

Project number: 6416

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Multidisciplinary programme to deliver improved diagnosis, on-farm strategies, and economic drivers for the control of *Mycobacterium avium* subsp. *paratuberculosis* on Irish farms.



Key external stakeholders:

Dairy Processors, Department of Agriculture, Food and the Marine, Animal Health Ireland, Farm organisations, Irish Cattle Breeding Federation (ICBF),

Practical implications for stakeholders:

- The effect of the paratuberculosis (MAP) ELISA status on test-day milk performance of cows from Irish herds enrolled in the pilot national voluntary Johne's disease control program during 2013–2015 was estimated.
- Infection with *Mycobacterium avium* subspecies *paratuberculosis* (MAP) has been associated with reductions in milk production of dairy cows.
- The standardized fat and protein corrected milk recorded at test-day between cows with a MAP positive status and those with a MAP negative status depending on scenario ranged from -0.182 to -0.326 kg/test-day

Main results:

- A dataset comprising 92,854 cows and 592,623 complete test-day records distributed across 1,700 herds was used in this study as part of the Animal Health Ireland Pilot program.
- Analysis of the Eliza results from the AHI pilot program have shown a statistically significant effect of Eliza status and milk production performance
- The standardised mean difference recorded at test-day between cows with a ELISA MAP positive status and those with a MAP negative status;
 - Was estimated at -0.182 kg/test-day when all cows that tested positive and inconclusive were compared to cows with negative results
 - Was estimated at -0.297 kg/test-day when all cows that tested positive were compared to cows with negative results;
 - Was estimated at -0.209 kg/test-day when all cows that tested positive and inconclusive were compared to cows with negative results and gathered exclusively from herds where at least 2 further ELISA non-negative (inconclusive or positive) cows were found were assigned a MAP positive status
 - Was estimated at -0.326 kg/test-day when all cows testing ELISA positive were exclusively from herds where at least 2 further ELISA positive cows were present

Opportunity / Benefit:

Across the food supply chain there is an increasing focus on sustainable farming systems. The AHI pilot program has shown that the status of the Irish dairy industry in relation to MAP infection is low. This study has shown that the effect of MAP on farm performance is very low. While this study has shown the effect of the disease and the prevalence is low, there is a significant opportunity to implement a control program to maintain these levels.

Collaborating Institutions:

Animal Health Ireland, Irish Cattle Breeding Federation, Department of Agriculture, Food and the Marine, University College Dublin

Teagasc project team: Dr. Laurence Shalloo, Dr. Bruno Brotaro, Dr. AnaBehlan Garcia

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1. Project background:

The consequences of MAP infection in Ireland may differ from other studies due to the grass based systems of milk production operated by most producers. A number of studies of the impact of Johne's disease have been published. The majority of these relate to the impact of subclinical infection, clinical infection or both in dairy herds. Overall, losses are considered to include reduced milk production, increased mortality, weight loss, premature culling and reduced slaughter value. For example Benedictus et al. (1987) in a study of culled cows reported 6% and 16% reductions in milk production in the second to last and last lactations respectively in sub clinically affected cows. In New Zealand, de Lisle et al. (1989) found a 17% reduction in milk production for the most seriously affected herds. Abbas et al. (1983) found a 15% (835kg) reduction in annual milk yield in sub clinically affected cattle compared to culture-negative herd mates. Sweeney et al. (1994) demonstrated a reduction in milk quality in subclinically affected cattle, with significant reductions in daily milk fat and protein. Other studies have found effects on other key traits such as mastitis incidence (Buergelt and Duncan, 1978), herd fertility (Johnson-lfearulundu et al., 2000).

2. Questions addressed by the project:

- The Economic effect of MAP infection across various countries, regions and systems of milk production
- The effect of ELISA status at the animal level in milk production characteristics of a dairy farm

3. The experimental studies:

Data used for this study were obtained from dairy herds voluntarily enrolled in the Johne's Disease Control Program (JDPCP), implemented by a Johne's Disease Implementation Group (JDIG) consisting of stakeholder representatives and chaired by Animal Health Ireland (More et al., 2011), from 1st November, 2013 to 23rd December, 2015. A total of 1,791 herds were enrolled in the program for one or more years during this period and 148,291 cows were tested on one or more occasions. As outlined by the AHI JDPCP (AHI, 2015), all cows in the herd over 24 months of age and older at the testing date were included for screening. For the purpose of testing, blood or milk samples could be collected from each eligible cow in a herd. Herd owners choosing to have cows tested using blood samples were required to test cows at least once a year. If milk was the selected sample matrix for testing, two samples per year were required for each cow, and the follow up sample was taken at least 90 days apart from the first sampling. First-week lactation cows were not screened, as the high concentration of non-specific antibodies in colostrum increases the odds of a cow test being inaccurate (Nielsen and Toft, 2012). In order to estimate the effect of cows' antibody response against MAP on test-day milk records, the range of the ELISA test results available in our dataset (negative, inconclusive and positive) was represented in the following scenarios. In each of the abovementioned scenarios, all cows from the same herd in a given year were assigned a MAP negative status if tested ELISA negative for all tests conducted in that same year.

4. Main results:

- MAP ELISA status on test-day milk performance of cows from Irish herds enrolled in the pilot national voluntary Johne's disease control program during 2013–2015 was estimated. A dataset comprising 92,854 cows and 592,623 complete test-day records distributed across 1,700 herds was used in this study. The resulting ELISA outcome (negative, inconclusive and positive) of each cow within each year of the program was used to allocate the cow into different scenarios representing the MAP status:
- Cows defined in a MAP positive status were associated with milk yield reductions which ranged from -0.182 kg/test-day to -0.326 kg/test-day depending on the scenario analysed
- As the MAP ELISA test result increased the milk yield reduction effect increased.
- A review paper completed as part of this research has shown that the variability and uncertainty surrounding the estimations of MAP prevalence and impact influence the design, implementation and efficiency of control programs in diverse areas of the world.

5. Opportunity/Benefit:

Infection with *Mycobacterium avium* subspecies *paratuberculosis* (MAP) has been associated with reductions in milk production of dairy cows. Accurate estimation of these losses from sub clinically affected cows can be challenging as currently available enzyme-linked immunosorbent assay (ELISA) methods for MAP screening may lead to misclassification of the animal's current infection status. The aim of this study was to determine the effect of ELISA status on test-day milk records for a large sample of dairy cows as well as developing a review of the effect of the disease in previously published research.

6. Dissemination:

Main publications:

Botaro B., Ruelle E., More S.J., Strain S., Graham D., O Flaherty J. Shalloo L. (2017) Associations between paratuberculosis ELISA results and test-day records of cows enrolled in the Irish Johne's Disease Control Program. *Journal of Dairy Science* 100 9 7468-7477.

Garcia, A. B.; Shalloo, L. (2015). Invited review: The economic impact and control of paratuberculosis in cattle. *Journal of Dairy Science* 98 8 5019-5039.

Botaro, McAloon G., O'Grady L., More, S.J. Strain, S., Citer, L., Graham, D., Shalloo L. (2019). Predicting test-day records of cows from milk ELISA responses to paratuberculosis in the context of the Irish Johne's Disease Control Program. *Journal of Dairy Science* (In Prep).

National conferences and seminars

Presented to Dairy Degree students that undertake their undergraduate programmes at Moorepark

Garcia, A.B. and Shalloo, L. (2015). Paratuberculosis in cattle: epidemiology, economic impact and control strategies. In: *Agricultural Research Forum, Tullamore Court Hotel, 09-Mar-2015*, p. 159

Open days:

Results were presented at a number of Moorepark open days.

Industry consultation

The results of this research helped to inform the debate around the introduction of an AHI control program. The results were presented on a number of occasions to the AHI working group on Johnes

Farmer discussion groups

Results were presented and discussed at several farmer discussion groups and seminars including meetings with the various farm organisations as the research was being completed.

7. Compiled by: Dr Laurence Shalloo
