



# **Annual Report**

## **October 2009**

## Contents

<b>Definitions:</b> .....	<b>2</b>
<b>JDRC DIRECTORS</b> .....	<b>3</b>
<b>JDRC BOARD OBSERVERS</b> .....	<b>4</b>
<b>MANAGEMENT</b> .....	<b>4</b>
<b>JDRC REPORT</b> .....	<b>5</b>
<b>THE SCIENCE PROGRAMME</b> .....	<b>6</b>
<b>JDRC'S 5 YEAR SCIENCE PROGRAMME</b> .....	<b>7</b>
<b>SCIENCE ACTIVITY AND PROGRESS</b> .....	<b>7</b>
<b>THE HIGHLIGHTS FOR 2008-09</b> .....	<b>9</b>
WHAT THE FARMERS TOLD US .....	9
MORE THAN JUST GENETICS .....	11
DEER AGE SUSCEPTIBILITY .....	12
COMMUNICATING OUR RESULTS .....	13

### Definitions:

JDRC	Johne's Disease Research Consortium
MAP	<i>Mycobacterium avium paratuberculosis</i> – the bacterium that causes Johne's disease
Paratuberculosis	Another name for Johne's disease
PTB	Paratuberculosis
UJV	Unincorporated Joint Venture

## JDRC DIRECTORS



Dr Andrew MacPherson, Independent Chairman



Dr Jimmy Suttie, AgResearch Limited



Dr Eric Hillerton, DairyNZ



Mr Mark O'Connor, Deer Industry Association Zealand



Livestock Improvement Corporation



Dr Grant Guilford, Massey University



Dr Max Kennedy, Meat and Wool NZ



Dr Bret Morris, Otago University



## JDRC BOARD OBSERVERS



Dr Liz Feary, Foundation of Research Science and Technology



Dr Lindsay Burton, Dairy Companies Association of New Zealand



Mrs Robyn Deacon, Meat Industry Association



## MANAGEMENT



Miss Kaylene Larking, JDRC Manager

## JDRC REPORT

The Unincorporated Joint Venture (UJV) document establishing the Johnes's Disease Research Consortium (JDRC) was officially enacted in June of 2008, following two years of negotiations between the collaborating parties. The Parties to the UJV, Meat and Wool New Zealand Limited, DeeResearch Limited, DairyNZ Limited, Massey University, Otago University, Livestock Improvement Corporation and AgResearch Limited, have committed to invest \$5.5 Million dollars over 5 years towards the goal of reducing the impact of Johnes's disease on farm in New Zealand. This funding is matched dollar for dollar by the Foundation of Research Science and Technology Consortia fund. The Meat Industry Association and Dairy Companies Association of New Zealand are associate participants to the agreement.

The disease is complex and combining the resources of our major industry associations and research expertise is vital to ensure New Zealand benefits as much as possible from our investment in this area.

The results from the first year of operation are very satisfying. Although the programme is in its infancy we are already in a better position to assess the prevalence of the disease in New Zealand and are seeing some practical outcomes from the research that will contribute to controlling Johnes's disease on farm. At the completion of the science programme it is our intention that JDRC will have developed a number of cost effective, practical tools for New Zealand, aimed at ensuring that that Johnes's disease is not a threat to New Zealand's agricultural economy or trade.

## THE SCIENCE PROGRAMME

Reducing the impact of Johne's disease on farm is the multifaceted, long term goal for the Johnes Disease Research Consortium (JDRC). *Mycobacterium avium paratuberculosis* (MAP), the bacterium which causes Johne's disease, is a difficult organism to study. It grows slowly in culture systems, is difficult to detect and its effect on ruminant animals is most often long-term. Research is progressing, but the speed of the research is limited by these constraints and the full 5 years of the programme will be required to see JDRC progress towards its goal.

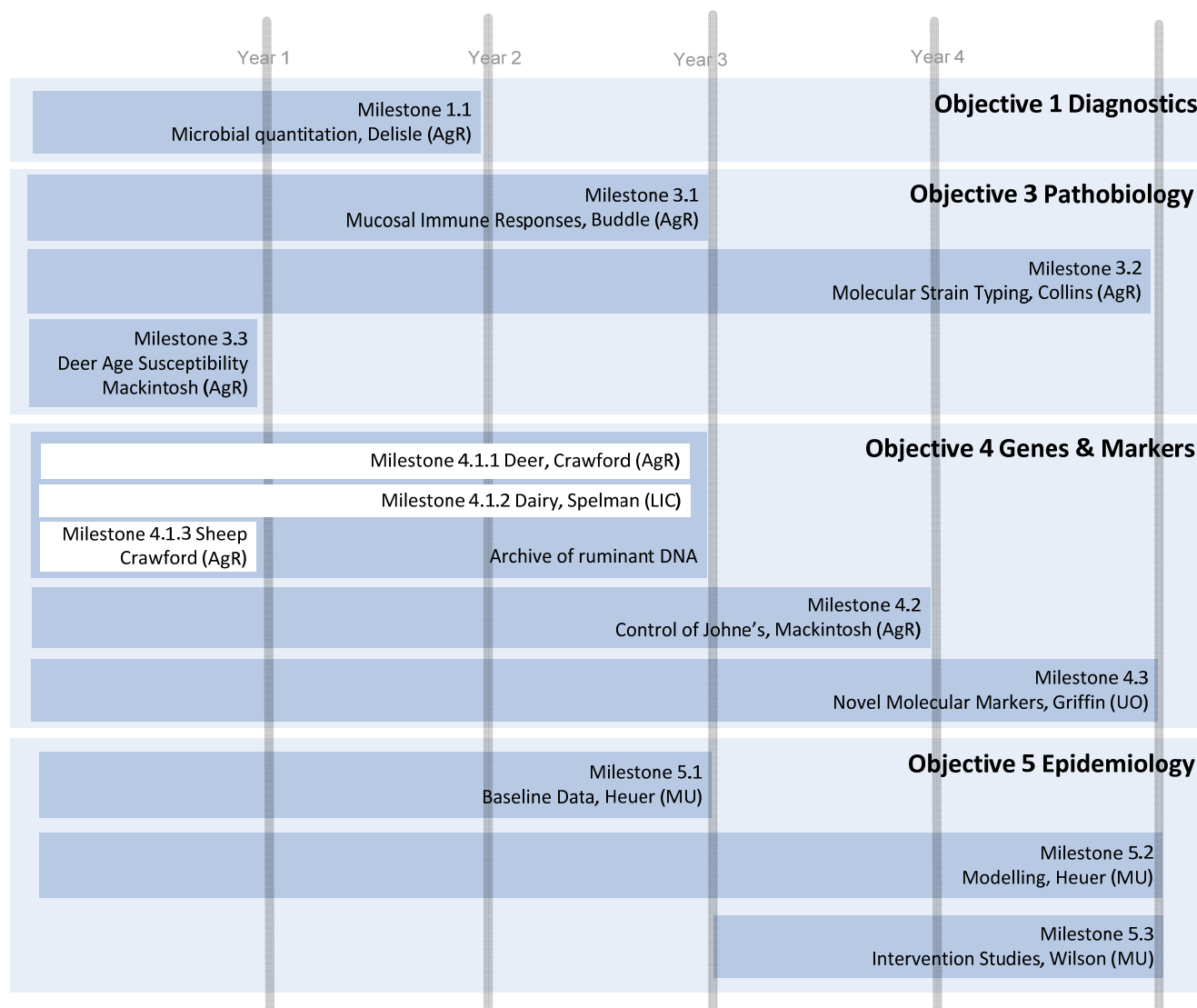
JDRC recognises the breadth of research being carried out internationally to address Johne's disease. We both contribute to and draw from the global effort to minimise the effects of the disease and through our own research programme seek to expand knowledge of the disease and understand its prevalence, control and management in New Zealand.

The JDRC science team is composed of experts from AgResearch, Livestock Improvement Corporation, Massey University and the University of Otago. Individuals in the team have been studying paratuberculosis for many years. The science funded by the consortium is both supporting existing research programmes and funding the expansion of research into new areas of understanding. The strength of the consortium is its ability to combine the expertise of this science group with the backing of the agricultural industry and the Government to ensure New Zealand is well positioned to manage and control this potentially devastating disease.

The JDRC is investing in four major objective areas; improving diagnosis of Johne's disease, understanding the pathobiology of the disease, determining markers for genetic resistance and understanding Johne's disease epidemiology in New Zealand. A number of achievements have been made in 2008-09 as well as steady progress towards reaching long term goals in the science programme. In all activities, the JDRC supports and encourages collaboration between science teams, sharing information and practical resources wherever possible to maximise the outcome of the research expenditure.



## JDRC'S 5 YEAR SCIENCE PROGRAMME



## SCIENCE ACTIVITY AND PROGRESS

Diagnostics	<p>A key factor that affects all aspects of Johne's disease management and control is the ability to diagnosis infection accurately, as none of the current methods available are 100% reliable or accurate. In 2008-09 the JDRC diagnostic team have improved methods for detecting MAP in faeces and tissues.</p> <p>These initial results already have the potential to improve diagnosis for the JDRC's experimental programme, but more promising is the hope that further studies will result in an improved diagnostic test for the industry.</p>
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Pathobiology	<p>Improved strain typing and understanding the effects of Johne's disease on the gut of animals are two aims of the pathobiology studies.</p> <p>There are two major strains of MAP in New Zealand, bovine and ovine, however there are many more sub levels of these strains present in the environment. When sub-strains can be identified, there is the potential to track how that variant moves through an ecosystem and therefore design better strategies to control the spread of the organism. Studies in 2008-09 established assay techniques for identifying sub-strains of MAP from New Zealand sheep and cattle, as a precursor to the collection and identification of isolates in the coming years.</p> <p>Gut pathology studies are also underway. In this project a number of naturally infected cattle have been examined using immunological, bacteriological and histopathological techniques to evaluate the gut response. One benefit of this 3 year study will be information to assist the genetics researchers identify key traits for selection of Johne's disease resistant animals.</p>
Genes and Markers	<p>Genetic variation exists in ruminant animals with respect to resistance to Johne's disease. Therefore, knowledge of the genetic control of susceptibility and resistance offers a potential method for future control strategies.</p> <p>Alongside the collation of a database and tissue archive for MAP infected animals, JDRC is investing in state of the art genetic studies to identify markers of resistance in animal populations. In 2008-09 steady progress has been made in collecting samples for the database and examining immune responses in MAP infected animals and in cells cultured in the laboratory to support these genetic studies.</p>
Epidemiology	<p>Epidemiology is the study of factors that affect health and illness and is fundamental for providing insights into disease management. The JDRC epidemiology programme is looking to identify cost effective management procedures for reducing production losses caused by Johne's disease.</p> <p>Alongside studies to help understand disease prevalence and its effects, the JDRC is funding modelling studies to predict the effect of modifying various parameters on the impact of the disease. In 2008-09 JDRC has funded a survey of 2000 New Zealand farms and a sampling programme to support the ongoing evaluation of the impact of Johne's disease in New Zealand.</p>



## THE HIGHLIGHTS FOR 2008-09

WHAT HAS BEEN DONE	THE RESULTS	HOW THIS HELPS	WHAT IS STILL TO BE DONE
Completed a New Zealand wide survey reporting the incidence of Johne's disease suspected or confirmed by farmers.	18-35% of Deer , 18-21% of Dairy Cattle, 5-14% Sheep and 2-4% of Beef cattle farms responding to our survey have suspected or confirmed clinical Johne's disease on their properties in the past 3 years.	Understanding prevalence and the impact of the disease on production performance is strategically valuable for NZ.	Validation of these data by sampling on farms to confirm test results and provide robust data for data modelling.
Validated an economical screening test for Johne's disease in dairy cattle.	It has been established that Elisa testing of vat milk can be used to screen herds for the disease reliably.	Reliable diagnostic tests are necessary to study and control the disease. This work has also confirmed the low prevalence of Johne's disease in the NZ dairy population.	Creating a database of cattle samples from which genetic studies can be conducted. JDRC will use this database to support studies for breeding JD resistant animals.
Completed a study into the susceptibility of deer to Johne's disease as they age.	The study has proven that younger deer are more susceptible to developing Johne's disease on exposure to MAP than yearlings or adult animals	There are practical steps farmers should take to isolate young deer from exposure to infection from other stock and pasture to reduce clinical disease on farm	This work has been completed and no further studies are planned.

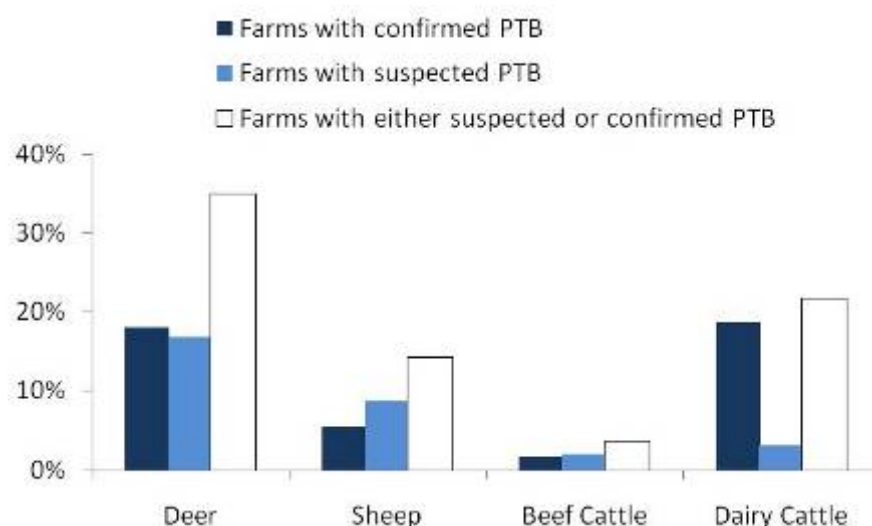
## WHAT THE FARMERS TOLD US

Clinical Johne's disease is suspected to be widespread in pastoral ruminant species and in wildlife in New Zealand, but current evidence is unclear about its distribution. Previously there has been very little in the way of a coordinated effort to answer the complexity of the questions surrounding disease prevalence in New Zealand. Similarly, little data exist about the transmission of MAP in domestic ruminants and about associations between clinical Johne's disease and herd production performance.

An answer to this, in part, has been to complete a large population-based survey intended to describe farmer observed and confirmed clinical Johne's disease incidence in various regions of New Zealand. Funded by JDRC, this survey was undertaken by researchers at Massey University.

The survey questionnaire, sent to approximately 8000 farmers in 7 regions, requested information about the observation of clinical PTB in the past 3 years, the pattern of co-grazing with other ruminant species, and reproduction performance. Farmer observed clinical disease prevalence was determined from the 1,934 (24%) commercial farms responding to the survey. The data shown in Figure 2 indicate that Johnes's disease is most frequently observed and confirmed in deer and dairy cattle in New Zealand, and is reported less frequently in sheep and beef cattle.

Reporting by sheep and beef farmers is believed to be limited to events of severe clinical loss, as clinical observations are rarely confirmed by laboratory diagnosis on such farms.



**Figure 2: Farmer Observed Prevalence**

The information gathered has indicated that there are relationships between animal co-grazing and the occurrence of Johnes's disease (see Table 3), raising the hypothesis that virulent MAP may be transmitted between species during contact on pasture. Of note was the observation that co-grazing a species free of observed clinical Johnes's disease appears to be associated with less disease in other species. This may be a useful parameter for practical control of the disease on farm.

**Table 3. Reported Prevalence seen with Co-grazing**

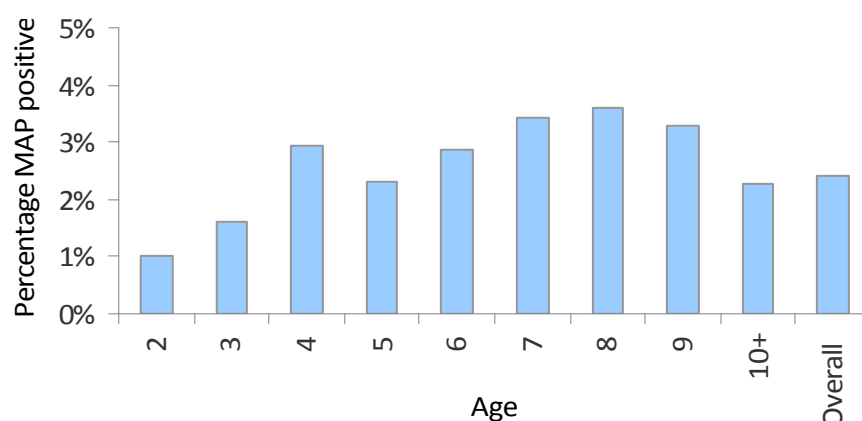
Species	Status	Effect on Sheep Prevalence	Effect on Beef <sup>1</sup> Prevalence	Effect on Deer Prevalence
Sheep	PTB negative		None	3 fold decrease
Beef Cattle	PTB negative	Decrease		None
Deer	PTB negative	Decrease	None	
Sheep	PTB positive		8 fold increase	7 fold increase
Beef Cattle	PTB positive	10 fold increase		None
Deer	PTB positive	6 fold increase	None	

Observations also suggest that the presence of clinical Johnes's disease is negatively associated with reproductive performance of deer. Pregnancy rates of sheep were not found to be associated with clinical Johnes's disease.

<sup>1</sup> While interactions are less apparent between deer and beef cattle, this may be due to a low reporting rate for PTB in beef cattle and a small number of beef farms keeping deer.

## MORE THAN JUST GENETICS

For each species within its science programme JDRC is investing in the development of DNA sample archives, which will provide robust databanks for all genetic studies. LIC is tasked with establishing this database for dairy cattle. An early outcome from this work has been the validation of a Johnes' disease diagnostic screen for dairy cattle. ELISA testing of pooled vat milk samples for pre-screening herds and subsequent pooling of samples to identify positive cows has shown to be a robust and economical diagnostic technique for the disease and has had the added benefit of confirming that the prevalence of Johnes' disease is low in the national dairy cow population. Of the approximately 19,000 samples screened across New Zealand during the validation study approximately 2.75% of herds tested positive for MAP. The results also indicated that there is differing frequency of Johnes' disease across breeds (Table 4) and that the incidence of Johnes' disease increases as cattle age (Figure 3). This work will now progress to sampling large numbers of cattle, with known infection status for the DNA archive.



**Figure 3: Disease Incidence with Age in Dairy Cattle**

**Table 4. Sero-prevalence by breed**

Breed	Number of cows	% Positive samples
Jersey (> 13/16)	11033	3.1
Holstein Friesian X Jersey	2295	2.7
Holstein Friesian (> 13/16)	4972	0.9
Miscellaneous	622	2.1
Overall	18922	2.75

## DEER AGE SUSCEPTIBILITY

A 3 year study investigating the susceptibility of deer to paratuberculosis, initially supported by the Foundation of Research Science and Technology funding was completed by JDRC in 2009, at AgResearch, Invermay. The study has shown a clear age-related susceptibility of deer to the development of Johne's disease following heavy challenge with a bovine strain of MAP. Weaners, yearlings and adult deer were exposed to MAP and then monitored for 12 months following exposure to the organism. Results



indicate that the disease is most severe in younger animals; clinical cases of Johne's disease only occurred in the weaners, and weaners were much more likely to be shedding MAP in their faeces than yearlings or adults. Almost all of the yearlings and adult deer became sub-clinically infected with MAP, but very few developed lesions in their intestinal tract characteristic of Johne's disease. This implies resistance to the development of clinical disease in older animals. It is hoped that understanding the relative susceptibility of different age groups to disease may assist the management and control of Johne's disease on infected farms.

## COMMUNICATING OUR RESULTS

A key objective for the JDRC is ensuring that the information developed by this Consortium is available to and used by farmers. JDRC is using existing networks and resources of its participants to distribute information to the public, including industry newsletters. JDRC has also developed a website ([www.jdrc.co.nz](http://www.jdrc.co.nz))





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