FACULTY OF VETERINARY MEDICINE
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GHENT UNIVERSITY

INVITATION
PUBLIC DEFENSE
Towards decision support for treatment of *Dictyocaulus viviparus* infections in grazing cattle

PROMOTERS
Prof. Dr. Edwin Claerebout
Dr. Johannes Charlier

Marieke Vanhecke
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Faculty of Veterinary Medicine, Ghent University

Curriculum Vitae

Marieke Vanhecke was born on February 5th in Bruges, Belgium. In 2009, she completed secondary school in mathematics-sciences at the Virgo-Sapientiae Institution in Maldegem, after which she started studying Veterinary Medicine at Ghent University. She obtained her Master's degree in Veterinary Medicine (specialization: Ruminants), with distinction, in 2015. She was appointed as Assisting Academic Personnel at the Laboratory of Parasitology (Department Virology, Parasitology and Immunology; Ghent University) in 2015. Marieke is (co-)author of several scientific publications and she presented her work in multiple oral/poster presentations on national and international scientific conferences/symposia. She also successfully completed the Doctoral Training Programme, organized by the Ghent University Doctoral Schools.

Where?

The public defense will take place on
Tuesday 31st of August at 16:30 pm

Auditorium Maximum
Faculty of Veterinary Medicine
Ghent University, Campus Merelbeke
Salisburylaan 133, Merelbeke

Members of the examination committee

Prof. dr. S. De Vliegher
Chair of the examination committee

Prof. dr. G. Opsomer
Faculty of Veterinary Medicine, Ghent University

Prof. dr. C. Strube
University of Veterinary Medicine, Hannover

Dr. J. van Dijk
Zoetis, UK

Prof. dr. B. Pardon
Faculty of Veterinary Medicine, Ghent University

Summary of the thesis

Lungworm disease, also known as 'husk' or 'fog fever', is caused by the parasitic nematode Dictyocaulus viviparus and can lead to substantial economic losses, due to mortality, reduced weight gain and milk production and treatment costs. Lungworm control relies heavily on the use of anthelmintics, but only few validated parameters are available to inform farmers and veterinarians on the optimal timing/frequency and the economic benefit of anthelmintic treatments. As a consequence, anthelmintic treatments to control lungworm infections are often applied inappropriately. The epidemiology of D. viviparus is very volatile. Pasture infection levels can rise rapidly if weather conditions are favorable, causing unexpected lungworm outbreaks. The democratization of data collection and sharing tools and the availability of a Major Sperm Protein (MSP) Enzyme-linked immunosorbent assay (ELISA) has provided researchers new tools to revisit the D. viviparus epidemiology and its predictability.

In Chapter 1, a literature review on D. viviparus is given and the (economic) impact of infections with D. viviparus is enlightened as well as the predictive tools for helminth infections in ruminants. Lastly, the aims and objectives of the thesis are set out.

In Chapter 2, the association between BTM ODRs and farmer-reported lungworm outbreaks based on the clinical sign "coughing" was assessed throughout the grazing season and a comparison on the sensitivity and specificity of two ELISAs under field conditions was made. The Hannover MSP-ELISA and the prototype Svanova MSP-ELISA were used for the detection of D. viviparus antibodies in BTM samples on 717 dairy farms during the 2018 grazing season. The results showed that the Svanova ELISA had a lower sensitivity (40-65%) and specificity (75-90%) for the detection of D. viviparus infections in BTM compared to the Hannover ELISA, which had a sensitivity of 42% and 74% and specificity of 100% and 98% at a cut-off of 0.41 ODR and 0.25 ODR, respectively. Therefore, analyses of the associations between milk antibody levels and farmer-reported outbreaks during the 2018 and 2019 grazing season were assessed using the Hannover ELISA. A positive association was found between a farmer-reported outbreak and having at least two consecutive positive BTM ODRs at a cut-off of 0.41 in 2018 (Odds Ratio (OR) = 5.5) and 2019 (OR = 2.8). On the farms with a farmer-reported outbreak and positive BTM samples, over half (2018 = 77%; 2019 = 57%) of the positive ODRs were situated before the outbreak and 47% (2018) and 42% (2019) within 12 weeks before the outbreak. In conclusion, a positive association was observed between farmer-reported outbreaks and the occurrence of a positive BTM sample at the cut-off of 0.41 ODR using the Hannover ELISA.

Chapter 3 aimed to assess the impact of (sub)clinical lungworm infections on productivity in dairy cows and to identify or confirm risk factors, related to herd management, for infections in grazing dairy cattle. Using the Hannover MSP-ELISA from Chapter 2, the presence of D. viviparus antibodies in BTM samples was evaluated on 717 and 634 farms at two-week intervals during two grazing seasons (2018 and 2019). Associations between milk antibody levels and production data (mean milk yield in kg/cow/day, percentage of fat and protein, herd standard cow (HSC) in kg milk/cow per day and net gain (NG) in €) were assessed, as well as associations with putative risk factors in the herd management, gathered through a questionnaire survey. In both years, there was a substantial, but non-significant, difference in the annual mean milk yield on farms with at least one BTM sample above the cut-off of 0.41 ODR, compared with the mean milk yield on farms that stayed under this threshold on each sampling day (-0.17 and -0.70 kg milk/cow/day in 2018 and 2019, respectively). In 2019, this association was stronger, and significant, when the cut-off was exceeded in at least two consecutive BTM samples (-1.74 kg milk/cow/day). A single or two consecutive positive tests were used in the risk factor analysis as a proxy for lungworm-associated milk yield losses. Purchase of new animals (OR = 2.68) and the proportion of the first

grazing season covered by preventive anthelmintic treatment (OR up to 3.88, depending on proportion) were positively associated with lungworm-associated milk yield losses, while mowing at least 50% of the pastures (OR = 0.57) was negatively associated with lungworm-associated milk yield losses. These results suggest that the ELISA holds promise to identify herds with significant production losses due to lungworm infections, under the condition that BTM sampling is done repeatedly during the grazing season. Based on the confirmed risk factors, adjustments of the farm management could perhaps mitigate these losses.

In Chapter 4, the potential of predictive model development to support more preventative approaches for lungworm disease was assessed by aiming to understand the influence of weather conditions on D. viviparus BTM antibody ELISA results. BTM samples were analysed with an MSP ELISA (expressed ODR) twice monthly on 717 Flemish dairy farms during the grazing season (April-October) in 2018. Meteorological data of the sampled farms were obtained on a 1 km scale using the ALARO-SURFEX climate model. A mixed effects association model showed that the BTM ODR was significantly associated with the month of sampling, evapotranspiration, temperature and its quadratic term, the number of hot days (> 20°C) and the number of rainy days (> 2 mm) in the 7-8 weeks prior to sampling. There were significant farm effects involved. The model's accuracy to predict the BTM ODR infection status was 80%, while ODRs were generally overestimated by 38%. Inclusion of the previous (2-week-old) ODR values increased the accuracy to (86%) and reduced the mean square error by 1-3%. We conclude that meteorological parameters have a predictive value for BTM ODR results, while further research should evaluate model improvements through the addition of management factors as well as confirm the predictive power through external validation in unsampled farms and additional years.

Chapter 5 is a general discussion on the research data, generated in this thesis, in which the insights on the current epidemiology and prevalence of D. viviparus were summarized. Also, novel findings on the diagnosis of lungworm infections through antibody detection in BTM samples are discussed, as well as the results on the impact of infections with D. viviparus on milk production and possible management risk factors for lungworm disease. Lastly, the predictive value of meteorological parameters for D. viviparus infections is discussed. The general discussion also contains an outlook on future research.