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Prevalence and seasonality of bulk milk antibodies against *Dictyocaulus viviparus* and *Ostertagia ostertagi* in Irish pasture-based dairy herds

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ABSTRACT

Infections with *Dictyocaulus viviparus* and *Ostertagia ostertagi* nematode parasites are of importance to bovine health and production in temperate areas across the world. Losses due to these parasites in dairy herds can be considerable due to decreased milk productivity and fertility. However, information on current epidemiological patterns in Irish dairy herds is limited. Bulk milk samples were collected from a total of 319 dairy farms across the Republic of Ireland. The *D. viviparus* samples were tested with an ELISA based on recombinant major sperm protein, while the *O. ostertagi* samples were tested with an ELISA based on crude saline extract, whole worm *O. ostertagi* antigen. Management data were collected from the farms using a questionnaire. Logistic regression was used to find significant associations between the presence of antibodies against *D. viviparus* and *O. ostertagi* and management factors. The overall prevalence of *D. viviparus* infection was 62.8%, while over 98% of herds had antibodies to *O. ostertagi* at the specified cut-off. Both *D. viviparus* and *O. ostertagi* antibodies were highest in November, which could be explained by the accumulated uptake of larvae through the grazing season. In herds of farmers that dosed their in-calf heifers with anthelmintics were significantly more likely to be positive for antibodies against *D. viviparus* infection. This study highlights that both *D. viviparus* and *O. ostertagi* infections are widespread in dairy herds in Ireland throughout the grazing season.

1. Introduction

Dictyocaulus viviparus and *Ostertagia ostertagi* infections in dairy cows are generally of a subclinical nature, particularly in the case of *O. ostertagi*. Recognition of infection with these nematode parasites, therefore, can be difficult (Bennema et al., 2009; Perri et al., 2011). Traditionally diagnostics of these parasites were performed using corpological techniques, however, the use of low-cost and practical bulk tank milk (BTM) enzyme-linked immunosorbent assays (ELISA), has eased diagnosis and determination of herd antibody status (Charlier et al., 2005b, 2010; Klewer

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et al., 2012). Furthermore, BTM ELISA can be used to quantify possible production losses due to *O. ostertagi* infections (Charlier et al., 2007a, 2010; Sanchez et al., 2005). Forbes et al. (2008) developed a guide to quantify milk yield losses associated with *O. ostertagi* based on BTM optical density ratios (ODR). This guide outlines estimated production losses when ODR readings exceed 0.5 ODR. For each increase of 0.1 ODR, an average of 0.32 kg/cow/day decrease in milk yield can be expected (Forbes et al., 2008). Additional investigations by Charlier et al. (2005a) showed that herds recording an ODR of >0.8 could be identified as having potential milk production losses (Charlier et al., 2007b).

O. ostertagi exposure in dairy cows in Europe has been shown to follow a seasonal pattern with access to pasture and length of the grazing season linked to *O. ostertagi* antibody levels (Bennema et al., 2010; Forbes et al., 2008; Sekiya et al., 2013). As the grazing period progresses, ELISA ODRs increase, probably due to cattle ingesting infective larvae (Charlier et al., 2007a). Forbes et al. (2008) reported that high mean *O. ostertagi* ODRs were associated with pasture-based dairy systems. Additionally, Bennema et al. (2010) reported that ODR levels were highest in countries where cows were housed later in the year, and the grazing time per day was longer.

With regard to *D. viviparus*, an increase in outbreaks of parasitic bronchitis in dairy cows has been reported in the UK since 1993. This has been linked to *D. viviparus* naïve heifers entering the adult herd (David, 1999; van Dijk, 2004). Moreover the application of BTM ELISA has highlighted the presence of *D. viviparus* antibodies in adult cows in Germany, Belgium and Sweden (Bennema et al., 2009; Hoglund et al., 2010; Schunn et al., 2013). *D. viviparus* outbreaks in dairy cows are generally recorded from July to October in Europe, although outbreaks can be experienced at any time of year (van Dijk, 2004). More recent studies by Hoglund et al. (2010) and Schunn et al. (2012) reported higher antibodies at the start and towards the end of the grazing season on *D. viviparus* seropositive farms, which was explained by Schunn et al. (2012) due to the development of resuming hypobiotic larvae in carrier animals.

The Irish climate, being temperate, humid, and having abundant rainfall, is well-suited to grass production (Drennan et al., 2005; Keane and Sheridan, 2004). Irish dairy systems, therefore, are most commonly based on producing milk during the grass-growing season in order to reduce farm inputs such as supplementary feed and increase farm profits (Dillon et al., 1995, 2008). This has led to lengthened grazing seasons and increased proportions of grass in the diet of dairy cows over the last decade. Grass growth generally commences in early spring, when temperatures exceed 6 °C (Drennan et al., 2005). Irish farmers employ compact spring-calving systems (January–April) to facilitate milk production from grass (Drennan et al., 2005), with cows being turned out to grass full time from as early as February in the South. Cows then remain at grass until November when grass growth slows considerably (Drennan et al., 2005). The Irish climate is also favourable for the survival and development of *D. viviparus* and *O. ostertagi*. The mild winters and moderate summers favours the survival of *O. ostertagi* and *D. viviparus* larvae on pasture and soil all year round (Eysker and Hubert, 2002), thereby potentially increasing infection pressure.

Data on the prevalence of *D. viviparus* and *O. ostertagi* infections in Irish dairy herds are limited. The most recent study recorded post-mortem prevalence at abattoirs of 14% and up to 59% for *D. viviparus* and *O. ostertagi*, respectively (Murphy et al., 2006). Specific data on geographical and seasonal trends in *D. viviparus* and *O. ostertagi* infection in Ireland are not available. The current study was therefore set up to determine the prevalence of differing levels of exposure (i.e. ODR readings) to *D. viviparus* and *O. ostertagi* in a geographically representative group of Irish dairy farmers using BTM ELISA. Secondary aims included determining the seasonality of nematode exposure in dairy cows and management factors associated with exposure to these parasites.

2. Materials and methods

2.1. Sample population

The dairy herds selected for this study were members of HerdPlus®, a breeding information decision support tool co-ordinated by the Irish Cattle Breeding Federation (ICBF). In 2009, the HerdPlus® database contained records from 3500 farmers, which represented 18% of the Irish national dairy population. A total of 500 dairy farms were randomly selected from the database with the expectation that over 300 farmers would eventually be recruited to yield sufficient study power. A stratified sampling procedure based on herd size and geographical location was applied to select members to join the 'HerdAhead' programme and a total of 312 commercial farms were subsequently recruited. The study population has previously been shown to provide a geographical representation of the Irish dairy farm population (O'Doherty et al., 2013).

A sub-group of 22 commercial farms from the sample population were also members of a Dairy Management Information System (DairyMIS) discussion group coordinated by Teagasc (Irish Agriculture and Food Development Authority). All farms regularly contributed data to Teagasc and were all based in the southern-most province of Ireland, Munster. An additional seven Teagasc research farms which also regularly recorded farm data to the 'DairyMIS' system were added to this sub-group yielding a total "DairyMIS" sub-group of 29 farms.

2.2. Sample collection

Sampling frequency differed between 'HerdAhead' farms ($n = 290$) and 'DairyMIS' farms (22 commercial plus 7 research). 'HerdAhead' farms were forwarded a bulk milk sampling kit on four occasions throughout 2009 in a standardized sampling kit (23rd March, 8th June, 31st August and 2nd November). 'DairyMIS' farms ($n = 29$) submitted samples on a monthly basis between March and November (2009) for the purposes of providing more detailed seasonal data. The sampling kit was previously described in detail by O'Doherty et al. (2013). Briefly, each dairy farmer was supplied with a 500 ml jug, a 250 ml sampling container containing five milk preservative tablets (Broad spectrum