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Research paper

Three-year evaluation of best practice guidelines for nematode control on commercial sheep farms in the UK

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ABSTRACT

Anthelmintics are commonly used on the majority of UK commercial sheep farms to reduce major economic losses associated with parasitic diseases. With increasing anthelmintic resistance worldwide, several countries have produced evidence-based, best practice guidelines with an example being the UK's Sustainable Control of Parasites in Sheep (SCOPS) initiative. In 2012, a pilot study demonstrated that SCOPS-managed farms used fewer anthelmintic treatments than traditionally managed farms, with no impact on lamb productivity and worm burden. Building on these results, we collected data for three consecutive years (2012–2014) with the following aims: (1) To compare the effects of traditional and SCOPS-based parasite management on lamb productivity and worm burden; (2) To evaluate the effect of region and farm type on lamb productivity and worm burden; (3) To compare the frequency and patterns of use of anthelmintic treatment on traditional and SCOPS-managed farms. The study was carried out on 16 farms located in the North east and the South west of England and Wales. Lamb productivity was assessed by quantifying birth, mid-season and finish weights and calculating daily live-weight gains and time to finish in a cohort of 40–50 lambs on each farm. Five annual faecal egg counts were carried out on each farm to assess worm burden. No differences in lamb productivity and worm burdens were found between farms that adopted SCOPS guidelines and traditional farms across the three years. However, mean infection levels increased for both the SCOPS and the traditional groups. Lamb production was not significantly different for farm type and region but the effect of region on infection was significant. For both ewes and lambs, SCOPS farms carried out significantly fewer anthelmintic treatments per year, and used fewer anthelmintic doses/animal than traditional farms. The data suggest a trend to increasing use of anthelmintics in ewes on traditional but not on the SCOPS farms and a decreasing use of anthelmintics in lambs on both SCOPS and traditional farms. Across time, an increasing number of SCOPS farmers left their ewes and lambs untreated and the reverse was true for traditional farmers. Overall, farms implementing SCOPS guidelines used less anthelmintic treatments and less frequently than traditionally managed farms, without loss of animal performance or increased worm burden. Implementing SCOPS guidelines might have economic benefits for farmers, help reduce development of anthelmintic resistance on farms and decrease any environmental impact of anthelmintics. Furthermore, these data suggest some important epidemiological trends that should be investigated in long-term studies.

1. Introduction

A worldwide increasing demand for animal protein, due to growing human populations, requires that food is produced with more efficient land use and reduced waste (Fitzpatrick, 2013; Kastner et al., 2012). As parasitic diseases have the greatest economic impact on grazing livestock production (e.g. Perry and Randolph (1999) and Borges et al. (2013)), anthelmintics have been traditionally used by farmers to mitigate the impact of parasites on flock productivity and optimise meat production. However, with widespread development of anthelmintic resistance, particularly in nematode parasites of small ruminants (dos Santos et al., 2014; Geurden et al., 2014; Karrow et al., 2014), control strategies for gastrointestinal nematodes that minimise the use of anthelmintics are of increasing importance. Also, the trend towards non-chemical (ecological, organic, green) farming of livestock has

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led to an increased understanding of the environmental impact of anthelmintics, particularly on other invertebrate communities and placed constraints on the type and levels of some chemicals that can be used in food production (Beynon, 2012; Beynon et al., 2012; Jensen et al., 2009).

Potential resistance-delaying strategies which can be implemented on commercial farms are now well documented (Charlier et al., 2014; Coles, 2002, 2003; Gaba et al., 2006; Michel, 1985; Van Wyk, 2001). Research-based guidelines for best practice for sustainable control of parasites in sheep such as SCOPS (Abbott et al., 2012) and WormBoss (www.wormboss.com.au) are available respectively in the UK and in Australia. These initiatives recognise that a range of common practices, such as whole-flock treatment of adult ewes around lambing, and treatment of lambs as they are moved onto pastures with low parasite contamination, can be considered as "high-risk" for selecting resistant parasites. Practical advice is given for the implementation of strategies which may be beneficial in slowing the development of resistance, for example, leaving a proportion of lambs untreated (Kenyon et al., 2009), or introducing products with a novel mode of action. Understanding some of the factors involved in selecting anthelmintic-resistant nematodes is particularly important when considering the use of novel compounds, as it should be possible to manage new classes of anthelmintics in such a way as to significantly extend their effective life. This is relevant in the UK due to the relatively recent market release of two novel anthelmintics: monepantel (aminoacetyl derivate [4-AD]), formulated as Zolvix™ (Novartis Animal Health, UK) and derquantel (spiroindole [5-SI]), formulated with abamectin (macrocyclic lactone [3-ML]) as Startect™ (Zoetis, UK). Data from modelling work suggests that the resistance delaying potential of Startect is highest when used alongside best practice management and while 3-ML resistance allele frequencies are low (Learmount et al., 2012). SCOPS guidance suggests that the early integration of the new product groups, combined with management strategies that ensure high efficacy and high levels of refugia, is imperative. However, uptake of the two new anthelmintic classes on UK farms has been slow. Furthermore, data from surveys carried out in England and Ireland suggest that farmers have been relatively slow to adopt the SCOPS guidelines (McMahon et al., 2013; Morgan and Coles, 2010). It is likely that the greatest benefits of investment in initiatives such as SCOPS can only be realised if guidelines are adopted by a large proportion of farmers, particularly where there is exchange of animals between farms and the potential for spread of resistant genotypes. Although there is compelling evidence from controlled experiments for the ability of the proposed guidelines to delay the development of anthelmintic resistance and maintain production (Kenyon and Jackson, 2012; Leathwick et al., 2006, 2008), there are no data currently available for this effect on commercial farms apart from those reported by (Learmount et al., 2015) in a one year study. Robust evidence of the long term effects of SCOPS implementation on UK farms is critical to effectively promote the message to farmers and to inform future research in this policy critical area. The effect and success of implementation of resistance delaying strategies in the field is also relevant to other areas of animal and human health, where increasing reports of antimicrobial resistance are of concern.

The aims of this study were: (1) To compare the effects of traditional and SCOPS-based nematode management on lamb productivity and worm burden for three years; (2) To evaluate the effect of region and farm type on lamb productivity and worm burden; (3) To compare the annual frequency and patterns of use of anthelmintic treatment in traditional farms and in farms that implemented SCOPS guidelines.

2. Materials and methods

2.1. Selection of study farms

All study farms were those previously reported by Learmount et al. (2015) and had a range of sheep breeds, flock sizes and grazing systems to ensure that they were representative of UK commercial sheep farms (Table 1). The farms were selected based on historic data for husbandry practices, worm infections and anthelmintic resistance status and assigned to one of two experimental treatments: (1) SCOPS, for farms that were already using or were willing to implement the SCOPS guidelines; and (2) TRADITIONAL, for farms employing traditional worm control.

Farmers in the SCOPS treatment group adopted the following low-risk management practices: (i) effective quarantine drenching; (ii) partial (selective targeted) or no treatment of adult ewes around lambing; (iii) selective treatment of lambs; (iv) no drench and move treatments of lambs; (v) use of appropriate anthelmintic class depending on resistance status on the farm and nematode species present; (vi) administering effective treatment by dosing to the heaviest animal in group and calibrating the dosing gun at all treatments; and (vii) administering a mid-season treatment with monepantal or derquantel-abamectin, if deemed appropriate. When employing selective treatment of lambs, farmers agreed

Table 1
Main features of the study farms.

Farm Ref.	Region	Farm Type	Parasite management	No. ewes (Years 1–3)	No. lambs (Years 1–3)	Mixed or alternate grazing?
1	NE	Lowland	SCOPS	400–600	800–1000	Both
2	NE	Upland	SCOPS	600–800	1200–1400	Both
3	NE	Lowland	SCOPS	1000–1200	1800–2000	No
4	NE	Upland	SCOPS	200–400	400–600	Both
5	NE	Upland	TRADITIONAL	200–400	600–800	Alternate
6	NE	Lowland	TRADITIONAL	200–400	400–600[a]	Both
7	NE	Lowland	TRADITIONAL	200–400	400–600	Both
8	NE	Upland	TRADITIONAL	200–400	200–400	Mixed
9	SW	Upland	SCOPS	200–400	200–400	Mixed
10	SW	Upland	SCOPS	800–1000[b]	1200–1400[c]	Both
11	SW	Lowland	SCOPS	1000–1200	1800–2000	No
12	SW	Lowland	SCOPS	<100	100–150	Mixed
13	SW	Upland	TRADITIONAL	400–600	400–600[d]	Alternate
14	SW	Upland	TRADITIONAL	400–600	600–800	Both
15	SW	Lowland	TRADITIONAL	<200	200–400	No
16	SW	Lowland	TRADITIONAL	600–800	1200–1400	Alternate

[a] Decreased to 300 in Year 3.
[b] Increase from 200 in Year 1.
[c] Increase from 300 in Year 1.
[d] Increased from 250 in Year 1.