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Efficacy of targeted anthelmintic treatment for suppression of the peri-parturient egg rise in ewes and impact on 50-day lamb weights

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ABSTRACT

This study was conducted to determine whether targeted anthelmintic treatment of peri-parturient ewes lambing in the winter, spring and/or autumn would suppress the peri-parturient egg rise (PPER) and improve 50-day lamb weights. Three farms in Ontario, Canada, that practiced out-of-season lambing were enrolled in 2010 and sampled for three consecutive lambing seasons (winter, spring and autumn). For each lambing season, all farms were visited three times. On the first visit, all ewes due to lamb that season were randomly allocated to treatment with ivermectin, fenbendazole or levamisole at the recommended dosage, or left untreated. Among these treated ewes, 40–60 animals (10–15 ewes per treatment group) were randomly selected for fecal sampling during the 3 sampling visits and processed individually to measure gastro-intestinal nematode (GIN) fecal egg counts (FECs). Ewe and lamb productivity data, including approximate 50-day lamb weights, were collected for all ewes lambing in each season, where available. A Fecal Egg Count Reduction Test was performed on all three farms to determine the ivermectin, fenbendazole and levamisole resistance status. Both farms A and B had fenbendazole resistance, while farm C had ivermectin and fenbendazole resistance; levamisole was effective on all three farms. The effect of targeted treatment on the subsequent PPER depended on the farm, possibly a partial surrogate variable for the different anthelmintic resistance levels on each farm, lambing season and sampling time-point. On farm A, during the winter and autumn lambing seasons, ivermectin and levamisole were more effective at reducing the FECs, compared to fenbendazole. In contrast, during the spring lambing season, treatment of ewes with ivermectin, fenbendazole or levamisole had no effect on the FECs. On farm B, all anthelmintic treatments were associated with a reduction in the FECs during the spring lambing season, while no reduction was observed during the winter and autumn lambing seasons. On farm C, the FECs decreased in ewes treated with levamisole in both the winter and spring lambing seasons, while ivermectin only reduced the FECs in ewes treated in the winter lambing season. Litter size was positively associated with FECs. Anthelmintic treatment was not associated with approximate 50-day lamb weights, although the power to detect

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significant difference was lower than anticipated due to only having relevant weight data from farm A. These results suggest that the efficacy of targeted treatment for the suppression of the PPER depends on the anthelmintics' efficacy and time of treatment in relation to the grazing period.

1. Introduction

Gastro-intestinal nematodes (GINs) are ubiquitous on grazing sheep farms worldwide (van Dijk et al., 2010; Stear et al., 2011; Knox et al., 2012), and cause both acute and chronic parasitic gastroenteritis (Taylor, 2009). As a result, infections may impact sheep welfare, and represent a major economic constraint to the productivity and profitability of the sheep industry worldwide (Sutherland and Scott, 2010).

Lambing and lactating ewes in the spring typically exhibit an increase in fecal GIN egg shedding that is termed the Peri-Parturient Egg Rise (PPER) (Salisbury and Arundel, 1970). This phenomenon has been attributed to both immunological and nutritional changes occurring in peri-parturient ewes (Houdijk, 2008; Beasley et al., 2010, 2012), and to seasonal effects related to the reactivation of hypobiotic parasites (Dunsmore, 1965; Michel, 1978). However, the PPER has been observed not only in temperate climates where spring occurs (Brunsdon, 1970; Cvetkovic et al., 1971; Barger, 1999; Mederos et al., 2010), but also in tropical climates where there is no spring (Tembely et al., 1998; Ng'ang'a et al., 2006). More recently, studies have confirmed the occurrence of a PPER in Ontario sheep flocks that practiced out-of-season lambing (Falzon et al., 2013b), indicating that the PPER can occur independent of environmental conditions, likely due to immunological changes in ewes at the time of parturition.

Several authors have described the PPER as a major source of pasture contamination and infection for suckling lambs (Taylor et al., 1997; Taylor, 2009; Morgan and van Dijk, 2012; Sargison, 2012). Therefore, "targeted" anthelmintic treatment (i.e. treatment of certain groups at specific times which are epidemiologically driven) of peri-parturient ewes is often considered an integral part of pregnant ewe health management, as it reduces the ewe GIN burden, thereby reducing both pasture contamination and subsequent lamb infection (Coop and Jackson, 2000; Fthenakis et al., 2012). Moreover, several studies have indicated that anthelmintic treatment of ewes during pregnancy may also improve ewe productivity parameters such as lamb birth-weight (Mavrogianni et al., 2011), milk yield (Thomas and Ali, 1983; Cringoli et al., 2009), and lamb growth rates (Darvill et al., 1978; Fthenakis et al., 2005), therefore improving the overall profitability of sheep production (Moors and Gauly, 2010).

However, increasing reports of anthelmintic resistance (AR) in most sheep-rearing countries (Pomroy, 2006; Papadopoulos et al., 2012; Torres-Acosta et al., 2012) underscore the importance of judicious anthelmintic use. A recent study conducted on Ontario sheep farms reported a high frequency of ivermectin and fenbendazole resistance, the two most commonly used anthelmintics in Ontario, while levamisole was effective on almost all farms tested. Most of the resistance observed was associated with *Haemonchus contortus* (Falzon et al., 2013a). This may be a consequence of the common practice of treating ewes in the spring and the poor ability of this parasite species to overwinter on pasture under central Canadian climate conditions, leading to very few *H. contortus* present on pasture in *refugia* at the beginning of the grazing season (Falzon, 2012).

Since at least 30% of sheep producers in Ontario practice out-of-season lambing (Ontario Sheep Industry Survey–Composite Report, 2009), and 55% (17/31) of all producers surveyed in a separate study of risk factors associated with AR reported routinely treating their ewes at lambing (Falzon et al., 2013c), treatment of peri-parturient ewes occurs at different times of the year, when levels of parasites in *refugia* on pasture may or may not be low. Therefore, it is important to improve our understanding of whether targeted treatment of peri-parturient ewes is actually effective at suppressing the PPER, even when lambing is occurring in the autumn or winter, and from a financial perspective, whether this targeted treatment translates into an impact on lamb productivity. This information, in turn, will allow us to make better recommendations to producers on how to maintain ewe and lamb productivity while using anthelmintics judiciously.

The objectives of this study were to determine whether targeted treatment of peri-parturient ewes that lamb in the winter, spring or autumn would: (i) suppress the PPER; and (ii) improve 50-day lamb weights. We hypothesized that the targeted treatment would suppress the PPER, regardless of lambing season, and improve 50-day lamb weights.

2. Materials and methods

2.1. Farm and animal selection

A randomized clinical trial was conducted between December 2010 and December 2011, in which three farms were purposively selected in south-western Ontario; the sample size was dictated by logistical and financial constraints. The farms were selected based on their willingness to participate in the study, distance from the University of Guelph (within a 200 km radius) due to a requirement for frequent sampling, willingness to withhold routine use of anthelmintics, and a known history of GIN parasitism on the farm. Specifically, both farms A and B participated in a previous GIN research project in 2010 (Falzon et al., 2013b), while on farm C, the flock veterinarian had confirmed the presence of clinical GIN parasitism in 2010. Other inclusion criteria were that farms had to (i) practice out-of-season lambing, and (ii) expect to have more than 60 pregnant ewes in each lambing season.

The three farms were visited following a specific schedule which was set around the predicted date when 50% of ewes scheduled to lamb that season would have lambed ("50L"). The 50L was estimated as the date of ram introduction plus 148 days plus 14 days, based on the average gestational length in ewes and the expected success of ram breeding within the first 2 weeks of the breeding season (Senger, 2003). The farms were visited three times for every lambing period, for three consecutive lambing seasons (winter, spring, autumn): four weeks before 50L (TP1); at the end of the lambing season (TP2); and four weeks after the end of the lambing season (TP3).