Targeted anthelmintic treatment of parasitic gastroenteritis in first grazing season dairy calves using daily live weight gain as an indicator


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ABSTRACT

Control of parasitic gastroenteritis in cattle is typically based on group treatments with anthelmintics, complemented by grazing management, where feasible. However, the almost inevitable evolution of resistance in parasitic nematodes to anthelmintics over time necessitates a reappraisal of their use in order to reduce selection pressure. One such approach is targeted selective treatment (TST), in which only individual animals that will most benefit are treated, rather than whole groups of at-risk cattle. This study was designed to assess the feasibility of implementing TST on three commercial farms, two of which were organic. A total of 104 first-grazing season (FGS), weaned dairy calves were enrolled in the study; each was weighed at monthly intervals from the start of the grazing season using scales or weigh-bands. At the same time dung and blood samples were collected in order to measure faecal egg counts (FEC) and plasma pepsinogen, respectively. A pre-determined threshold weight gain of 0.75 kg/day was used to determine those animals that would be treated; the anthelmintic used was eprinomectin. No individual animal received more than one treatment during the grazing season and all treatments were given in July or August; five animals were not treated at all because their growth rates consistently exceeded the threshold. Mean daily live weight gain over the entire grazing season ranged between 0.69 and 0.82 kg/day on the three farms. Neither FEC nor pepsinogen values were significantly associated with live weight gain. Implementation of TST at farm level requires regular (monthly) handling of the animals and the use of weigh scales or tape, but can be integrated into farm management practices. This study has shown that acceptable growth rates can be achieved in FGS cattle with modest levels of treatment and correspondingly less exposure of their nematode populations to anthelmintics, which should mitigate selection pressure for resistance by increasing the size of the refugia in both hosts and pasture.

1. Introduction

Anthelmintic resistance (AR) has become a major driver for parasitology research and in tailoring advice on parasite control. In northern temperate Europe there are currently only three classes of anthelmintic that are licensed for the control of parasitic gastroenteritis (PGE) in cattle: benzimidazoles, tetrahydropyrimidines (levamisole) and macrocyclic lactones (MLs), none of which are available in combination with each other. The most commonly reported cases of resistance in bovine nematode parasites in Europe have been in Cooperia species, in which the efficacy of MLs has been shown to be sub-optimal (Geurden et al., 2015). Given that Cooperia spp. are dose-limiting for several MLs (Vercruysse and Rew, 2002), accurate weighing of animals and administration of the correct dose is essential for efficacy and reports of resistance in which these basic criteria have not been fulfilled should be treated circumspectly. In addition there is some evidence for ML-resistant Ostertagia ostertagi in Europe, which has also been observed in other regions of the world (Sutherland and Leathwick, 2011; Waghorn et al., 2016). For these reasons it is paramount that practices that reduce selection pressure for resistance and conserve the longevity of the current array of cattle anthelmintics are adopted.

In New Zealand, the emergence of ML-resistant Cooperia was associated with high frequency (every 3–4 weeks) administration over periods of six months or longer each year in young cattle grazed...
intensively (Jackson et al., 2006). There is little evidence for similar use patterns in Europe, where specific risk factors for AR in cattle have not been determined. Early season strategic anthelmintic treatments have been well established in Europe and shown to provide effective control of parasitic gastroenteritis (PGE) particularly in set-stocked, weaned first grazing season (FGS) cattle (Shaw et al., 1998), but also in the second year at grass (Taylor et al., 1995). The primary objective of strategic approaches is to limit concentrations of infective larvae in the herbage throughout the grazing season by minimising worm egg output and re-infection, so strategic treatments create low challenge pastures with correspondingly low refugia; this has the potential to increase the speed of selection for anthelmintic resistance (Martin et al., 1981).

Irrespective of the possible risk factors for AR in cattle nematodes, practices that reduce anthelmintic usage are likely to limit selection pressure on parasite populations. One such approach is targeted selective treatment (TST) in which, rather than the more typical, synchronous group anthelmintic treatments, individual animals are treated on the basis of a marker or markers that indicate that they will benefit from removal of their parasite burdens. Targeted selective anthelmintic treatments (TST) were initially studied in small ruminants (Kenyon et al., 2009), in which proof of concept was demonstrated insofar as disease control and animal performance could be maintained with TST at a level comparable to that seen in animals that were treated more intensively. Equally important was the demonstration that TST applied over successive years led to lower selection for resistance compared to that in lambs treated at 4-week intervals over the grazing season (Kenyon et al., 2013).

There is limited published literature regarding the use of performance-based TST approaches in cattle in the field (Charlier et al., 2014; Kenyon and Jackson, 2012). Analysis of published trial data using reporter operating curve (ROC) analysis suggested that an appropriate threshold for daily live weight gain (DLWG) in a TST regime in young cattle would be 0.75 kg/day (Hoglund et al., 2009). This figure coincides with growth rates that are required for replacement dairy heifers to reach minimal breeding weight at 15 months in order to calve at two years of age (Froidmont et al., 2013; Zanton and Heinrichs, 2005).

Weight-gain based TST approaches have provided similar results to those reported in sheep, that is to say acceptable weight gains have been maintained and the number of anthelmintic treatments has been reduced compared to routine, whole group treatments (Greer et al., 2010; Hoglund et al., 2013; McAnulty et al., 2011). It should be noted that to date, TST has only been shown to be effective in the management of PGE, furthermore, if, for example, lungworm (*Dictyocaulus viviparus*) is present and has not been controlled through vaccination, then parasitic bronchitis can thwart efforts to control PGE through TST (O’Shaughnessy et al., 2015).

A series of studies were conducted to extend the scientific evidence base for TST in cattle and to determine its on-farm feasibility (Jackson, 2012). Included in this work was an assessment of various biomarkers as potential indicators for TST, an evaluation of the accuracy and utility of weigh bands for farms that do not have access to weigh scales and implementation of a weight gain-based TST. The objective of the study described in this paper was to determine the feasibility of a weight-gain based TST in first season dairy-bred calves on three livestock farms, two of which were organic.

2. Materials and methods

This TST study was approved by the Ethics and Welfare Committee of the School of Veterinary Medicine, University of Glasgow.

2.1. Participating farms

Three dairy farms located in central and south-west Scotland were recruited into the study: two organic and one conventional (Farm O1, Farm O2 and Farm C3). The three farms were a sub-set of the six farms that were involved in a monitoring study of gastrointestinal parasitism the previous year (Jackson, 2012).

2.1.1. Organic farm 1 (O1)

Organic dairy farm 1 comprised a mixed breed milking herd, predominantly of Friesians and Ayrshires, with some Brown Swiss and Jersey crosses, calving all-year-round and grazing over 93 ha (ha) of semi-improved grassland from April to October. All FGS cattle in the study were vaccinated against lungworm prior to turnout in late April, when the calves grazed a small paddock near the farm and were given supplementary feed. Two weeks later the calves were moved onto another pasture and subsequently were rotated every two weeks around seven different paddocks in an extensive grazing system. The previous year these fields were grazed by FGS, second season grazers (SGS) or adult dairy cattle.

In the year prior to the TST study, faecal egg counts (FEC) were taken in June and September and only calves with a FEC of ≥ 200 eggs per gram (epg) were treated with fenbendazole (Panacur® 10% oral suspension, MSD). The farmer had used this method of anthelmintic treatment over the previous two grazing seasons. The average DLWG in FGS calves during the year that preceded the TST study was 0.46 kg/day.

2.1.2. Organic farm 2 (O2)

Organic dairy farm 2 covered 344 ha which supported a milking herd of 135 Ayrshire and Ayrshire cross cows; some Aberdeen Angus suckler cows and sheep were also kept on the farm. Approximately forty per cent of the dairy herd calved between November and December, the rest calved year-round; heifers calved between February and April. The FGS were turned out in early May as a group of sixty calves, which were rotationally grazed over three fields, each of ~20 ha. The year before the TST study, based on faecal egg counts, all FGS were treated with fenbendazole drench in mid-July; the treatment was repeated again at housing in late November. The average DLWG in FGS calves during the year that preceded the TST study was 0.57 kg/day.

2.1.3. Conventional farm 3 (C3)

The conventional dairy farm milked a herd of eighty five Holstein-Friesian cows and there were also beef and sheep enterprises on the farm. Calving in the dairy herd was year round and both heifer replacements and beef x dairy calves were grazed together. The previous year, the FGS animals were not turned out until mid-July because herbage regrowth after early sheep grazing was insufficient; they were set-stocked on four hectares of land and treated with moxidectin injection (Cydec™ 10%, Zoetis) at turnout. The average DLWG in FGS calves during the year that preceded the TST study was 0.93 kg/day.

2.2. Experimental animals

All first season grazers (FGS) on-farm were included in the study (Farm O1 n = 20, Farm O2 n = 41, Farm C3 n = 43). All animals on Farms O1 and C3 were vaccinated against *D. viviparus* (Bovilis Huskvac™, MSD) before turnout to control lungworm disease.

2.3. Experimental design

Farms were visited in late April and early May 2010, just prior to turnout from housing onto pasture and then at 28-day intervals until housing in the autumn, except for September, when two of the farmers were unable to gather the cattle because of other farming activities. At visit 1 on all farms, each FGS animal had its live weight calculated by weigh-band (Coburn® weigh tape). On Farm C3, all FGS were also weighed on Ritchie® mechanical weigh-scales. At visit 3 in July, eight to ten weeks post-turnout, the girth of all FGS calves were measured using the weigh-band and their live weight gain from turnout calculated. If the live weight gain of an individual animal was < 0.75 kg/day they...