THE ART OF TB DIAGNOSIS IN DEER.

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Summary.

The successful execution of a disease control programme for tuberculosis in farmed deer requires informed and committed input by a number of individual groups. These include the farmer, the veterinarian, the diagnostic laboratory, the DSP staff, the MAFQual field veterinarians and livestock officers, and the MAFQual diagnostic laboratory. The success of the programme will depend to a large measure on the confidence shared by the individuals and their committment and efficiency in executing their respective roles in the programme. The input and cooperation by the informed and compliant farmer is the prime consideration in disease control. This will be complimented by technically competent testing and the identification of reactors, and their designation for second line testing to accurately exclude or identify tuberculosis. The pivotal role of the veterinarian is sustained throughout the programme and ranges from his informed input on the farm to skin testing and retrieval of diagnostic information from the DSP, the diagnostic laboratory or the MAFQual diagnostic laboratory. The diagnostic laboratory can play a role in identifying the basis of reactivity in individual skin test reactors so that an appropriate scheme can be put in place to retain non-specific reactors or recommend autopsy of animals at risk from Tb with specific reactivity to *M. bovis*. Submission of representative fresh and fixed pathological specimens from farm autopsy or DSP is a mandatory requirement to ensure confirmed diagnosis or exclusion of Tb. Differences in *M.bovis* biotypes means that the isolation of the organism will provide valuable epidemiological information in disease diagnosis within the herd but also facilitate surveillance and trace-back for disease. Inadequate input by any of the above groups will jeopardise the success of the disease control programme. The complexities of tuberculosis and its diagnosis demands that the most competent input by all concerned individuals is required for the efficient implementation of the National Disease Control Programme for tuberculosis in New Zealand deer herds.

PERSPECTIVE

The title has been chosen to highlight some of the complexities which influence Tb diagnosis schedules for farmed deer. The 'art' represents the exercise of available skill to effect the accurate diagnosis or exclusion of *M. bovis* in deer. The 'artists' involved are many and varied, and their combined skills contribute to the quality and value of the art form. The performance may be as varied as the artists involved, and may result in a product which can evoke emotions ranging from despair to indifference or euphoria, in the consumer. The inexact nature of the science involved in Tb diagnosis demands that considerable understanding and tolerance is exercised by all the participants if the satisfactory product is to result. The outcome will be influenced as much by the confidence shared by the individual artists as their respective competence, so it is important that efficient levels of communication are established from the outset.

INTRODUCTION.

The pioneering studies by Beatson begun in 1978 (Beatson *et al*; 1984), have not only identified tuberculosis in deer as an important disease but also highlighted the possibility that Tb in deer could present the same, if not greater, problems in diagnosis and management as had been seen in the earlier studies in humans and cattle. The irony being that whereas tuberculosis has been identified as an important disease in humans and domestic animals for centuries, its pathology on associated immune reactivity has been under researched and its diagnosis is still incompletely understood.

Confounding gaps in our knowledge of the aetiology and diagnosis of Tb has meant that we are not forearmed with sufficient scientific information to apply well tried diagnostic systems for the management and ultimate eradication of Tb in deer. As in other facets of deer farming recent developments and experiences gained first hand have provided a relatively effective means for the ultimate control of this important disease. Using the premise that 'a little knowledge is a dangerous thing', the industry was at the outset left to speculate as to overall relevance of Tb and its diagnosis in farmed NZ deer herds. The lack of precise understanding of the disease and its diagnosis in deer has meant that perceptions within the industry have ranged from indifference or extreme caution in the approach of individual farmers to the disease. Its relevance has in turn ranged through the spectrum from it being considered as no more

than a nuisance to it being so important as to pose a significant threat to the development of the industry *in toto*. The reality is that unlike any other infectious process which affects deer, tuberculosis must be considered as a prospective disease which will touch every deer farm within New Zealand. The reasons for this are that Tb is an important disease in domestic animals, which can infect human beings, so that it has significant implications for human health and in the commercial exploitation of animal products within domestic and export markets. This means that every deer farmer has the obligation to set in place a disease management programme which will exclude or diagnose Tb in each herd, because unlike other diseases it must be accurately excluded to guarantee the long term viability of each individual herd. Unlike other infectious processes, where the disease need only be considered when clinical evidence of its presence is established within the herd, Tb must be considered until its absence is accurately confirmed. The outcome is that all NZ deer farmers must invest time and money in a disease management programme whose object may be none other than to exclude tuberculosis from their herd. Contingent in such a programme is the reality that only a small proportion of deer farmers will in fact diagnose Tb within their herd, and these individuals will have to apply rigid and defined management systems to ensure its accurate and complete diagnosis, before it can be excluded from the affected herd.

The individuals involved in the implementation of a successful Tb diganosis and eradication programme range from the Farmer, to the Veterinarian, the Diagnostic Laboratory, the Deer Slaughter Plant, MAFQual; Field Officers, Veterinary Investigation Officers and Diagnostic Laboratory Staff.

The Farmer.

The farmer has the primary and potentially most important role in the successful implementation of a disease control programme within the individual herd. The attitudes held by the farmer will facilitate the execution of a successful disease control programme or serve to obstruct the best efforts and intentions of all other participents in the scheme. Even with the imminent prospect of a compulsory Tb control scheme in view, its success is not guaranteed solely by the imposition of draconian measures on the farmer without his benign acquiesence. The attitude of the individual farmers will be influenced in a large measure by the confidence they place in the individuals involved in the test programme and the skills they bring to bear to complete an effective diagnosis. This will in many cases require

an initial educational input to ensure that the farmer is fully informed as to the technical possibilities and limitations which apply to the different facets of disease diagnosis and management.

Not only has the farmer an important contribution to make in providing an accurate herd history which will allow for effective design of the disease control programme, but also his husbandry skills and management will facilitate necessary strategies throughout the disease control programme. An informed approach by the farmer will ensure that the most appropriate steps can be taken at all stages of the disease control programme to optimise the possibility of early identification or exclusion of Tb within the test schedule.

The Veterinarian.

The veterinarian has the pivotal role to play in most facets of a Tb control programme within the individual herd and throughout the local region. The initial input should be to provide appropriate information to ensure that the client is fully briefed as to the objectives, prospects, and limitations likely to be experienced throughout the programme. Following this it is appropriate to identify an overall plan for the farmer to fit within his routine management scheme, so that testing targets can be reasonably met to the benefit of the farmer, without any compromise to proper disease control. The veterinarian has then a major input at a technical level to ensure that skin testing programmes are put in place which satisfy the highest technical standards and maximise the chance of identifying sensitised animals. At this stage the farmer must be confident that the test is being applied at a level appropriate for disease diagnosis and that the fullest confidence is shared by both the farmer and the testing officer. The farmer should be made aware from the outset that the real object of an immunodiagnostic programme for Tb diagnosis using a screening skin test, is to identify reactivity due to mycobacterial sensitisation. The farmer should be made aware that the identification of a skin test reactor is reasonable and that such a reactor should not be viewed as a potential disaster but may represent the most informative and valuable stock unit in the herd. He must be convinced that the object of the test programme is to find reactors, and then proceed to identify the basis of such reactions so that tuberculosis can accurately be excluded or diagnosed.

Accepting the likely outcome that skin test reactors will be found in the initial stages of a diagnostic programme, then it is necessary to properly define routes for further study of such animals to execute an efficient diagnostic programme. The

farmer must be convinced that the reactor animal is a potential asset rather than a liability and its further study will clarify the overall status of the herd. To ensure that appropriate information is obtained from reactors it is vital that the most sensitive second line diagnostic tests are put in place to guarantee the effective diagnosis or exclusion of disease. The only options available to the farmer for reactor stock found in the initial stages of a Tb control programme are; 1) to slaughter all reactor animals, or 2) to apply sensitive second line tests which will accurately and specifically identify the basis of the initial skin test reaction. Whereas slaughter of all reactor stock can be extremely efficient in diagnosing true tuberculosis which will produce lesions at autopsy on the farm or through the DSP, there are problems in excluding tuberculosis if no lesions are found in small numbers of reactor animals. Because of the high levels of sensitisation of deer with *M.avium*, blanket slaughter of all ST(+) animals will probably lead to wastage of non-specific ST reactors, at no risk from *M.bovis*. This identifies the advantage of using ancilliary laboratory tests such as the BTB which can accurately designate the basis and specificity of the individual skin test reaction. This means that if the BTB is carried out on a reactor animal it should accurately identify the likelihood of exposure to tuberculosis (*M.bovis*) or specifically identify exposure to *M. avium* or other Saprophytic Mycobacteria. Following slaughter or the use of ancilliary laboratory tests it is necessary for the testing veterinarian to report and interpret the findings so as to alert the farmer to the likeliehood of disease or provide convincing evidence for non specific reactivity. The veterinarian should be sufficiently informed so that alternative and less sensitive second line tests are not used to clear ST reactors early in a skin test programme. The ill considered and routine use of the CCT to clear ST reactor animals may result in tuberculosis being missed and a significant breakdown in disease control early in such a programme. Serious consideration must be given to the stage at which it is appropriate to introduce the CCT into a skin test programme.

The Diagnostic Laboratory.

With the development of the BTB in recent years (Griffin & Cross, 1986, 1989), and the emergence of second line screening tests such as the ELISA, the veterinarian now has a number of sensitive ancilliary tests available to accurately identify the basis for skin test reactivity in ST(+) reactor animals. The BTB can be used very effectively to identify the basis for sensitisation in reactor animals at any stage of a skin test

programme and can be extremely cost effective in the execution of such a programme. Should Tb exist within a herd and a reasonable number of reactor animals be submitted for BTB testing, then *M.bovis* sensitisation will become evident early. In this situation the logical autopsy of such animals will be recommended and the farmer can set in place an appropriate programme for the identification or exclusion of *M. bovis* disease. Should sensitisation be confirmed due solely to non-specific reactivity associated with *M.avium* in ST reactors, the farmer can be confident that animals need not be slaughtered and he is alerted to the possibility that non-specific sensitisation may be the basis for reactor status.

In situations where a large number of ST reactors are found there is the very likely possibility that dual sensitisation, due to mixed infection and exposure to *M. bovis* and *M. avium* will be the cause of ST reactivity. In such a situation the BTB will allow for the salvage of all ST reactor animals with sensitisation due solely to *M. avium* exposure. At the same time it is possible to identify specific reactivity due to *M. bovis* in individual animals and accurately identify such animals as appropriate for autopsy. The comprehensive post mortem examination of all animals with specific sensitisation due to *M. bovis* is totally justified irrespective of whether lesions are present or absent at autopsy. Significant debate has emerged in situations where *M. bovis* sensitisation is identified following BTB or CCT testing in animals which subsequently are shown to be NVL at autopsy. The laboratory takes the view that when evidence of specific *M. bovis* reactivity is present animals must always be submitted for autopsy. It is possible in a small number of herds that such apparently specific *M.bovis* reactivity will be due to sensitisation to environmental mycobacteria which cross react specifically with *M.bovis.* However in the majority of cases the reactivity will more likely be evidence of specific exposure to *M.bovis*. Should *M.bovis* infection not be present in a herd which shows spurious reactions then this will become evident on subsequent screening tests, where extra caution can be exercised in the identification and clearance of reactors. When Tb is present in such a herd it will become evident in 'sentinel' reactivity of 'in-contact' animals at a subsequent screening skin test.

Considerable debate has occurred as to the cost inherent in individual laboratory tests such as the BTB but a proper perspective must be given to such investment. The farmer should be made aware that his investment in the definitive testing of a small proportion of his animals represents the critical

examination of the most interesting stock within his herd with respect to disease diagnosis The information obtained and cost due for such tests relate not alone to the value of the individual reactor animal in question, but also serve to provide important information which allow the farmer to continue the test programme in the confidence that herd sensitisation is due to the non specific *M.avium* reactivity, or that reactions are due to *M. bovis* exposure within the herd. The early and specific establishment of the status of a herd will save considerable time and cost in the execution and completion of an effective disease control programme. Screening tests such as the skin test have the advantage that each animal within a herd is subjected to the test, whereas by contrast laboratory tests, such as the BTB, are used more selectively on very small populations of reactor animals. Even so, consumer perception demands that the test should provide information of a quality to allow the best decisions to be made not only with respect to the individual reactor animals, but that these findings should also reflect the status of residual stock within the herd. In both repects the BTB represents a cost effective 2nd line test for characterisation of ST(+) reactors.

The emergence of new generation tests such as the ELISA now mean that there are further tests available to farmers where *M. bovis* infection has been identified, but the prospect of residual disease due to false negative ST reactions is countenanced. To date the ELISA has been shown to be particularly effective in identifying seriously infected animals; the ones that are most likely to pass successive skin tests as false negative animals, so there is justification in applying cheaper second line screening tests in herds where significant disease is thought to exist. The application of such tests which use an independent measurement of immunity to Tb, mean that a farmer can identify and exclude seriously diseased animals, which can persist as a significant reserviour of infection, and confound the successful completion of a skin test programme using skin testing alone.

MAFQual. Veterinary Investigation Officers.

MAFQual staff have a very important role to play in the efficient implementation and successful conclusion of a disease control programme. The confidence enjoyed between the MAFQual Veterinarian and the practitioner will ensure to a large degree the efficient and painless implementation of a disease control programme. A rational and informed input by the MAFQual veterinarian should allow some flexibility in the implementation and completion of a disease management programme. Any adversarial interactions between the MAFQual veterinarian and

the practitioner will serve only to compromise a disease control programme. Providing a complete and accurate herd history is forthcoming, and a skin test programme has been implemented, then the most appropriate second line strategy for disease diagnosis or exclusion can be made by the collaborative interaction between the Statutory veterinarian and the practitioner.

DSP Inspection Staff

Should animals have been submitted for slaughter through a DSP then it is important that communications are established between the MAFQual veterinarian, the meat inspection veterinarian at the DSP and the practitioner Unless widespread tuberculosis lesions are found in the vast majority of reactor animals submitted for post mortem, and they are confirmed as true tuberculosis by laboratory diagnostic tests, then it is necessary that representative samples from all reactor animals from an individual herd considered to be at risk from *M. bovis* should be submitted for confirmatory diagnostic laboratory tests. Representative pathologic specimens from each individual animal examined at post mortem should be submitted from every animals considered to be at risk from *M. bovis*, having been selected for autopsy as high risk reactor stock. Our experiences infer that histological or microbiological confirmation of Tb is attempted in less than 50% of animals which had post mortem lesions compatible with Tb (ie Tb suspect) at the DSP. Incomplete or unrepresentative submission of material from farm autopsies or DSP meat inspection may result in an inaccurate assessment of the true disease status of individual animals or a herd at post mortem. Because there is no such thing as a 'typical' Tb lesion in deer, it is possible that pathologic specimens diagnosed macroscopically as 'typical' of tuberculosis may be excluded by laboratory examination as other than tuberculosis. On the other hand incomplete or inadequate post mortem examinations may mean that significant disease due to atypical *M. bovis* lesions may be overlooked, and animals infected with Tb may be designated as clear. This could mean that a farmer may be lulled into the false security that the herd is free from Tb when residual infected stock may remain undetected Informed caution as to the prospect of Tb will not cause infection to occur if it is not present, but should ensure that the chance of subsequently identifying Tb, when present, will be maximised.

MAFQual Diagnostic Staff.

The full confidence of the farmer cannot be sustained unless a

complete diagnostic regime is pursued to accurately identify or exclude tuberculosis. The unequivocal diagnosis of Tb due to *M. bovis* cannot be confirmed until *M.bovis* is isolated by the Animal Disease Laboratory at MAFQual. Until such a situation is reached for a sample submitted from an individual herd then it is possible that true tuberculosis may be overlooked or nonspecific lesions not due to Tb may incriminated as evidence of tuberculosis. The vagaries of tuberculosis in deer have meant that any pathologic lesion found in animals at autopsy must be regarded as suspicious of Tb when other test evidence points in this direction. Similarly, not all lesions in fact will be due to Tb and these will be evident from histopathology.

All costs due for completed diagnosis through the MAFQual diagnostic laboratory can be justified as appropriate for the ultimate diagnosis and control of Tb in NZ deer herds. An indirect benefit is that where Tb is accurately excluded the farmer can be saved significant worry and be given the increased confidence that Tb is not present to confound overall management systems. Clarification is required as to the extent and the future role that the MAFQual Diagnostic Laboratory will have in the diagnosis of Tb through pathological and microbiological examination of specimens obtained from Tb reactor deer. The contribution made by this group in the confirmation of Tb in deer has significant implications for the ultimate sucess of the National Control Programme for Tb in farmed deer.

References:

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