Veterinary Parasitology 218 (2016) 22–30

Contents lists available at ScienceDirect

Veterinary Parasitology

journal homepage: www.elsevier.com/locate/vetpar

Viability of the Happy Factor™ targeted selective treatment approach on several sheep farms in Scotland

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ARTICLE INFO

Article history:
Received 1 October 2015
Received in revised form 5 January 2016
Accepted 7 January 2016

Keywords:
Targeted selective treatment
Refugia
Gastrointestinal nematodes
Sheep

ABSTRACT

The aim of this study was to examine the use of Happy Factor™ weight based targeted selective treatment (TST) on several commercial farms in Scotland in combination with findings from a long term trial on a research farm to assess the potential for TST use in varying farming operations as an alternative to the current regimen of whole flock treatment. Lambs on each farm were regularly weighed and climatic conditions and pasture availability measured for inclusion into the Happy Factor™ model to calculate weight targets. Half of the lambs were allocated to TST treatment and any failing to reach the weight target was treated with the anthelmintic of choice on that farm, while the remaining half of each flock was treated with anthelmintic as per normal practice on that farm (routine treatment, RT). The research farm (farm 1) hosted a long term trial using four anthelmintic treatment regimes over 6 years, and data from two regimes are presented here, alongside findings from three further farms: two commercial enterprises (farms 2 and 3) and a research farm operating as a commercial analogue with two breeds (farms 4a and 4b). The effect of TST strategy on lamb productivity and the number of anthelmintic treatments was investigated. There was no evidence ($p > 0.300$) that mean bodyweight or growth rate was different between TST and RT groups on any of the farms and 95% confidence intervals of TST and RT groups generally suggested that TST had negligible unfavourable effects on the average growth of lambs for most of the farms. Growth rates ranged from 97.39 to 189.16 g/day reflecting the varied nature of the farms. All commercial farms used significantly less (1.34 RT versus 1.14 TST treatments per animal, $p < 0.05$) anthelmintic in lambs following TST, with a reduction from 1, 1, 1.03 and 1.14 to 0.77, 0.57, 0.82 and 0.81 in the number of treatments per animal for farms 2, 3, 4a and 4b respectively. This study suggests that TST is a viable means of controlling parasitic disease without incurring production losses.

1. Introduction

Infection with ovine gastrointestinal nematodes leads to a significant threat to efficient sheep production due to considerable welfare and productivity issues coupled with the growing global problem of resistance to many of the currently used anthelmintic drug classes (Waller 1999; Papadopoulos et al., 2012; Torres-Acosta et al., 2012). To meet global demand for ever increasing food supplies, increased animal productivity and sustainability are key issues, and hence there is a pressing need to slow the development of anthelmintic resistance (Fitzpatrick, 2013). The current method of controlling such infections through use of anthelmintic drugs, conventionally administered in a whole flock suppressive treatment strategy, contributes strong selection pressures for the development of resistant strains of parasites (Sargison, 2012; Taylor, 2012); so alternative means of controlling production losses while maintaining drug efficacy are required.

The concept of leaving parasites unexposed to treatment ("in refugia") and thus maintaining susceptible alleles within the population is considered to be of critical importance in slowing the evolution of resistant parasite strains (Van Wyk, 2001). Recently research has focussed on maintaining parasites in refugia through targeted selective treatment (TST) strategies using disease indicators such as anaemia (FAMACHA©, Van Wyk and Bath, 2002), faecal egg count (FEC, Leathwick et al., 2006; Gallidis et al., 2009) or production traits such as liveweight (Happy Factor™) (Greer et al., 2009; Kenyon, 2013a), body condition score (BCS, Gallidis et al., 2009) or milk production (Hoste et al., 2002; Cringoli et al., 2009;

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http://dx.doi.org/10.1016/j.vetpar.2016.01.008
0304-4017/

Gallidis et al., 2009) to identify individuals at risk of parasitic disease and treating only those animals, thus leaving reproductive parasites in untreated hosts.

This study used the Happy Factor™ method (Greer et al., 2009) which involves predicting an individual weight target for growing lambs and only treating each animal which fails to achieve this level of productivity. Identification of the most suitable indicator is critical for acceptance by farmers (Kenyon et al., 2009), with clear evidence of the benefits of maintenance of efficacy and minimised production losses necessary for uptake of any TST strategy (Van Wyk et al., 2006; Kenyon et al., 2009). TST implementation also depends on the decision support method being easily introduced and cost effective for use on farm (Kenyon et al., 2009). BCS, FAMACHA© and liveweight gain indicators such as Happy Factor™ fall into this category. BCS has been found to be effective at identifying individual ewes which would benefit the most from anthelmintic treatment (Cornelius et al., 2014) however it may be less suitable for a lamb production system as these animals are still growing, with associated natural changes in body shape and fat coverage unassociated with worm infection. FAMACHA© is unsuitable in assessing pathological effects of temperate species such as *Teladorsagia circumcincta* which are not haematophageous and has been found to be of low value in identifying early infection with *Haemonchus contortus* (Chylinski et al., 2015) in a study where weight reduction was found to be the most effective of several indicators of infection examined. In the UK, Happy Factor™ based liveweight gain has been shown to be an effective indicator of animals requiring treatment under a TST strategy (Greer et al., 2009; Kenyon et al., 2013a), maintaining productivity while reducing anthelmintic use. That study also proved that the development of resistance can be dramatically slowed using this approach. Studies on one farm in Scotland (Busin et al., 2014) further demonstrated that lambs treated under this TST regime received 50% of the anthelmintic treatments of lambs treated routinely every 6 weeks, without significant penalty to productivity compared with RT lambs in terms of daily weight gain or time to reach slaughter weight.

The present study aimed to extend the study of Kenyon et al. (2013a) for a further two grazing seasons as well as to apply the TST approach on three other commercial farms in Scotland to compare the productivity and anthelmintic usage of the TST groups with a routine treatment strategy. The individual farm trials were designed to compare weight gain of fat lamb production systems using either the Happy Factor™ TST protocol or the farms' own routine anthelmintic treatment protocol.

2. Materials and methods

2.1. Experimental design

On each farm, lambs were grouped according to weight and sex and each group allocated randomly into routine treatment (RT) or targeted selective treatment (TST) groups, with RT animals following a simulation of common farming practice. Lambs were monitored for body weight during the trial period which lasted from approximately end July/beginning August until the lambs were either sold for slaughter or housed for winter on each farm. Anthelmintic treatment was given individually based on target growth rates (TST) or following the farms' normal treatment policy. TST animals were treated immediately when they failed to reach weight targets generated by the Happy Factor™ model described by Greer et al. (2009). Specific anthelmintic products used were also in line with normal farm practice and administered at manufacturers recommended dose rate according to weight.

Table 1
Farms used in the study.

Farm	Farm type	Breed	*n* (RT)	*n* (TST)
1	Lowland	Black face/texel	239	240
2	Lowland	Suffolk crossbred	60	60 (monepantel) 80 (ivermectin)
3	Lowland	Suffolk crossbred	82	41
4a	Upland and hill	Scottish black face	234	234
4b	Upland and hill	Lleyn	153	163

n—number of lambs within each treatment group.

2.1.1. Farms

Summary data for the four farms used in the study are shown in Table 1 with treatment regimes in Table 2.

2.1.1.1. Farm 1. Data from this experimental trial was drawn from the TST (targeted selective treatment) and SPT (here described as RT or routine treatment) groups previously described in Kenyon et al. (2013a) with the addition of two further years of study (a total of six years: 2007–2012). This farm used twin lambs grazing with their dams. Replicated groups (2 paddocks per treatment group) of 16–20 lambs were grazed on separate paddocks in close proximity, with the same 2 paddocks per treatment group used every year. RT animals received whole flock treatment at pre-determined times on the basis of prior knowledge of the epidemiology of parasite infection on these premises, namely at weaning and at six weeks post weaning.

2.1.1.2. Farms 2 and 3. These two farms were purely commercial enterprises in nature and consisted of lowland pasture. Trials on these farms were conducted within a single grazing season and both RT and TST groups grazed the same pasture throughout the trial. Animals were chosen from a single mob on each farm and groups were balanced for sex and initial bodyweight and randomly assigned to treatments. Both farms also treated RT lambs at pre-determined times with whole flock treatments, while TST lambs were treated as required at fortnightly weighing times. On farm 2, TST was used in two groups of lambs, receiving either Zolvix (Novartis Animal Health, UK) or Oramec (Merial Animal Health Ltd., UK) with RT lambs receiving Zolvix.

2.1.1.3. Farm 4. A research farm operating a commercial fat lamb production system covering a mixture of upland and rough hill grazing. Two breeds of lambs, Scottish Blackface (farm 4a) and Lleyn (farm 4b) were used on this farm and these were analysed separately. Lambs were grazed on a number of pastures in mobs over the course of a single grazing season. Each mob comprised approximately 50% RT and 50% TST lambs from both breeds, balanced for sex and initial bodyweight. Lambs were weighed approximately monthly, which is normal practice for such a farm. RT treatments were reactive on this farm, with pooled faecal egg counts being taken and treatments being administered to all RT animals in each mob when the mean FEC was over 500 eggs per gram (epg).

2.1.2. Happy Factor™

The Happy Factor model (Greer et al., 2009) was used to determine individual weight targets. In brief, the maximum possible growth rate achievable was calculated from each lambs' previous weight in conjunction with mean temperature, estimated pasture quality and actual pasture mass. In previous studies, the optimum threshold for treatment was calculated to be 0.66 of the theoretical maximum (Greer et al., 2009) and had been used successfully in the studies by Kenyon et al. (2013a,b) and Busin et al. (2014). In the absence of historical data for farms 2 to 4, the same treatment threshold was applied. The available pasture mass was measured using a Grassmaster II pasture probe (Novel Ways, New Zealand) by