INDUSTRY AND INDIVIDUAL FARM PERSPECTIVES OF DEER JOHNE'S DISEASE

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Johne's disease (JD) is clearly an emerging disease of deer industries a North America, New Zealand, Australia and the UK. The global occurrence of JD in other species suggests it is also likely to become a concern to deer industries in other countries. The clinical occurrence and diagnosis of this disease has been discussed elsewhere. It is clearly a complex problem at an individual herd and industry level. This presentation will focus on the issues faced by the individual farmer and the industries as a whole in relation to JD, and will propose a number of options, particularly at the industry level. Areas for research necessary to underpin industry and on-farm JD management programmes will be proposed.

JD and the individual farmer

The individual farmer will view JD in relation to the risk to his or her herd. It can be seen from two perspectives:

Not a serious issue

Farmers whose herds already have JD and who have not experienced outbreaks of this disease in young deer might consider JD to be of minimal concern. If only an older herd is managed, only sporadic losses might occur, provided nutrition, handling, environmental management and disease prevention/animal health programme are optimum. A farmer with an infected farm may choose to alter the stock policy, such as to older stock for only a short term (eg. purchase pregnant hinds, calve them, and slaughter them, and sell weaners), to minimise financial risk. Thus, some farmers with JD will adopt a pragmatic approach and live with the disease.

Alternatively, some farmers may be unaware of this disease and its potential impact on their farming system. This ignorance could be costly, as some farmers have found. However, with increasing awareness of this condition a growing number of farmers are becoming wary.

A serious issue

Johne's disease is a real or potentially serious issue in the following circumstances:

- If JD does not currently exist on the farm, and the farmer wants to keep it that way;
- If JD does not exist on a deer component of a larger sheep and/or cattle farm which has the infection in those stock classes;

- If the farming enterprise relies on purchase of weaners from a number of sources for venison finishing. This is important since the highest loss rates have been in this class of animal and under those circumstances;
- If the farm is a stud selling high-value animals or genetic material. In New Zealand declaration of JD is now beginning to affect stud deer sales. It is becoming more imminent that stud deer farmers will be asked by wary buyers to provide an assurance of the JD status of their property. Potentially, because the risk of transmission in semen and with embryos is very small, the market may dictate that a reputable studs with JD may be able to sell only genetic material rather than live deer;
- If a commercial deer farm is genetically recorded as part of a breeding and selection programme, the effective value of individual animals increases and therefore the risk of loss of genetic potential through disease such as JD increases;
- If highest profitability is the goal of the property, risk of clinical and/or sub-clinical losses will limit the ability to achieve that goal;
- Food safety, either real or perceived, is one of the major risks to the marketplace. The risk of transmission of *M. paratb* to humans has not yet been proven. While it is unlikely that JD would transmit via venison, this has not been proven not to be the case. The consumer may be less convinced by lack of evidence rather than evidence that confirms lack of risk. Furthermore, while one tends to focus on the consumer of the product as being "the market", in reality it is frequently the big chain retailers who determine acceptability of product in the marketplace. To differentiate product from that of competitors, a large retail chain could decide that they only wish to source venison from proven JD-free herds, regions or countries, thus giving a competitive advantage over their rival retailers.
- There is always a risk that those in the venison supply chain may talk the price of venison down if there is a perceived or real risk of disease transmission;
- While there is no indication that JD has transmitted with velvet antler, this product is unique in that the first step in the processing chain is at the farm, in a deer yard environment, which in most circumstances would not meet the requirements for hygienic food handling. Contamination of the velvet from faecal material or dust containing mycobacteria may be inevitabe. The organism may survive the processing procedure, depending on which method is used, eg. freeze-drying vs. heat.

Keeping a herd JD-free

Many farmers whose herds currently demonstrate no evidence of JD are becoming concerned to keep their current "JD-free" status. Increasingly questions are being asked of veterinarians as to how the JD status of live animals can be verified. The following options are proposed:

- *JD-free herd of origin for deer purchases* - At present, without a validated herd screen test, this can be based only on clinical evidence of absence of disease, coupled with the integrity of the seller's declaration. Definition of status on these criteria alone is unlikely to be robust since the complete history of the herd of origin would require knowledge of sources of stock coming onto that property over a prolonged period, whether at-risk sheep or cattle had mixed with deer or been grazed on the deer farm, and the trustworthiness of the supplier of the information.

- *Semen* – there have been no published studies in deer to establish whether *M. paratuberculosis* will survive in deer semen. However, *M. paratuberculosis* has been cultured from fresh semen from clinically affected cattle. Thus, semen destined for other properties should not be collected from deer with clinical symptoms of JD despite the temptation for the owner to do so, if a valuable stag is clinically sick and unlikely to survive. However, preservation for use on the property of origin is an option.
- If semen is frozen there may not be a significantly reduced likelihood of transmission of *M. paratuberculosis*. There appears to be no studies that show whether or not JD can survive in frozen semen, even in Cattle. However, extenders are designed to protect cells of sperm and may protect cells of *M. paratuberculosis* during the freezing process, so the risk may not be eliminated.
- A further consideration is whether or not the infection would become established in an inseminated hind. In cattle, recovery of *M. paratuberculosis* from the reproductive tract of artificially inoculated cows has been reported in the absence of development of clinical disease. Thus, the organism may sequester in the reproductive tract.
- Embryos - fresh embryos may contain a small risk of transmission of *M. paratb* but it is likely to be very low. Frozen embryos are likely to present an even lower risk.

Farmer risk aversiveness

Based on these criteria the farmer needs to decide how risk-averse they are to the introduction of JD. One example of risk aversiveness was where a farmer wanted to use a trophy stag destined later to be shot in a safari park, as a natural breeding sire, to attempt to achieve good antler genetic gain. In that instance, because the risk was unacceptable because the JD status of the herd of origin was unknown, semen was collected from the reproductive tract of the animal immediately after it was killed by hunting. At the same time the animal was inspected for health, a blood sample was collected for gel immunodiffusion, ELISA and complement fixation tests, faeces were smeared for a ZN stain and cultured, gross pathology was observed, a histological section of ileocaecal valve examined, and the semen was both cultured and subjected to a PCR test. It was agreed that if all of those test criteria were negative the risk of transmission of JD from that semen was very minor!

JD and "the industry"

In New Zealand, because of the prevalence of this disease in sheep and cattle, and because of political and economic ideologies, for most situations the presence of JD in the deer industry is regarded as a problem for the industry and not a responsibility of MAF on behalf of society as a whole, as are exotic diseases like Foot and Mouth. Thus, the industry is generally required to fund programmes both to investigate means of control and to implement control or eradication programmes. However, that is not the case for all industries. One notable exception is the Animal Health (Australia) National Johne's Disease programme that is setting out to eradicate JD from sheep cattle and deer. For that programme it is recognised that infected deer herds could confound the eradication programme. During surveillance, a number of JD-infected herds have been found. However, that scheme is on technical thin ice when it comes to deer herd screening since no test has been validated for that purpose.

Another issue that industries face with "industry ownership" is that decision makers are often those directly affected or who may have voting constituents who are directly affected by the disease. This places those people in a potentially person and public dilemma.

Further, deer industries worldwide are small and their ability to generate revenue is limited compared with the funding required to operate national disease control programmes and to fund the research that is necessary to underpin such programmes.

An industry therefore has the following options:

Option 1. Do nothing

This may be the appropriate option if the herd prevalence of infection is already high, since current technology is insufficient to allow eradication of the disease by test and slaughter alone.

If the herd prevalence of the disease is low as is currently believed in New Zealand and North America, the "do nothing" option could result in:

- spread of the infection with a resultant increase in herd prevalence, and therefore this would result in:
- a higher incidence of clinical disease threatening the economic viability of individual farms
- potentially putting future markets at risk due to food safety concerns
- farmers whose herds are currently not affected are at risk of introducing infection forcing a policy of closing their herds if they are risk-aversive.

Option 2. Eradication

Eradication may be targeted, at least theoretically, at the individual animal and herd levels.

- *Individual animals*: currently a test and slaughter programme within a herd is not a feasible option. Firstly, no tests or combination of tests are adequate to detect infected animals reliably at a satisfactory sensitivity. Secondly, prolonged survival of the organism in the environment means that infection of other deer is virtually inevitable. This is in contrast with eradication of *Mycobacterium bovis* that has a shorter survival time in the environment, and for which there is an adequate series of tests and management methods to eliminate the disease in most situations.
- *Herd*: The infected herd can be depopulated thereby removing the infection from animals in the herd. However, unless there is a guarantee that replacement animals come from JD-free herds, this may be an exercise in futility. Furthermore, a considerable depopulation period is required to reduce the risk of reinfection via soil. Fifteen months depopulation, including two summers, is applied in the Australian sheep industry scheme, with a suggestion of cropping, if possible, in the interim. This is politically, personally and economically difficult, even with state funding.

  If the herd prevalence of the disease in a country is high there is little point in a herd depopulation option since most herds for replacement would be infected. Depopulation of large numbers of herds would result in an over-supply of venison and therefore a fall in the price, thereby further seriously affecting the economics of the deer industry.

Option 3. Control: A market assurance programme

The aim of a market assurance programme (MAP) is to reduce the rate of spread of the disease, therefore reducing the increased rate of increase in herd prevalence. This can be implemented to put the disease into a "holding pattern" pending future technology for diagnosis and/or control and/or eradication, eg. individual animal tests and/or validated vaccination.

A market assurance programme would have validity only if the herd prevalence of JD is low. Thus the first step is accurately estimate the herd prevalence. Speculation in New Zealand has chosen a national herd prevalence figure of less than 20% as a realistic starting point for a MAP. Another consideration is whether the MAP should apply to a whole country, a region, or another appropriate unit.

What does a market assurance programme do?

Market assurance programmes:

- establish a risk category for the farm based on a range of herd screening tests. The Australian sheep scheme has the following categories: "monitored negative 1-3 (years)", "Check tested", "Tested to MAP standard", "Nil assurance", "Suspect", "Under surveillance" and "Infected";
- allow the buyer to choose the risk category when sourcing animals;
- identify the herd status for the owner to manage, eg. if there is a high animal prevalence versus a low animal prevalence, or if there is a prevalence in difference classes of stock shown by a screen test, then management practices can be put into place.

How would a MAP be implemented?

Once the herd prevalence of the disease is established, and it is decided a MAP could be effective, the following proposal, put by the New Zealand Veterinary Association Deer Branch to the New Zealand deer industry, could be implemented:

- A voluntary programme would be the most feasible
- Herd screening tests would be applied sequentially to establish the risk status of the herd
- There would be a central register of infected herds. This register would be independent of the deer industry. One proposal is that it be managed by a central diagnostic laboratory contracted to perform herd screen testing
- Farmers would have the option then to declare their herd status or to withhold that declaration
- There would be education throughout the industry to encourage a "Buyer Beware" approach, meaning that purchasers of stock would request a declaration of herd status from potential sellers.

Advantages of a MAP

- It would decrease the rate of spread of JD throughout the national herd
- It would allow farmers to select deer from low risk farms
- It would buy time for research and introduction of new technologies to control and/or eradicate the disease
- It is a voluntary programme
- It is non-bureaucratic and therefore has minimal cost.
- Data would evolve to enable the industry to have a better idea on the herd prevalence of infection. This could have beneficial effects in the market place.
- If in the future product needed to be differentiated from JD-free herds for various market niches, it could be done as part of a quality assurance programme

Disadvantages of MAPs

- Tests are yet to be validated for this purpose
- Infected herds are exposed to the financial implications
- The programme will not, in itself, result in eradication of the disease. It can only limit the spread on infection
- Costs are borne by the individual farmer

Option 5. Vaccination

This option is applied in some circumstances the UK, with apparent success. At present, vaccination is permitted in New Zealand only upon application to MAF, because of possible confounding effects on the interpretation of tuberculosis tests. To date, no commercial deer herds in NZ have been vaccinated. (See the need for research, below).

What knowledge is now needed

The following would significantly aid deer industries in grappling with the problem of Johne's disease:

- Development and validation of cost-effective herd screening tests;
- Development and validation of individual live animal tests which are cost-effective;
- Investigation of the risk of carcass and velvet antler contamination with M. paratuberculosis to provide information for consumer food safety concerns;
- Understanding of the epidemiology and risk factors associated with disease outbreaks and spread of this disease so individual farmers can implement better management strategies to minimise the risk of clinical and sub-clinical losses associated with JD;
- Development of a vaccine. Ultimately this currently would appear to be the most appropriate method for management of JD within the deer industry. There are a number of technological advances in vaccine developments, including sub-unit vaccines, which may show promise. However, any vaccine introduced to the deer industry must be demonstrated not to cross-react with the tuberculin tests and therefore confound the tuberculosis control and eradication programme;
- There needs to be an awareness campaign amongst the industry to provide farmers with a better understanding of this disease and the difficulties that it currently poses to their industry

Conclusion

Johne's disease was predicted more than twenty years ago to be a potentially emerging disease for the deer industry in New Zealand, particularly after publications from the UK describing severe outbreaks of this disease in young deer. It is of significance that many deer industries throughout the world are now grappling with this problem. There is a considerable opportunity for industries to amalgamate their knowledge, their research needs, their funding and intellectual wisdom.

This disease currently is not having a huge impact on the deer industry in relative terms, but because of the rapid recent escalation in clinical diagnoses it is clear that the disease is spreading, and could severely affect the industry in future. Currently, a number of options exist for the individual farmer and deer industries. For both parties, there is no better time to implement a management programme than while the herd prevalence of the disease is low.