MEAT & LIVESTOCK AUSTRALIA

On farm

Modelling of OJD

Extension of project to include economic analysis and preparation of an existing package.

Project number OJD.027A
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INTRODUCTION

Under MLA Project OJD.027, the pathogenesis, epidemiology and options for control of Johne's disease in sheep were reviewed and mathematical models developed to simulate the spread of Johne's disease within infected flocks, and between flocks on a regional basis. The models also allow the evaluation and comparison of various control options at both flock and regional levels. These models were completed during 2002, and a final report on the project prepared for MLA.

However, for these models to be effectively used as an aid to the control of OJD in Australia, it is essential that managers and advisers involved in the OJD program at State and local levels are familiar with the models and with the predicted effects of various control strategies, at both farm and regional level. At the farm level, information on the predicted effect and cost-benefit of various strategies will assist advisers in formulating effective and efficient control strategies for individual farmers. Similarly at local and State/Regional level, the output of the regional spread model and simulated control strategies will assist disease managers to make informed decisions about preferred control options for OJD.

OBJECTIVES

This extension to Project OJD.027 was undertaken to:

1. Familiarise key managers and advisers in New South Wales, Victoria, South Australia and Tasmania with the models and to identify model scenarios that would provide useful information in the field.

2. Develop a package of advisory information for use by managers and advisers based on model output from scenarios identified in Objective 1, above.

3. Extend the existing flock model to incorporate an economic analysis of the effect of OJD and the cost-benefit of various control strategies.

METHODS

The project was undertaken as follows:

1. A series of workshops on the models were held, involving key OJD policy-makers, advisors and industry people in New South Wales, South Australia, Victoria and Tasmania.

2. Model scenarios were developed for presentation at these workshops, and these scenarios were revised and additional scenarios developed as a result of discussion at the workshops.

3. Draft material based on selected scenarios was prepared for inclusion in an extension/advisory package for use by producers and their advisors to assist in decision-making.

4. In consultation with an economist, the OJD Flock model was re-developed to include an economic analysis of the estimated direct costs of disease in infected flocks and the cost-benefit of any selected control options.

RESULTS

1. Workshops/presentations were undertaken as follows:

   - 12 February, 2003 – NSW Agriculture, Orange
   - 20 February, 2003 – National OJD Technical Advisory Group, Canberra
   - 27 February, 2003 – Producer field day, Kangaroo Island
   - 28 February, 2003 – SA OJD Advisory Committee and PIRSA staff, Adelaide
   - 13-14 March, 2003 – Victorian OJD Advisory Committee and Primary Industries staff, Melbourne
   - 26 March, 2003 – Tasmanian Advisory Committee and DPIWE staff

2. A range of scenarios were developed for both flock and regional models, and were discussed at the regional workshops. Additional scenarios were also developed following these discussions, and the original scenarios were modified and refined as necessary. There was considerable interest expressed at the workshops and some very valuable discussions evolved.

3. Advisory material was prepared on the following topics, based on the scenarios developed and presented at the workshops, and suggested refinements and additions. Draft material was prepared for MLA to develop further, on the following topics:

- Modeling the spread of OJD
- Patterns of disease – basic scenarios and costs of unrestricted disease
- The tip of the iceberg

- Control options – vaccination, low-efficacy vaccination, management and test-and-cull
- Cost of disease
- Vaccination options – high and moderate prevalence scenarios
- Early vaccination and vaccination of adults
- Vaccination plus management

5. Copies of annotated presentation slides were prepared in PowerPoint®, for further development into standard presentations by MLA.

4. A summary of the modifications made to the flock model to incorporate economic analysis is provided in Appendix 1, and a copy of the revised model was provided to MLA.

5. Some minor revisions were also made to the regional spread model, and a copy of the revised model was provided to MLA.

CONCLUSION

Modifications were made to the OJD Flock Model to support economic analysis of control options. A range of scenarios were then developed for both flock and regional models, in consultation with State departmental and industry representatives, and were provided to MLA for incorporation into advisory material for use by affected producers and their advisers.

Appendix 1: Inclusion of economic analysis in OJD flock model

Background

MLA Project OJD.027 was completed in July 2002, with provision to MLA of a final report and copies of flock and regional models for the spread of OJD. This project was subsequently extended to include the addition of an economic analysis component to the flock model.

Methods

The original model was amended to support economic analysis, as follows:

Table 1 summarises additional input values included in the model to allow economic analysis of the farm gate cost of disease in infected flocks and the cost-benefit of alternative control options:

Table 1. Summary of additional input parameters for economic analysis of OJD costs and control options.

Input	**Description**	**Default value**[a]
Vaccine cost	The net cost of purchase and administration of OJD vaccine ($/head)	$2.00
Test cost	The net cost of OJD testing ($/head)	$10.00
Management costs	The net cost of implementing management changes, as an overhead cost ($ total)	$0[b]
Replacement costs	The net cost of replacing sheep that die of OJD or are culled because of a positive test result, off-shears ($/head for adults, hoggets and lambs)	$44.00 (adults) $46.00 (hoggets)
Cull value	The cull value of test-positive animals that are culled	$20.00
Lamb value	The value of lambs not born or that die because of OJD in their dam ($/head)	$40.00
Wool price	Average net price received for wool (cents/kg greasy)	$4.60 (adults) $3.90 (hoggets)
Wool cut	Average weight of wool cut per head (kg/head greasy)	5.0 (adults)

		3.8 (hoggets)
Discount rate	The discount rate applied to future costs and benefits for calculation of Net Present Value and Benefit-Cost ratios	5%

[a] Default values derived from: Anonymous, 2002. Sheep gross margins August 2002: Merino ewes - 21 micron [Web Page]. Available at http://www.agric.nsw.gov.au/reader/3007. (Accessed January 2003).

[b] $0 default cost for management changes assumes no management changes for the default scenario. An appropriate value should be entered for scenarios where management changes are included as part of the control program.

Additional outputs were also included, to facilitate economic analysis of the cost of OJD and control measures, as shown in Table 2.

Table 2. Summary outputs for the analysis of OJD costs and control options.

Output	Description
Total wool cut (kg)	Actual kilograms of wool shorn - with disease scenario
Total wool return ($)	Actual $ return on wool shorn - with disease scenario
Expected wool cut (kg)	Expected wool cut in the absence of OJD
Expected wool return ($)	Expected wool return in the absence of OJD
Lost wool cut (kg)	Kilograms of lost wool production due to OJD
Lost wool return ($)	Value of lost wool production and reduced wool quality due to OJD
Replacement costs	Cost of replacing sheep dying because of OJD
Lost lambs	Value of lambs lost or not born because of OJD
Total disease cost	Total of above costs
Control costs	Total cost of control measures implemented
Control savings	Value of reduced costs due to OJD realised because of the control program
Net Benefit (annual)	Net benefit of the program = control savings – control costs
Net Present Value	Cumulative discounted benefits less cumulative discounted costs for each year of the control program, discounted to the year control measures started.
Benefit-cost ratio	Ratio of cumulative discounted benefits to cumulative discounted costs for each year of the control program, discounted to the year control measures started.

All economic parameters were calculated on an annual basis, and presented as mean, median and percentiles of values, from the number of iterations simulated. Net present values and benefit-cost ratios are calculated on a cumulative basis for each year that control measures are maintained, rather than as single values calculated for a pre-determined period of control (for example 20 years). This was done deliberately because on-farm control programs for OJD are not likely to be implemented as planned programs of a pre-determined duration. Rather they tend to be of indeterminate length, and may cease at any time depending on a variety of factors. Presenting these indices for each year that control continues allows an assessment of the benefit of continuing the program for any desired period. Alternatively, net present value and benefit-cost ratio could be presented as single values for a pre-determined period of control, if this was preferred.

Appendix 1 shows an example of summary output from the model, assuming vaccination in a 2,000 head flock from 20 years, using the default values listed above. The control program commenced in year 20, to allow time for the disease to establish and for mortality rates to peak.

Stopping vaccination

The model was also varied to include an option of stopping vaccination in any year after it has commenced, to allow evaluation of the likely scenario of producers ceasing to vaccinate after mortalities drop to a low level. Depending on the length of time for which vaccination is maintained, mortality rates rise again and stabilise at the same level as if vaccination had not been used, unless eradication has been achieved.

MAP testing

Simulated MAP testing has been added to the model, with testing undertaken during every simulated year. Additional inputs include the sample size for MAP testing (default = 350). Estimated test sensitivities by stage are as for the test-and-cull control option. Additional outputs include: the estimated probability of detecting infection for each year and iteration; the weighted-average sensitivity of the test adjusted for the number of animals in each state for each year and iteration; the proportion of iterations in which infection was actually detected for each year; and the cumulative proportion of iterations in which infection has been detected.