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Production impact of a targeted selective treatment system based on liveweight gain in a commercial flock

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ABSTRACT

The sustainability of sheep production is hindered by anthelmintic resistance. Options to slow down or prevent resistance have been widely studied but their application in the field is still limited. In this study, the practical application and effect of a targeted selective treatment (TST) approach for the treatment of parasitic gastroenteritis was investigated in lambs ($n = 385$) over a 2 year period. At 14-day intervals during the grazing season, liveweight, breech soiling and anthelmintic treatments were individually recorded. Selection of lambs for anthelmintic treatment in the TST group was based on pre-calculated individual growth rates, with a matched cohort routinely treated (RT) with anthelmintic drug every 6 weeks. The adoption of a TST approach had no negative effect on the liveweight gains of the lambs, time to finishing or breech soiling measures compared to RT lambs; however a 50% decrease in anthelmintic treatment was observed in the TST group. The time to implement this system averaged 2 min per lamb. It is concluded that the TST could be suitable for commercial sheep farms, in association with automated weighing systems, potentially reducing selection for anthelmintic resistance, while having no negative effect on production.

Introduction

Anthelmintic resistance is a serious concern, causing treatment failure and subsequent reduction in productivity and threatening the sustainability of sheep production (Sargison, 2011). Repeated whole flock/herd treatments are now strongly discouraged, as evidence suggests a relationship between frequency of treatment and development of resistance (Martin, 1987). In the case of nematode control, it is now accepted that routinely leaving a proportion of animals untreated will slow the development of anthelmintic resistance by maintaining a susceptible parasite population in refugia (Martin et al., 1981; Besier, 2008).

The use of targeted selective treatments (TST) has been advocated as a refugia-based control strategy, whereby anthelmintic treatments are directed only to those animals that will benefit from being treated (Kenyon and Jackson, 2012). *Reliable and efficient markers to identify those animals requiring treatment have been studied and applied in different situations* (Hoste et al., 2002; Van Wyk and Bath, 2002; Cabaret et al., 2006; Leathwick et al., 2006; Cringoli et al., 2009; Gallidis et al., 2009; Greer et al., 2009; Stafford et al., 2009; Gaba et al., 2010).

Despite efforts to promote alternative measures to more efficiently use anthelmintic drugs, control of parasitic gastroenteritis on most UK farms still depends on routine whole-flock anthelmintic treatments (Burgess et al., 2012). Various reasons have been suggested as major constraints to a wider implementation of sustainable nematode control programmes across farming systems, with availability of cheap drugs, preference for simple solutions and lack of specialist veterinary advice being among the most common (Bath, 2006).

Of the TST markers, the use of liveweight gain is non-invasive, pen-side and relevant to farm economics. A recent study on the use of liveweight gain as a marker for TST treatment (Kenyon et al., 2013) showed very encouraging results in slowing the development of anthelmintic resistance, while effective control of gastrointestinal parasitism was achieved. Since the implementation of a TST approach on commercial farms depends upon ease of application and avoidance of negative effects on production, further studies are needed on the practical application and impact on productivity of leaving a proportion of animals untreated. The TST method described by Kenyon et al. (2013) was therefore tested in a commercial flock, where only anthelmintic administration was

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Table 1
Number of lambs included in the 2 year study at each data point.

Weeks	Number of lambs			
	RT year 1	TST year 1	RT year 2	TST year 2
0	95	88	100	102
4	92	88	99	101
6	85	83	100	102
8	83	79	86	85
10	62	65	85	86
12	43	48	69	68
14	29	32	57	52
16	12	12	48	43
18	11	9	27	33

RT, routine treatment (whole flock anthelmintic treatment every 6 weeks); TST, targeted selective treatment (anthelmintic treatment based on the 'Happy Factor'; Greer et al., 2009).

altered, while management of the farm was left unchanged. The marker for TST was based on the 'Happy Factor' (Greer et al., 2009), where prediction of liveweight gain is estimated for each lamb based on nutrient availability.

The aims of the present study were twofold: (1) to assess the effect of a TST regime based on liveweight gain on the frequency of anthelmintic treatments, as well as health and production measures, and (2) to evaluate the practical application of this system in a commercial farm, based on the time and labour involved in implementing the strategy.

Materials and methods

Study design

The study was conducted on an upland commercial sheep flock in the South-West of Scotland during May to October in 2011 and 2012. Each year all Texel cross lambs born on the farm ($n = 191$ in 2011 and 206 in 2012) were initially included in the study. Twelve lambs were excluded due to production limiting diseases (e.g. lameness and respiratory diseases) or missing data points (8 in 2011 and 4 in 2012).

All lambs were fitted with an electronically readable ear tag (Allflex) at approximately 6 weeks old (Day 0) and at the same time treated with fenbendazole (Panacur, MSD) at the manufacturer's recommended dose rate of 5 mg/kg bodyweight to remove spring *Nematodirus* spp. infection. This dose has not been counted in the number of treatment calculation as it was targeted to a different parasite species for which this TST was not applicable.

The lambs were randomly assigned to two treatment groups, a routine treatment group (RT) and a targeted selective treatment group (TST), and the groups were balanced for liveweight, sex and siblings (numbers of single, twin and triplet lambs). All lambs from the RT group were treated at 6 week intervals from Day 40, as determined by normal management on the farm. Treatments in the TST group were based on target growth rates calculated for each individual using the Happy Factor decision support model (Busin et al., 2013), with animals failing to reach predetermined growth-rate targets receiving an anthelmintic treatment.

The anthelmintic drench used throughout the study was ivermectin (Oramec, Merial Animal Health), administered at the recommended dose rate of 0.2 mg/kg. Efficacy of the compound had been evaluated before starting the trial with a faecal egg count reduction test (FECRT) (Coles et al., 1992) and no evidence of anthelmintic resistance had been detected (efficacy of 99.8%).

Production measurements

Lambs were grazed together on the same pasture. During the trial, lambs were sold to market at the sole discretion of the farmer, which was not influenced by the treatment protocol (the farmer did not know which lambs were in the RT or TST group). All lambs present on the farm at each data point were included in the calculation. Once the animals left the farm no more data points were gathered (Table 1).

At 2 week intervals, throughout the grazing season, individual liveweight, breech soiling and anthelmintic treatments were recorded, for a total of eight visits per year. At the same time, faecal samples were collected per rectum from a randomly pre-selected number of animals (over the 2 year study this ranged between 20% and 50% of animals in the trial) to determine the ratio of nematode eggs/g of faeces (epg) using the method described by Christie and Jackson (1982). Parasite speciation was carried out on pooled faeces from year 1 faecal samples, by random examination of 100 exsheathed larvae after coproculture for 14 days at 20 °C.

Mean daily liveweight gains for each animal were calculated as difference between their first and last recorded weight divided by days in the trial. A target predicted weight, based on the Happy Factor, was calculated for all animals in the trial. To determine the effect on production of leaving animals untreated, short-term (4 week) weight gains were compared between RT lambs that had reached their target predicted weight at treatment weeks 6 and 12 (treated RT; $n = 89$) and TST lambs that on the same weeks had reached their target predicted weight and were therefore not treated (untreated TST; $n = 70$). Time to reach slaughter weight was calculated as weeks from the beginning of the trial (Day 0) to reach 42 kg (the minimum target weight set by the farmer to send animals to slaughter).

The level of breech soiling was assessed based on a 1 to 5 scale, in which 1 indicated no visible faecal soiling, while 5 indicated very severe, watery diarrhoea extending to the hocks (Australian Wool Innovation, 2007). Data for breech soiling were analysed in different categories: presence of breech soiling (animal presented at least once during the study with a score of 3 or higher), maximum breech soiling (maximum score reached during the trial), and breech soiling duration (number of weeks with a score of 3 or higher).

Statistical analysis

Data were analysed using Minitab v16 and Stata. Comparisons were made using the Mann-Whitney *U* test. A chi square test was carried out for presence of breech soiling. A generalized linear model was run with liveweight gain as the outcome and treatment group (RT/TST), year, number of siblings and sex as fixed effects.

System measurements

Permanent outdoor handling facilities were in place and a manual crate scale was used to weigh the lambs. A spreadsheet with each lamb's ear tag identification, predicted target weight and previous treatment was prepared before each visit. The time to implement the system in the farm was recorded, with two separate calculations made. The first involved gathering animals and was measured by taking note of the time from arrival at the farm to the first lamb ready to be weighed. The second calculation was the time to assess and treat the animals, which was measured as the time from the first lamb being weighed to the last lamb leaving the handling facilities. The total time was then divided by the number of lambs included in the study at each sampling time. For both calculations the average time from all visits was considered.

Results

Production measurements

A total of 195 lambs in the RT (96 males, 99 females) and 190 in the TST group (93 males, 97 females) were studied. Mean daily liveweight gains were 303 ± 6.5 g/day for the RT and 298 ± 6.6 g/day for the TST in 2011 and 252 ± 6.6 g/day for the RT and 259 ± 6.6 g/day for the TST in 2012. The overall mean liveweight gain is shown in Fig. 1.

There was no significant difference ($P = 0.71$) in mean daily liveweight gain between the two groups across the whole study. Untreated TST (not treated on week 6 or 12 and in the following 4

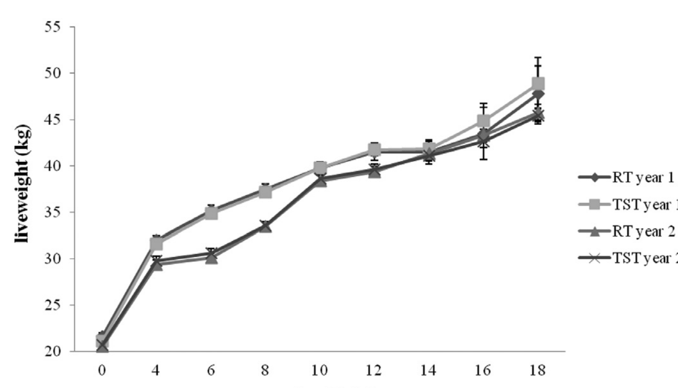

Fig. 1. Overall mean (±SEM) liveweight (kg) for RT (lambs that received anthelmintic treatment every 6 weeks throughout the trial) and TST (lambs that received anthelmintic treatment based on the Happy Factor marker), from the start to the end of the trial, divided by years 1 and 2 of the trial.