite (Table 1).

Residual Contamination Determination

After 12 months *tracer* goats were turned out to graze within each of the treatment suites. Dry does and does with kids at foot were assigned randomly to each suite on the basis of live weight and physiological status (wet=lactating and dry=non-lactating). The assignment was as follows: IVM- 5 wet, 12 dry, 3 kids; OXF- 5 wet, 11 dry, 4 kids; MOR-5 wet, 12 dry, 4 kids. Kidding occurred between 18 August and 24 August. At turn-out on 28 August each doe received 25 ml (twice the recommended dose for sheep) of ivermectin. Stock were grazed within each suite for 76 d without further drenching at which time 6 to 8 does and all of the kids from each treatment suite were killed and processed so total and differential worm burdens could be estimated by routine methods. FECs were determined from random animals on 2 occasions (14 October and 1 November) prior to slaughter.

RESULTS

Faecal Egg Counts

No statistically significant drench effects were recorded but a very strong season and an equally strong season by drench interaction occurred (Fig. 1; $P<0.001$).

At the first sampling FECs had attained the highest levels observed during the spring months. Subsequently, they were depressed to extremely low levels throughout the November to January period (Fig. 1). After OXF had been given to all animals between February and April FECs for the IVM and MOR groups peaked 21 d after the highest FEC for the OXF group was recorded (1260 epg).

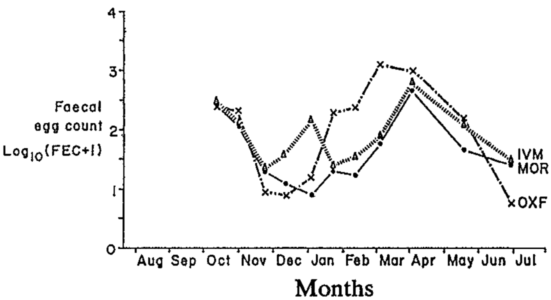

Fig. 1 Geometric mean faecal egg counts for lactating Saanen does drenched at 21 d intervals with ivermectin (IVM), oxfendazole (OXF), or morantel (MOR).

TABLE 1 Geometric mean faecal egg count depressions 7 d post-drenching.

Treatment group	Sample date Oct 15	Nov 5	Nov 29	Dec 14	Jan 9	Jan 29	Feb 18
Ivermectin	0	0	3	3	3	11	0
Oxfendazole	51	357	269	6	42	144	789
Morantel	120	348	3	3	8	8	144
SED	5	1	4	5	6	5	1
Significance	*	***	**	NS	NS	NS	***

Thereafter, extremely similar low FECs were detected (geometric means <100 epg) from all 3 groups.

FECs determined 7 d after drenching showed that treatment with IVM was extremely effective at removing worm eggs from goat faeces (Table 1). This was not so for both OXF and MOR treatments which left highly variable numbers of eggs being shed (Table 1).

Pasture Larvae Estimations

Challenge from pasture exhibited a bimodal peak during the 12 month monitor period (Table 2). Consistent across all 3 suites was a rapid rise of total density of larvae during the spring which produced peaks between mid-November and mid-December. Summer was characterised by reduced numbers of infective larvae. This gave way to heavy challenges in early autumn (February and March) that were comparable to those seen earlier. Few infective larvae were recovered during the winter and early spring months (July to September). On most occasions differential determinations revealed the presence of *Ostertagia* spp. and *Trichostrongylus* spp. If OXF and MOR were used species compositions exhibited seasonal shifts with *Ostertagia* spp. dominant in spring and summer (September to February) and *Trichostrongylus* spp. at higher densities during late autumn and winter (April to September) (Table 2). When IVM was used *Trichostrongylus* spp. dominated the challenge only for the January, February and May sampling times.

Residual Contamination

Tracer does faecal sampled 47 and 64 d after turn-out onto the 3 suites shed comparably low numbers of eggs (Table 3). Analyses showed no significant difference in geometric mean FECs between lactating and non-lactating does at these 2 sampling

TABLE 3 Geometric mean faecal egg counts for *tracer* does grazing treatment pasture suites.

Treatment suite	Days after exposure 47	64
Ivermectin	832	28
Oxfendazole	417	102
Morantel	110	145
SED	10	14
Significance	*	NS

TABLE 2 Infective nematode larvae densities (L3 larvae/kg grass DM) estimated on pastures grazed by Saanen does drenched at 21 d intervals with 1 of 3 anthelmintics.

	Anthelmintic					
Sample date	Ivermectin		Oxfendazole		Morantel	
	Total	Differential determination[1]	Total	Differential determination[1]	Total	Differential determination[1]
18 September	241	67	750	50	924	92
9 October	2471	97	531	100	5177	86
29 October	1297	94	3226	86	3374	91
20 November	561	75	10598	93	9624	86
11 December	8115	92	5900	84	10980	74
15 January	1690	49	1674	100	631	100
5 February	526	50	1000	63	0	-
26 February	10378	89	7182	41	1021	62
19 March	1238	100	6353	17	10801	68
9 April	2177	100	2550	33	0	—
24 May	1226	0	1102	0	5307	25
2 July	0	-	0	-	0	-
3 August	925	100	0	-	2040	50
3 September	0	-	0	-	1355	0
24 September	2317	100	0	-	0	-
8 October	0	-	0	-	0	-

[1] Proportion larvae identified as *Ostertagia* spp. (%).

times (224 *v* 417 epg and 47 *v* 83 epg, respectively). When samples could be collected from the kids FECs were generally low (0-800 epg) and well within the ranges recorded for the does. Worm counts made for the does revealed the presence of only *Ostertagia* spp. and *Trichostrongylus* spp. in the abomasa and the latter genus in the small intestines (Table 4). Does that had grazed the IVM suite were infected with more *Ostertagia* spp. and had heavier total worm burdens than animals that grazed the other 2 suites. This trend held for the kids as well (Table 4). Generally, very low numbers of the other nematode genera were isolated at necropsy.

DISCUSSION

Faecal Egg Counts

Consistent with observations made by Brunsdon (1986) of feral goats grazing at Wallaceville Research Centre, FECs of Saanen milking does run on the Ruakura Agricultural Centre between 1984 and 1985 exhibited seasonal fluctuations. Brunsdon (1986) reported that FECs of 2-year-old feral does left undrenched after December 1981 rose to maximum levels (>10,000 epg) in May and June 1982 and fluctuated between 7000 and 3000 epg thereafter until December 1982 when the final sample was taken.

Saanen does shed relatively low numbers of eggs throughout the present trial. However, even though management involved 21 d drenching programmes extended over 11 months, maximum FEC recorded during the present trial were approximately 5000 epg. This occurred during February and March. Annual maxima were generally seen then. The shift that produced earlier peaks probably reflected differences in management of the stock as well as annual climatic differences and variations in environmental conditions between the 2 locations.

As expected, FECs were similar or reduced 21 d after drenching irrespective of the drench administered. However, this pattern only appeared during spring and autumn-winter. When IVM was given FEC remained depressed throughout the summer period. If OXF or MOR was used in summer this was not the case. At this time larval densities declined and the population composition shifted from predominantly *Ostertagia* to *Trichostrongylus*. This is best exemplified by data collected from the group treated with OXF. Animals in this group continued to shed large numbers of parasite eggs in the absence of any detectable heavy challenge from pasture.

There are a number of inherent factors that could explain some of these observations such as ruminal by-pass of benzimidazoles (BZ) and regurgitation of any of the drenches. In all likelihood, the explanation is much more complex. Some potentially interrelated components can be postulated:

1. The present results may reflect differences in effectiveness of the various drenches against the 2 nematode genera which may inhabit different regions of the gastrointestinal (GI) tract. There is some experimental evidence with goats drenched after artificial infection that agrees with this observation (Elliot, 1987; McKenna and Watson, 1987). One likely explanation is that various anthelmintics are absorbed and metabolised at much faster rates by goats than sheep (Galtier *et al.*, 1981; Kettle and White, 1982; Gillham and Obendorf, 1985). Until more LC 50 and decay rate data are available this explanation may be somewhat speculative.

   Efficiacies of some chemicals used to control nematode infections are dependent on duration of exposure while others depend on

TABLE 4 Geometric means of nematode parasite burdens recovered from *tracer* goats after grazing for 76 d.

Animal	Treatment	Estimated worm burdens: Abomasal *Ostertagia*	Abomasal *Trichostrongylus*	Small intestinal *Trichostrongylus*	Total
Does	Ivermectin	5754	813	257	8912
	Oxfendazole	3388	1000	3	5012
	Morantel	1202	417	21	3802
Kids	Ivermectin	2291	14	48	3162
	Oxfendazole	22	120	0	170
	Morantel	513	91	0	812
	SED	9	18	14	5
	Significance	**	NS	**	**

concentration of chemical (Barragry, 1984a, b). Thus, if lethal concentrations do not reach the parasite via the blood, GI or other fluids, residual populations will naturally remain intact. This would be reflected by FECs observed well within the prepatent period and is often (but may be not always in the case of goats) indicative of drench failure and anthelmintic resistance as documented with sheep. Results from pasture and experimental slaughter trials in which animals have been fed concentrate feed, artifically infected, and treated at rates recommended for sheep have shown that BZ and IVM should have eliminated established worm populations (Swan and Gross, 1985; Elliot, 1987; McKenna and Watson, 1987). This may not have been the case with morantel which has been used with lesser success by the researchers cited previously.

2. Under the drenching programme adopted there was a tendency for FEC to plateau or decline during spring and autumn when pasture quality and availability were at their best. Increases in FEC were generally associated with feed when in demand and of poor quality. Concurrently, a general shift from an *Ostertagia* to a *Trichostrongylus* dominant challenge took place. Various nematode species exhibit widely different fecundities. Thus, any seasonal shift between parasite species would be reflected in some of the changes observed in the egg outputs. Even so, sheep exhibit differences in susceptibility to infection and nematode fecundity changes when diet is altered. In the absence of scientific evidence we must speculate that similar parasite-host interactions will occur when goats become infected. Although not demonstrated in goats, in experimental pen trials *T. colubriformis* has been shown to depress grass intake by sheep (Sykes and Coop, 1976; 1977; Sykes and Poppi, 1982). We postulate that a similar response could occur in heavily parasitised goats.

3. Numerous authors have suggested that goats do not build an effective resistance to re-infection by nematode parasites (Le Jambre and Royal, 1976; Bisset *et al.*, 1986; Brunsdon, 1986). If this view is valid exposure of goats to high numbers of infective larvae resistant or susceptible to any anthelmintic would be expected to dramatically reduce animal condition at the same time as FEC exploded upwards. Such has been the case with goats left undrenched (Brunsdon, 1986) as well as when resistance has been diagnosed (McGregor, *et al.*, 1980; Barton *et al.*, 1985). This was never observed during the present trial. FECs rose gradually and no mortality was associated with heavy nematode parasitism.

The variability observed in FECDs monitored at random was due to high FEC in 1 or more animals at any sampling when OXF or MOR was used. Only few goats drenched with IVM returned positive FECs and were always only 100 to 200 epg. Since anthelmintic was administered accurately via syringe directly after the animals were weighed all goats received drenches at the dose rates prescribed for sheep.

Prepatent periods (the time between infection and passing of parasite eggs in animals faeces) for most nematodes are generally between 18 and 21 d. When FECs recorded 21 d after drenching are similar to those determined prior to drenching, the assumption must be that uptake and establishment of large numbers of larvae has occurred almost immediately after treatment. Previously, when large increases in FEC were recorded over such time intervals the interpretations have been that the does have consumed very large numbers of infective larvae, drench delivery was faulty or that established populations were predominantly resistant to the drench given. In sheep FECDs determined 7 d after treatment have been used as a preliminary test for worm resistance. Such a test requires that a comparison be made between the drug in question and 1 from an entirely different family. FECs should be supported with worm recovery data. This technique has also been applied to diagnositc parasitology for goats (Kettle *et al.*, 1983; Pearson *et al.*, 1987). The most accurate BZ resistance assay is the egg hatch test in which eggs recovered from faeces are incubated and cultured in the presence of various concentrations of the BZ. Since BZs are ovicidal hatching is indicative of drench ineffectiveness.

At this time we must conclude that the nematode populations were not resistant. The absence of any major upward trend in FEC suggests that either establishment was being restricted, recruitment rate was similar to death rate or fecundity of the established population was altered by recruitment in which case population size increases would pass undetected. This latter possible outcome could potentially mask the presence of any resistant worm population. Further work is proceeding in this direction because of the implications such a result would have on animal health management.

Infective Larvae

Development and survival of infective nematode larvae on pasture are directly related to numbers of eggs dropped in the faeces of infected stock while grazing, pasture management and climatic conditions. In the Waikato region rainfall, in all probability, is the most limiting factor. Too little and the eggs and larvae desiccate; too much and they are drowned or washed away. If rainfall is adequate then temperture becomes the critical factor so when both are ideal (spring and autumn) maximum densities of larvae are expected to be available for consumption. This typical biphasic pattern has been well documented throughout temperate areas of the world, including New Zealand. The work being reported here does not follow well defined seasonal patterns as reported by other researchers in New Zealand (Vlassoff, 1982; Brunsdon, 1986) but the trends are present. It is important to note that the numbers of larvae recovered during the present trial are considerably higher than those cited by these authors (who give data as larvae/kg wet herbage).

It is particularly interesting that low numbers of infective larvae were recovered from the OXF group pasture suite over autumn and winter in 1985. OXF and other BZs (white drenches) not only kill adult and immature nematodes but also have ovicidal activity. IVM and MOR do not have such action. Thus, within the prepatent period sheep act as *vacuum cleaners* removing available larvae. This is the basis to the *preventive* drenching programme. Its major objective is to depress or eliminate the larval challenge that normally appears during the autumn months when lambs can be left untreated (Vlassoff, 1982; Vlassoff and Brunsdon, 1981). FECD data indicate that eggs continued to be shed after drenching so this ineffectiveness was, in all probability, associated with environmental conditions inappropriate for development and survival and probably helped depress challenge from pasture as the trial progressed.

Tracer Stock

The *tracer* does and kids grazed in the spring 1985 readily became infected as seen by the presence of nematode parasite eggs in their faeces. Infections occurred in animals on all 3 pasture suites even though numbers of infective larvae were so low that often nil recoveries were recorded on pasture larval estimates (Table 2). This shows very clearly the inadequacy of pasture larval counts and highlights the fact that *tracer* stock must be used in such trials where selective grazing by animals may increase the likelihood of exposure to infective larvae on grass.

These data suggest that animals which grazed land previously grazed by goats drenched with ivermectin consumed more infective larvae and/or more larvae established in the goats. Estimations of numbers of larvae on the grass suggests that more larvae were present. There was no evidence that IVM was less effective at removal of worms. Quite the contrary; those does given IVM consistently exhibited lower FEC regain after 21 d. Furthermore, throughout the trial they had the highest milk yields (Watson, 1986b). One possible explanation is that subtle differences in the microclimate on 1 or more of the paddocks grazed by the IVM-treated group of does was better suited for development and survival of the free-living larvae.

CONCLUSION

The present work highlights that the whole question of host-parasite interplay must be re-examined before field data can be interpreted accurately and we can have confidence in many management recommendations presently being made for goats.

Drenching has a very strong effect on productivity of Saanen milking does. However the effects on parasite epidemiology and host susceptibility may not be similar to those documented for sheep so must be viewed with caution. This study suggests that reliance solely on anthelmintics may not depress nematode infective larval challenge on improved pasture appreciably after prolonged drenching at 21 d intervals. The *small block* goat farmers or those in a single species grazing operations will, in all likelihood, encounter difficulties relating to parasitism and parasitic disease that will be reflected in lost productivity. Furthermore, once a problem appears it is likely to be present while goats are grazed on the property. Finally, these comments may apply not only to Saanen goats but also other breeds.

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