Eradication of Johne's Disease from a Heavily Infected Herd in 12 Months

M.T. Collins and **E.J.B. Manning**
School of Veterinary Medicine
University of Wisconsin, Madison, WI 53706.

Background (paraphrased narrative from the herd owners):

"We started milking in 1982 after purchasing cows to start our herd. At the beginning our herd average was 12,000 lb. In 1987 we remodeled the barn by putting in comfort stalls, a pipeline milking system, and faced the cows to the center of the barn. Milk production then was up to 17,000 lb. We had some trouble with the small pipeline that was installed and so replaced it with a 2 inch line in 1988.

Production continued to increase but at a slower rate. By 1990 it was at 18,500 lb. We built a Harvestor® silo to have a better supply of corn for feed. Production stayed the same or declined a little. We started to feed a total mixed ration in 1992 with a Uebler feed cart. We thought these management decisions would help our level of milk production. We also thought that our SCC count was too high so we contacted a milking system dealer to check our system. They thought our milker vacuum pump was poor so we installed a new vacuum pump. At the same time we also checked for stray voltage and no problem was found. Then, we noticed the cows were not eating consistently so we checked for stray voltage again a year later and some stray voltage problems were found.

We had the stray voltage task force team visit the farm in September, 1992. They recommended we put in a four wire system and we also worked with a mastitis specialist on bringing down our SCC. By the Spring of 1993 his recommendations were implemented but our milk production continued to decline.

In the Fall of 1993 a heifer died on pasture. In retrospect we now think the heifer died of Johne's disease, but the vet insisted that Johne's disease only shows up in older animals. In 1994 we lost more heifers on pasture. I talked with a state district veterinarian at Farm Progress days and decided to get my veterinarian to do an ELISA for Johne's disease on four animals. Two of these tested positive. Then the district veterinarian for our county came to our farm for a visit and discussed Johne's disease diagnosis and control. On her advice we tested all the cows (45) by the ELISA blood test for Johne's disease and seven were positive. We had sold eighteen cows and first-calf heifers to a slaughter house in 1994, including those that were Johne's positive. After seeing those bred heifers die on pasture and knowing they had Johne's disease, we sold all the remaining yearling heifers. We then were faced with trying to buy good Johne's-free cows, which seemed impossible.

We wanted to rid our herd of this disease, but was financially very difficult to replace that many animals after having lost their milk production income, and incurred the breeding costs, feed costs, registration costs, and other investments in raising those animals. They also had very little salvage value. It also seemed difficult to buy new cows at a good price and be confident they did not have Johne's. We contacted the School of Veterinary medicine to as for help in eradication of Johne's from our herd."

When herd production and farm income began falling, the owners elected to stop using the services of DHI. Consequently, detailed analysis of production records was difficult. However, annual reports of average herd size and total annual milk production were available from the herd owner's banker. These are shown in Figure 1.

Summary herd status at the start of the eradication campaign in July '95.

Herd milk production was falling. Herd size was down to 41 cows and net farm income was a problem. The estimated true prevalence of *M. paratuberculosis* infection was 31% (calculated as test prevalence of 7/45 (15.6%) x test sensitivity (approx. 50%). In addition, the herd history and ELISA data indicated a high infection rate in the heifers.

Methods

Goal: Eradicate paratuberculosis in 12 months

The goal was to see if it was feasible to rapidly eradicate Johne's from a heavily infected herd. While animal

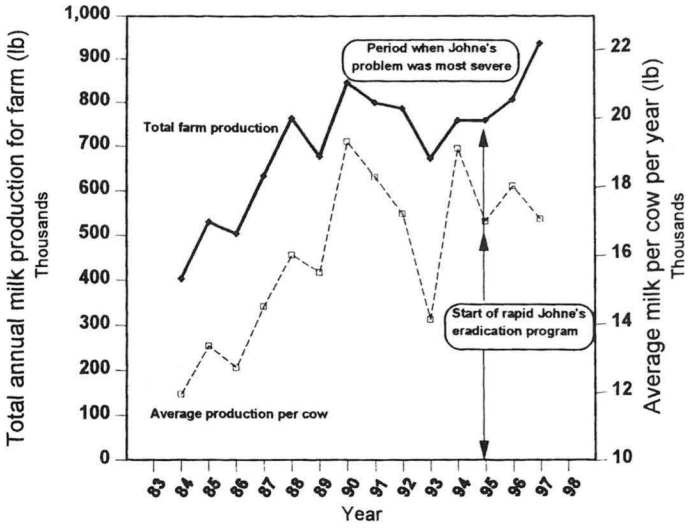

Figure 1. Production records (from banker) for annual production. Average production per cow was calculated by dividing the total annual farm milk production by the average number of cows in the herd in that year.

husbandry changes were important to the program, the experiment was designed to assess three key questions:

1. Are the diagnostic tests for Johne's good enough to find all of the infected animals?
2. Can clean herd replacements be found to sustain herd production and farm income?
3. Will environmental contamination cause herd re-infection with *M. paratuberculosis* ?

Experimental rapid Johne's eradication program:

1. Test all animals >6 months old by 3 different tests on two occasions, July, 1995 and March, 1996. The three tests were: ELISA for serum antibodies (IDEXX Laboratories, Inc), gamma interferon (IFN) (IDEXX Laboratories, Inc.), and radiometric fecal culture (modified BACTEC method).
2. Slaughter all animals positive on any test and all daughters of test-positive cows. (Seven of these culls were necrospied at the School of Veterinary Medicine to verify the accuracy of the diagnostic tests.)
3. Replace slaughtered cows with cows bought from a totally test-negative herd based on two tests: ELISA and IFN.
4. Improve calf husbandry:
   a) prompt removal of calves from cows after birth
   b) stop all feeding of fresh milk; begin feeding only milk replacer to all calves.
   c) clean and disinfect heifer rearing shed.

Independent evaluation of other herd production problems

To determine if there were other herd problems affecting herd productivity, the Production Medicine team of the University of Wisconsin, School of Veterinary Medicine, headed by Dr. Ken Nordlund, visited the study farm to evaluate overall farm health and productivity (2 herd visits in July '95), nutrition (November '95 and January '96) and milking system and mastitis control (January '96). No major problems were noted other than nutritional problems associated with the herd owner's limited experience with TMR feeding and experimentation with grazing. In addition, there was found a lack of consistent animal identification and deficiencies in record keeping.

Results & Discussion

[presented in chronological order]

July '95 herd test

Of 41 cows, 7 (17%) tested positive. The test and necropsy results for each of these seven cows is shown in Table 1. Two of the ELISA-positive cows were not confirmed to have been *M. paratuberculosis*-infected at necropsy by histopathology and culture of tissues (false-positive ELISAs). On the July '95 test 1 of 14 yearling heifers tested ELISA-positive. None of the 29 younger heifers tested positive. Several of these animals were daughters of cows positive on one of the three tests. For this reason, and because of the history of clinical Johne's in heifers on the farm, we advised culling of all heifers on the property. However, the owner elected not to follow this recommendation.

Table 1. Diagnostic tests results for Johne's disease and necropsy findings for seven cows culled from the study herd.

Cow ID#	ELISA	IFN	BACTEC	Necropsy
13	POS	POS	POS	POS
35	POS	POS	POS	POS
37	POS	POS	neg	POS
76	neg	POS	POS	POS
32	neg	POS	neg	POS
25	POS	neg	neg	neg
27	POS	neg	neg	neg

August '95 - replacement herd test

After culling the animals positive on any one of the three tests, replacement animals were needed. A local dairy herd owner was retiring and interested in selling his entire herd. His herd of 25 cows had been closed and he was perfectly willing to have it tested for Johne's as a condition of sale. The herd tested 100% negative by ELISA and IFN. All 25 animals were bought and added to the original herd.

March '96 herd test

Of the original herd, 25 cows remained in March '96. All 25 tested negative by all three tests. The heifers had not yet been culled. Of these heifers 4/15 (26.7%) of the yearling heifers tested positive and 8/11 (72.7%) of the younger heifers tested positive on at least one of the three tests. All heifers were ELISA-negative. Nine of the 12 positive heifers (75%) were found positive by BACTEC fecal culture. Six of the 12 positive heifers (50%) were found positive by the interferon test. We again advised slaughter of all heifers born before July '95 when the Johne's eradication program was initiated. This time the owners followed our advice.

June '96 - considering another purchase of more dairy replacements

A candidate herd was tested by ELISA. Of the 96 animals tested, there was 1 positive, 1 weak positive, and 7 "suspect" cows. (Note: the use of categories such as "weak positive" and suspect is an ELISA interpretation system developed by our laboratory; the kit is designed to report results only as positive or negative). We advised the study herd owners not to buy cows from this herd and he complied with this advice.

May '97 - follow up herd test

The adult herd was tested by ELISA, IFN and BACTEC fecal culture. All 70 animals were ELISA-negative and fecal culture-negative. Two cows had suspicious IFN test results. One of these cows died of accidental injury before follow up testing could be done. The other cow, #116, when retested was ELISA-negative and IFN-negative but BACTEC fecal culture-positive. Tracing back the origin of this cow, we discovered it was purchased shortly before the project began when the clinical Johne's was plaguing the herd and cow numbers were dropping. Thus, this *M. paratuberculosis*-infected cow was neither a member of the original herd nor a member of herd purchased in August '95 for dairy replacements.

March '98 - status

Herd production continues to climb but the herd is having health and some production problems due to the advancing age. For the past two years the owners have not had home-raised dairy replacement heifers. They would like to remove older and low-producing cows from the herd and replace them, but on farm reared replacements, born after the herd clean up, will not calve until May, 1998. Consequently, the owners are actively seeking to buy herd replacements from Johne's disease test-negative herds. This is a challenge facing many herd owners wishing to expand or simply purchase modest numbers of dairy replacements from outside sources.

Discussion

Thorough evaluation of the herd by the Production Medicine team found no major problems that could account for the declining milk production in the herd. Thus, we conclude that paratuberculosis was the most significant cause of the production problem. Given the prevalence of clinically as well as sub-clinically affected animals in this herd, the production decline in the face of adequate nutrition was not surprising.

In the July '95 herd test, 17% of 41 cows tested positive. Judging by either the estimated true prevalence (2 times test prevalence) or by adding these 7 test-positive animals to the number culled for Johne's disease in the past year, the herd had a very high *M. paratuberculosis* infection rate. Two cows had false-positive ELISA results. In our clinical experience, this occurs most often in heavily infected herds. We suspect that on heavily contaminated premises, adult cattle can be extensively exposed to the organism, at times resulting in a serological response that does not represent a progressive infection.

The heifers on this farm were suspected of being be highly infected based on prior herd history, prior herd husbandry (extensive feeding of transition and waste milk), the number of test-positive cows, and the familial relationship of heifers to these cows. Laboratory tests did not support this suspicion in July '95, however, and the economic pressures on the owners caused them to resist taking our advice to cull all heifers on property.

The aggressive culling program diminished the milking herd to 34 cows causing a financial strain on the dairy. Consequently, purchase of dairy replacement cattle was necessary. A local herd owner was found who had no reluctance in having his herd tested for Johne's disease. The ELISA and IFN tests were unequivocally negative on the sellers herd. The entire herd of 25 was purchased and 5 of the less desirable animals were immediately sold.

The March '96 test verified that all of the adult cattle (25 of the original herd and 20 of the purchased dairy replacements) were negative on each of the three diagnostic tests for Johne's disease. The heifers, however, now had a high number of positive tests confirming earlier suspicions about the infection level in these animals. All heifers were then sold and the facilities thoroughly cleaned and disinfected. Heifer raising in clean facilities, under stricter husbandry rules, began again in the summer of 1996. Often in heavily infected herds, the worst source of dairy replacement heifers are those being raised on the premises. In those situations, it is less risky (from a Johne's disease perspective) to go to outside sources for replacement animals. Slaughter of the highly infected heifers is preferred. It is hard,

however, for owners who sell these animals to dealers and guarantee that the heifers are in fact slaughtered. Since heifers show no outward signs of *M. paratuberculosis* infection, they are likely to end up being sold to some other unsuspecting producer. In this way, an aggressive culling program can unfortunately and innocently lead to spread of paratuberculosis to other herds. Recognition of tests for Johne's disease by the Secretary of Agriculture as official, and enforcement of federal rules on paratuberculosis (see CFR part 80 - Paratuberculosis in Domestic Animals requiring these heifers to have been ear tagged, branded, and sent directly to slaughter) would reduce spread of the disease. Control over movement of paratuberculosis positive cattle represents a major challenge for the cattle industry. The owner's sentiments are reflected in an article in May, 1997 issue of Dairy Today titled "Dairies dispersing disease".

The May '97 test showed the herd was 100% negative by ELISA and by BACTEC fecal culture. However, two cows had suspicious IFN test results. One of these two cows was lost to follow-up due to accidental death from an injury. Retest of the other clinically normal cow, #116, was ELISA-negative and IFN-negative but BACTEC fecal culture-positive. Cow #116 and her daughters were culled from the herd. This cow was purchased from an outside source before start of the rapid eradication program. These findings illustrate that the IFN test can be a sensitive means of early detection of infected cattle. We hope that presence of this single infected cow has not jeopardized the infection status of the herd.

Conclusion

Although possibly too early to make definitive conclusions, it appears that the rapid eradication program successfully eliminated paratuberculosis from the dairy herd. While the aggressive culling plan caused financial hardship, the herd acquired clean replacements without great difficulty. Re-infection of the herd from environmental sources has not been detected thus far. Herd production rebounded with the implementation of the Johne's eradication program (see Fig. 1) and the herd owners are very pleased with the results (read Dairy Today, May, 1997).

The goal of the project was to demonstrate that it is FEASIBLE to eradicate paratuberculosis, and that it can be done fairly quickly. The project was not intended to evaluate the most cost-effective strategy for Johne's eradication. Conscientious implementation of husbandry changes to limit spread of *M. paratuberculosis* infection coupled with accurate record keeping, and a testing program to identify the infected cows for culling should lead to control and eventual elimination of paratuberculosis from most dairy herds.

Acknowledgments

Rapid eradication of Johne's disease from this herd would not have been possible without a grant from the Wisconsin Milk Marketing Board. The investigators and herd owners also thank the Food Animal Production Medicine section of the School of Veterinary Medicine, University of Wisconsin-Madison for their help with this project.