Veterinary Parasitology 229 (2016) 150–158

Contents lists available at ScienceDirect

Veterinary Parasitology

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

Research paper

Perceptions and actions of Dutch sheep farmers concerning worm infections

H.W. Ploeger[a,*], A.F.G. Antonis[b], J.C. Verkaik[c], P. Vellema[d], M.H. Bokma-Bakker[c]

[a] Department of Infectious Diseases and Immunology, Faculty of Veterinary Medicine, Utrecht University, P.O. Box 80165, 3508 TD, Utrecht, The Netherlands
[b] Central Veterinary Institute of Wageningen UR, P.O. Box 65, 8200 AB, Lelystad, The Netherlands
[c] Wageningen UR Livestock Research, P.O. Box 338, 6700 AH, Wageningen, The Netherlands
[d] Department of Small Ruminant Health, GD Animal Health, P.O. Box 9, 7400 AA, Deventer, The Netherlands

ARTICLE INFO

Article history:
Received 5 July 2016
Received in revised form
19 September 2016
Accepted 13 October 2016

Keywords:
Sheep
Gastrointestinal nematodes
Tapeworm
Questionnaire survey
Parasite control
Farmer perceptions

ABSTRACT

Gastrointestinal (GI) nematode infections are considered among one of the toughest challenges sheep farmers face worldwide. Control still is largely based on the use of anthelmintics, but anthelmintic resistance is becoming rampant. To facilitate implementation of alternative nematode control strategies and to reduce anthelmintic usage, the purpose of this study was twofold: (i) to gain insight in common practices, knowledge gaps and perceptions of farmers regarding nematode control, and (ii) to provide foci of attention for improving parasite control practices and transfer of knowledge within the sheep husbandry. An internet-based questionnaire was made available to all sheep farmers pertaining to the year 2013, resulting in 450 entered questionnaires for analysis.

The two most important nematodes mentioned, were *Haemonchus contortus* and, to a lesser extent, *Nematodirus battus*. Of all respondents, 25.6% said they did not have any worm problems. Of these, almost a third did notice clinical signs that can be related to worm infections and about three quarters did use anthelmintics. Overall, clinical symptoms mentioned by farmers matched the worm species they identified as the cause of problems.

Ewes and lambs were treated up to 6 times in 2013. On average, ewes were treated 1.53 and lambs 2.05 times. Farmers who treated their ewes more often, also treated their lambs more often ($P < 0.001$). Both ewes and lambs were frequently treated based on fixed moments such as around lambing, at weaning and before mating, rather than based on faecal egg counts. Treatments based on faecal egg counts were practiced, but on a minority of the farms (32.7%). The majority of the farms (75.6%) did not leave 2–5% of the sheep within a flock untreated. About 74% of farmers keep newly purchased animals quarantined for at least 10 days, but some (13.4%) leave quarantined animals untreated nor check faecal egg counts. Of farmers who do treat their quarantined animals, just 12.6% check the efficacy of the treatment.

Slightly over 40% of the respondents said they did not experience bottlenecks in parasite control. Yet, over half of these said having problems with worm infections, over half did see clinical signs related to worm infections and over three quarters used anthelmintics. Within the group of farmers experiencing difficulties in parasite control, the most often mentioned bottleneck concerned pasture management (75.8%). When asking farmers for solutions, 90% of all respondents indicated they are willing to adjust their pasture management. Farmers are also interested in other methods to reduce the risk of worm infections, such as possibilities to enhance the immune system of sheep in general (71%), to increase specific genetic resistance to worms and to apply anti-parasite forages, both about 40%.

Results of this study gave the following potential foci of attention: (1) making complex scientific knowledge more accessible to farmers through simple tools and applicable in the daily farming process; (2) changing the mindset of farmers about their current worm control practices, i.e. breaking long-standing habits such as treating ewes and lambs at fixed moments rather than based on actual worm infection monitoring data; (3) demonstrating effective pasture rotation schemes on specific farms and using these in extension work; (4) making farmers more aware that checking anthelmintic efficacy is important; (5) improving quarantine procedures; (6) creating a wider array of applicable alternative control

* Corresponding author.
E-mail address: h.w.ploeger@uu.nl (H.W. Ploeger).

http://dx.doi.org/10.1016/j.vetpar.2016.10.012

measures from which individual farmers can choose what fits them most; and finally, (7) improving mutual understanding among farmers, veterinary practitioners and parasitologists alike.

1. Introduction

Gastrointestinal (GI) nematode infections are considered one of the toughest challenges sheep farmers face worldwide, causing diarrhoea, reduced growth rate, anaemia, and mortality with severe economic losses to individual farmers and the sheep industry as a whole (Hoste and Torres-Acosta, 2011; Mavrot et al., 2015). GI nematode infections used to be controlled with highly effective anthelmintics for several decades, as time and again new products became available while in the meantime anthelmintic resistance (AR) developed to some older products. However, over the last decade, prevalence of AR has risen sharply in the Netherlands with reports on AR to ivermectin, moxidectin and monepantel (Borgsteede et al., 2010; Van den Brom et al., 2013, 2015; Ploeger, unpublished results). A recent review concluded that AR and multi-drug resistance have become widespread in Europe (Rose et al., 2015). These developments have triggered major concerns within the Dutch sheep industry whether current GI nematode control practices are sustainable.

GI nematode control still is based mainly on the use of anthelmintic drugs (Kenyon and Jackson, 2012; Charlier et al., 2014), but it is increasingly recognized that dependency on anthelmintic drugs should be minimized to keep at least some of the drugs effective and, for instance, available for emergency situations. This requires more sustainable control strategies based on grazing management, biological control, host immunity enhancing strategies including vaccination and genetic selection of less susceptible hosts, selective treatment measures and nutritional measures including the use of plants with natural anthelmintic activity (Hoste and Torres-Acosta, 2011). Although increasing knowledge is available on several of these alternative control strategies, acceptance and implementation may not always be an easy process. They have to overcome both farmer's and veterinary practitioner's traditional management and perceptions, should be tailor-made aiming at an integrated approach that fits into overall daily management on farm level, and have to be profitable in a relatively short period of time (Van Wyk et al., 2006; Woodgate and Love, 2012). Not every alternative, therefore, may be equally applicable on every sheep farm. Furthermore, specific knowledge gaps on nematode life-cycles and interpretation of, for instance, faecal egg counting results, as well as on utility and applicability of alternative management strategies may hamper implementation by farmers. Finally, implementation of innovative approaches is most likely to occur and sustain when embedded into solid and cooperative social structures (Geels, 2002). In this respect it is of relevance that (1) Dutch sheep farms are partly still under-serviced by veterinary practitioners, (2) the sheep industry is a sector consisting of a variety of sheep farm types with different production goals and not strongly organised as a whole, and (3) that interactive knowledge exchange between parasitology experts, veterinarians and sheep farmers is limited.

To facilitate implementation of alternative nematode control strategies, the purpose of this study was twofold: (i) to gain insight in common practices, knowledge gaps and perceptions of farmers regarding nematode control (bottlenecks, promising solutions and desired supportive tools for management support), and (ii) to provide foci of attention for improving parasite control practices and transfer of knowledge within sheep husbandry. Although the focus was on GI nematodes, farmers also pointed at liver fluke and tapeworm infections. Since occurrence of both tapeworm and liver fluke infections may have consequences for GI nematode control, it was decided to include these as well in this study.

2. Materials and methods

2.1. Sheep farms in The Netherlands

The sheep industry in the Netherlands is relatively small with less than one million breeding ewes kept on 28,762 farms of which 20,226 are small-scaled farms keeping on average less than 32 animals, and the remaining 8536 are larger farms (Identification &Registration-database of the ministry of Economic Affairs, 2013). Most of these sheep are kept for slaughter lamb production.

2.2. Questionnaire

An internet-based questionnaire was developed using the SurveyMonkey® platform. The questionnaire contained questions about general farm characteristics (number of animals, size of premises, type of farm, lambing period(s), breed, type of pastures or plots used) and worm control strategies (which GI nematode or other helminth species, observed symptoms, routine deworming practices, use of faecal egg counts (FEC), measures to slowing down development of drug resistance, quarantine practices). In addition, questions were asked about perceived bottlenecks in worm control, desired (alternative) control measures and supportive tools. Questions for internal checks about the general reliability and consistency of given answers were included.

The questionnaire was made available between October 2013 and February 2014. All sheep farmers in the Netherlands were alerted to the questionnaire through (e-)mails from sheep organisations and the Dutch GD Animal Health, as well as through personal contact groups of farmers and farming press. Alerts were sent out up to three times over a period of two months. Farmers could enter the questionnaire anonymously, but were asked to enter the four digits of their postal code, which contains four digits followed by two letters, to allow a general assessment of the geographical distribution of entered questionnaires.

2.3. Analysis

After completion of a questionnaire, it was automatically entered into a spreadsheet. After closing the website where the questionnaire was made available, the spreadsheet was electronically retrieved and imported into Excel (Microsoft Windows 2007/2010). This database contained 574 questionnaires. Subsequently, the database was manually checked. Questionnaires in which only the general questions on sheep farm characteristics were answered, were removed. Because SurveyMonkey® records IP-addresses, the database was checked for entered questionnaires from the same address. If so, questionnaire answers were compared and the most recent or complete questionnaire was retained unless answers differed while the four digit postal code on both questionnaires was the same. In some instances the postal code differed, which indicated that either the sheep farmer owned more than one farm or that two farmers entered the questionnaire together on the