Veterinary Parasitology 164 (2009) 59–65

Contents lists available at ScienceDirect

Veterinary Parasitology

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

Weight-based targeted selective treatment of gastrointestinal nematodes in a commercial sheep flock

K.A. Stafford *, E.R. Morgan, G.C. Coles

Department of Clinical Veterinary Science, University of Bristol, Langford House, Langford, Somerset BS40 5DU, UK

ARTICLE INFO

Keywords:
TST
Weight gain
Anthelmintic resistance
Epidemiology
Reduced chemical use
Productivity
Parasite control
Low input
Easy care
Sheep breed

ABSTRACT

Targeted selective treatment (TST) strategies, in which a proportion of the flock or herd is left untreated so that anthelmintic-susceptible genotypes are preserved, are increasingly advocated as a means of prolonging the effective life of current anthelmintic drugs. The major limitation to this approach is a lack of efficient indicators for selection, which can be applied effectively on commercial farms to identify individuals that can be left untreated without fear of disease or production loss. With the advent of electronic identification and automated weighing technology, monitoring of short-term changes in weight gain shows promise as such an indicator, but its operation in the field as part of TST has yet to be evaluated. Widespread deployment of weight-based TST will be highly dependent on the likely production penalty from leaving the fastest growing animals untreated. On a commercial flock in south-west UK, the weight gain of 508 lambs of various breeds was tracked using an automated identification and weighing system, every one to ten weeks from June to December (one to four weeks in summer), and a variable proportion of the fastest growing individuals that also appeared to be in good condition with little breech soiling was left untreated during whole-flock dosing in June, July and August. In total, 51 lambs were selected for non-treatment on at least one occasion, while the other lambs were treated two or three times during the summer. Subsequent weight gain of untreated animals was not reduced relative to their peers in either the short-term or over the whole grazing season. Faecal egg counts from untreated individuals did not differ significantly from those of the rest of the flock, suggesting that animals left untreated on the basis of weight gain can contribute effectively to refugia. The application of TST in this case is cautious in its extent, but this is appropriate on a commercial farm with associated aversion to production loss. Results suggest that such losses can be avoided while leaving part of the flock untreated, and should encourage wider application of this approach to slow the development of anthelmintic resistance. Since the cost of investment in weighing and recording systems is likely to prove prohibitive to many farmers, other selective indicators should also be investigated. The co-ordination of TST with pasture use to maximise the benefit in terms of environmental refugia, and its integration with other control strategies, also requires further attention.

1. Introduction

Modern farming methods have seen an increase in the stocking density at which sheep are kept. This has primarily been made possible by the application of fertilisers to increase grass growth and regular whole-flock treatment with anthelmintics to control nematode infections. However, routine anthelmintic treatment inevitably selects for drug resistance in parasite populations. The common practices of regular whole-flock treatment, and dose and move to clean or rested pasture, have undoubtedly accelerated this process. Anthelmintic

* Corresponding author. Tel.: +44 117 9289495.
E-mail address: K.Stafford@bristol.ac.uk (K.A. Stafford).

0304-4017/$ – see front matter © 2009 Elsevier B.V. All rights reserved.
doi:10.1016/j.vetpar.2009.04.009

resistance is now widespread in gastrointestinal nematodes of sheep worldwide. In the UK as in many other countries the situation is serious, with the first farms ceasing production due to the development of multiple resistant *Teladorsagia circumcincta* (Sargison et al., 2005; Blake and Coles, 2007).

It has long been appreciated by parasitologists that helminth infections are typically aggregated (or, equivalently, overdispersed), with the majority of worms in the minority of animals (Barger, 1985; Gaba et al., 2005). As well as influencing host–parasite population interactions (Anderson and May, 1978; Quinnell et al., 1990), aggregation has practical implications for parasite control. By its nature, aggregation influences the effect of chemotherapy on morbidity in a group of hosts (Medley et al., 1993), and also its effects on parasite transmission (Churcher et al., 2005) and selection for drug resistance (Churcher and Basanez, 2008). Diagnosis of herd or flock infection levels as a trigger for treatment also become complicated when parasites are aggregated (Morgan et al., 2005). Importantly, overdispersion provides an opportunity for targeted control of parasites by treating relatively few hosts, since selective elimination of the burdens of the most heavily infected individuals will have a disproportionate effect on the parasite population as a whole. More than 20 years ago, Michel (1985) suggested that in the control of nematodes of grazing livestock, leaving some animals untreated could prove beneficial in terms of preserving the efficacy of anthelmintics. This should delay the development of resistance by leaving a pool of susceptible alleles of genes conferring resistance, thus diluting the frequency of resistant alleles in any given population. However, the importance of this approach was not widely recognised until it was reintroduced by Van Wyk (2001) and considered as part of general nematode control strategies (Coles, 2002; Sissay et al., 2006).

Although theoretically attractive, the concept of targeted selective treatment (TST) runs into practical problems when applied in a commercial setting. Its major drawback is the risk that some animals will be left with parasite burdens sufficient to cause sub-clinical or even clinical disease and hence production loss, as well as compromised welfare. Even if relatively direct indices of parasitism such as faecal egg counts are used to select which animals to treat, by the time elevations are noted production loss has already occurred, since many species cause most damage at immature stages. Practical methods that allow rapid identification of individuals that are least in need of treatment, in the field and in time to inform the decision on whether or not to treat, are therefore urgently needed (Jackson and Miller, 2006). Such a system has been developed for sheep in warmer climates, where *Haemonchus contortus* dominates. The FAMACHA© method uses the colour of the mucous membrane of the lower eyelid to estimate the degree of anaemia, leading to substantial decreases in the number of sheep treated (Van Wyk and Bath, 2002), although greater care may be needed in lambs, in which fatal anaemia can develop quickly (Kaplan et al., 2004). A different approach to TST, which targets treatment of highly productive individuals and therefore those most susceptible to the effects of parasitism, has also been successful in dairy goats (Hoste et al., 2002).

Where *H. contortus* is not the dominant species, as in most temperate regions, anaemia is not a suitable indicator for selective treatment. There are a number of possible alternatives, including faecal egg counts, faecal moisture content, breech soiling (dag score), body condition scoring and weight gain. Faecal egg counts or faecal moisture content are not practical in large commercial flocks since the time needed to collect individual samples, count the eggs and then re-muster the lambs for dosing is prohibitive even without considering laboratory fees. Faecal egg counts are therefore more relevant to grazing animals of higher value kept in smaller numbers, for example horses (Eysker et al., 2006). Body condition scoring is useful in breeding ewes or fat lambs (Russel, 1984), but inconsistent in growing lambs. Breech soiling is related to the number of eggs in the faeces (Broughan and Wall, 2007) and could be useful for nematode species other than *H. contortus*. However, factors other than nematode infection also cause breech soiling. Weight gain has the advantage that it can be measured quickly and non-invasively, and is of sufficient interest to farmers for reasons other than parasite control that routine monitoring through the grazing season is a realistic proposition. With the impending introduction of compulsory electronic identification of sheep in the European Union, as a result of increasing emphasis on food traceability, and the availability of automated weighing systems, monitoring the weight of individual lambs is less labour intensive than ever before. Commercially available automated weighing systems generally link to computerised record keeping and flock management software, such that weight gain and parasite treatment data can be easily integrated into flock health and production planning.

As an index for selective anthelmintic treatment, weight gain has the added advantage that alterations are detectable early in the course of sub-clinical parasitic gastroenteritis (PGE), and can be reversed with prompt treatment (Kyriazakis et al., 1996; Louie et al., 2007). Moreover, the major consequence of sub-clinical PGE to the farmer is reduced weight gain, so this index is more closely linked to the farmer's commercial interests than even direct measures of parasite burden. The production consequence of error is low: thus, if individuals with high burdens are missed because their weight gain is rapid, they are by definition showing resilience to the effects of infection and their non-treatment has few penalties beyond increased pasture contamination. In the context of TST to build refugia, such mistakes could actually be beneficial. The willingness of commercial farmers to deploy TST in the fight against resistance will depend on the perceived short-term costs of lost production, which are balanced against the long-term costs of anthelmintic failure. Given the lack of available data on the costs of TST in the field, most farmers are reluctant to consider this approach and continue to routinely treat on a whole-flock basis. A second potential drawback of weight-based TST is that if animals that are growing well have very low parasite burdens, their contribution to environmental refugia of