

The Association Between *Mycobacterium avium* subsp *paratuberculosis* Fecal Shedding or Clinical Johne's Disease and Lactation Performance on Two Minnesota, USA Dairy Farms

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Introduction

The scientific literature provides little information about the impact of *Mycobacterium paratuberculosis* shedding in dairy cattle on lactation performance, including the attributable reduction of milk production and productive longevity in the herd due to clinical and sub-clinical Johne's disease (JD). It is clear from the literature that JD infected cows are removed from the herd earlier in life than their non-infected herdmates. Many cattle with JD clinical signs are culled due to poor production even before a diagnosis of JD is confirmed, especially common in freestall housing where an individual cow's manure consistency is less obvious than in tiestall housing. Although several studies have considered the effect of JD on culling rate, none have addressed the impact of subclinical JD or fecal shedding level on the survival of the cow in the herd.

Because of its economic importance, the impact of JD on milk production has been the most commonly evaluated effect of JD. Most studies have shown that JD-positive cows produce between 2-17% less milk than their negative herdmates, though the diagnostic test and the definition of positive cows varied between the studies. None of these studies have addressed the potential confounding impact of other factors, such as other clinical diseases, on this relationship.

Few studies have estimated the impact of JD on reproductive performance. These studies have used different diagnostic testing methods, with some defining positive cows based on fecal culture or histology, and others using ELISA results. The lack of consistent associations in these studies may be explained by the variation of results from use of different diagnostic methods.

Materials and Methods

Two Minnesota dairy herds with approximately 1,400 milk cows were selected for this study based on four criteria: 1) at least 400 milking cows; 2) at least

10% of total culled cows showing clinical signs of JD in previous year; 3) routine use of computerized dairy herd management software program (Dairy Comp305®; Valley Agricultural Software, Tulare, CA); and 4) Dairy Herd Improvement Association (DHIA) participation. Milk production data were obtained from DHIA records using the computerized record system when cows completed a 305-day lactation (305 days in milk (DIM) milk production) or when cows left the study or completed the lactation before 305 DIM (total milk). Reproductive parameters evaluated were number of artificial insemination (AI) services and days from calving to conception (days open). Culling information was recorded for all cows that were culled (died or sold) and did not remain in the herd to the end of lactation. Information collected included reason for culling, date of culling, DIM at culling and signs of clinical JD, if present. A cow was considered to complete the study if she ended the current lactation pregnant and entered the dry period in preparation for a subsequent lactation. For each cow that completed the study, DIM in the study was recorded. Fecal samples were processed at the Minnesota Veterinary Diagnostic Laboratory, using the bacterial solid culture method. Colony counts were recorded weekly for 16 weeks, and final results were reported as negative, light (mean of 0.25 to 9 colonies/tube [CPT]) moderate (mean of 10 to 49 CPT), and heavy (mean of > 50 CPT) fecal shedding.

Results

Fecal samples were collected from a total of 1,052 cows during the close up period between January 2002 and March 2003. Of these, 84 cows (8%) had positive fecal samples during the close-up period (46% were light shedders, 26% were moderate shedders and 28% were heavy shedders). Overall mean (standard deviation) milk production was 20,768 lb (9,440 kg; 3,885 SD) or 75 lb (34 kg; 10 SD) per day. Mean SD milk production for fecal culture-positive and negative cows was 13,860

lb (6,300 kg; 4,400 SD) and 21,340 lb (9,700 kg; 3,700 SD), respectively. Mean milk production for light, moderate, and heavy fecal-shedding cows was 17,820, 13,860 and 5,940 lb (8100, 6300 and 2700 kg), respectively. Mean milk per day of lactation in fecal-positive cows was 15.4 lb (7 kg) less than the production of fecal-negative cows. Mean milk per day of lactation in light, moderate and heavy shedder cows was 70.4, 59.4 and 26.4 lb (32, 27 and 12 kg), respectively and heavy shedding cows produced 48.4 lb (22 kg) less than negative cows. Of 1,052 cows, 922 (88%) were inseminated at least once and 748 (71%) conceived by the end of the study. Fifty-eight of the 84 (69%) fecal-positive cows were inseminated at least once and 41 (49%) conceived. Percent of bred and pregnant cows among the light, moderate and heavy fecal shedding cows was 34%, 24%, 16% and 13%, 8% and 4%, respectively. There was no difference in the mean (median) number of AI services for pregnant positive and negative fecal-culture cows (3.1 (2.0) and 3.2 (2.0)), respectively. Positive, moderate, and heavy fecal shedding cows were 2.8 (OR 95% CI=1.4-5.7), 3.1 (OR CI=1.2-8.3) and 9.6 OR CI=3.6-24.5) times less likely to be inseminated than fecal negative cows, respectively. Positive, light, and heavy fecal shedding cows were 2.8 (OR 95% CI= 1.4-5.7; $p<0.01$) 2.4 (OR CI=1.1-5.5), and 3.8 (OR CI= 2.2-5.3; $p=0.02$) times less likely to conceive than fecal negative cows, respectively. Moderate fecal shedding was not significantly associated with the chance of being pregnant. For cows that eventually con-

ceived, mean (median) days open for fecal-negative and positive cows was 149 days (92) and 122 days (65), respectively. A total of 326 (31%) fecal-negative and 63 (75%) fecal-positive cows left the herd before completing the lactation. Mean (median) days from calving to culling for negative and positive fecal-culture cows was 236 days (195) and 155 days (124), respectively, including 231 days (206), 175 days (137) and 82 days (41) for low, moderate and heavy shedding cows, respectively.

Significance

Fecal culture-positive cows remained, on average, 102 days less in the herd than negative cows and produced approximately 1,540 lb (700 kg) less milk than negative cows. This reduction in milk production was greater than that due to days-in-milk alone. In addition, fecal shedding level was negatively associated with milk production. Reproductive performance of fecal positive cows was lower than negative cows, largely due to premature culling. Clinical JD cows remained on average 202 days less in the herd and produced approximately 7,260 lb (3,300 kg) less milk than all other cows that completed the study. While survival and reproduction parameters are significantly influenced by management decision-making in addition to biology, these study results indicate that JD is a significant determinant of productivity in dairy cattle herds.