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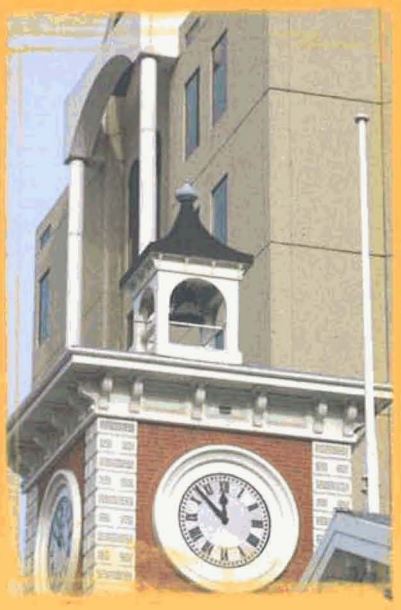

The Costs of Footrot and the Impact of the Footrot Gene-Market Test in New Zealand

A Report to the Sustainable Farming Fund

Glen Greer

Research Report No. 274
March 2005

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Executive Summary

- The Footrot Gene-marker Test (FGMT) programme has been funded by contributions from the Sustainable Farming Fund and the merino and mid-micron sheep industries to develop a tool for selecting footrot tolerant breeding animals. The research that is the subject of this paper has been conducted to calculate the costs of footrot to those industries and, therefore, the potential benefits from the FGMT programme, and to provide early estimates of the benefits that have been realised to date. It has also examined the level of understanding of the programme in the industry and, therefore, the success of the technology transfer element of the programme.

- The study involved postal surveys of merino and mid-micron farmers as well as personal interviews with a small sample of ram breeders and case studies of two commercial merino farms that are already realising substantial benefits from the use of the FGMT. The response rates, based on the proportion of total animals farmed on survey farms, were 45 percent in the case of the merino survey (247 valid responses) and 62 percent (634 valid responses) for the mid-micron survey.

- Sixty five percent of dominantly merino properties and 55 percent of dominantly mid-micron farmers had experienced footrot in their stock at some time. Approximately one third of each group of respondents had done so in all recent seasons, while 13 percent of merino growers and nine percent of mid-micron growers had no had footrot on their properties since before 2001/02. The remainder had experienced footrot infection of their stock in at least one season since 2000/01.

- The majority of farms that have been affected by footrot at some time (67 percent of affected merino farms and 66 percent of affected mid-micron farms) have experienced lower levels of footrot during the last three seasons than previously, which means that the total cost of footrot estimated by this survey is lower than would be experienced during a series of wet seasons. Approximately 12 percent of properties that have experienced footrot at any time have experienced more footrot than usual amongst stock during the last three seasons.

- On affected merino farms an average 8.8 percent of sheep have been affected by footrot during the past three seasons compared with six percent on affected mid-micron properties. The proportion of affected sheep on all surveyed farms (including those that have never experienced footrot) was three percent for farms of both types.

- Twenty five percent of merino farmers and 20 percent of mid-micron farmers reported that they include footrot tolerance amongst their selection criteria when they buy their replacement rams. Approximately a third of those who use FGMT results in selecting rams do not use actual scores but discuss the footrot tolerance of selected rams with their breeders in more general terms. Of the remainder the number who set a maximum score, and do not buy animals that have scores exceeding that, and the number who work to a preferred score providing other factors do not outweigh it are approximately equal.

- Thirty percent of merino farmers who use the FGMT results in ram selection and 36 percent of mid-micron farmers who do so report significant reductions in the impacts of footrot already. In general those who have experienced a difference to date rank footrot tolerance more highly as a ram selection criterion, require better FGMT scores in purchased rams, have been involved in the programme longer (have more stock

sired by footrot tolerant rams), and had higher cost of footrot at the outset than those who have yet to see a difference.

- The average costs of the prevention and control of footrot in 2003/04 dollars during the last three years on all surveyed merino farms was $2,963 or $0.50 per head, compared with $919 or $0.28 per head on all mid-micron farms during the same period. On merino properties on which footrot had been experienced, the average annual cost is estimated to be $4,545 or $0.78 per head, while affected mid-micron farms report costs of $1,665 or $0.48 per head. Labour comprises the largest element of cost (56 percent on merino properties and 53 percent on mid-micron properties).

- Properties that have already experienced significant impacts from adoption of the FGMT technology have reduced prevention and control costs by 50 percent on merino properties and 70 percent on mid-micron properties.

- Production losses attributable to footrot are estimated to cost $4,403 on all merino survey farms ($0.74 per head) and $958 on all mid-micron survey farms ($0.29 per head). On affected farms losses of production have been valued at $5,748 ($0.99 per head) on merino farms and $1,735 ($0.50 per head) on mid-micron farms. These losses have been reduced by approximately 60 percent on merino properties and 80 percent on mid-micron properties that had experienced footrot. The most expensive element of loss has been the need for premature culling of affected animals.

- The total impact of footrot has been estimated to be $7,365 ($1.23 per head) on all surveyed merino farms and $1,877 ($0.57 per head) on surveyed mid-micron farms. Total impacts on affected farms were $10,293 ($1.77 per head) on merino farms and $3,400 ($0.97 per head) on mid-micron farms. On merino farms where the impacts of the FGMT are already visible the average total impact of footrot has been reduced by 60 percent from $32,423 ($4.93 per head) to $13,293 ($2.02 per head). On mid-micron farms experiencing a difference the average total impact of footrot has declined by 77 percent from $12,240 to $2,893 or from $3.09 to $0.73 per head.

- The majority of ram breeders surveyed supported the FGMT programme with 84 percent rating it as “valuable” or “very valuable”. As yet they do not believe that their clients value the programme as highly as they do, which is supported by the results of the commercial farm surveys.

- Ninety percent will continue testing stud sires and 82 percent are still working towards a better maximum score. The largest group of these (34 percent) intend to achieve scores of 1/1 for all stud sires. The majority are testing sale rams and the average proportion tested is 75 percent. Sixty nine percent will continue testing sale rams although many do not know how for how long they will do so. A number expressed concerns about the end of the project funding and the impacts of higher testing costs on uptake of the technology.

- The majority (60 percent) of ram breeders supply all clients with footrot score data and a further 21 percent supply it on request, while twelve percent will discuss the test in general terms with clients who wish to do so. Fifty seven percent had supplied clients with information about the programme in newsletters, etc.

- The total annual costs of footrot estimated by this study must be regarded as “bottom-line” estimates only. In most parts of the country the last three seasons have been dry

and the incidence of footrot for most of the farmers surveyed has been lower than usual. In addition, the costs have already been reduced on some of the worst affected farms by the implementation of the FGMT programme. Under these conditions the industry-wide cost of footrot is estimated to be $5.32 million ($3.62 million to the merino industry and $1.70 million to the mid-micron industry)

- The potential benefits of the FGMT programme estimated by this study are also "bottom line" estimates of the reduction in costs and production impacts of footrot in drier than average seasons. The potential benefits were investigated under four scenarios including:

    1. Only surveyed farms realise benefits and the level of benefits is pegged at 2003/04 levels
    2. The level of benefits realised on survey farms is extended to the industry as whole but is capped at the level presently experienced on farms observing a significant difference
    3. All farms that have experienced footrot adopt the technology over the next five years and the benefits are capped at the level presently experienced on farms observing a significant difference
    4. All farms that have experienced footrot adopt the technology over the next five years and all benefits of footrot are eliminated in ten years.

- Under these scenarios the estimated annual benefits by 2013/14 range from 1.5 to 6.3 million dollars and the NPV(.10) of the project from seven to 24 million dollars. It is expected that annual benefits are most likely to be between three and six million dollars and the NPV(.10) between 14 and 24 million dollars.

- The reductions in chemical use on farms that have experienced the impacts of the programme are very marked. Zinc sulphate use has been reduced by 26 percent on merino farms and 55 percent on mid-micron farms, formalin use by 68 percent and 77 percent respectively, the numbers of doses of vaccine by 67 and 55 percent, and the numbers of doses of antibiotics by 66 and 99 percent.

Introduction

1.1 Background

The Footrot Gene-marker Test is a tool that has been developed for selecting footrot tolerant breeding sheep. Its use results in lower input costs as farmers reduce the use of other strategies for the prevention and control of footrot (vaccination, antibiotics, foot-paring and foot bathing). It also contributes to the protection of New Zealand's "clean-green" image by reducing the level of active chemical ingredients in the environment and by lowering the level of chemical use in food and fibre production.

Funds for the implementation of the test (which had previously been developed at Lincoln University) have been provided from the Sustainable Farming Fund and from merino and mid-micron industry groups and the test has been adopted by breeders of approximately 90 percent of all merino and mid-micron rams (76 breeders in total). Funding for testing in the merino industry has now ended and only one more season of funding is available for mid-micron ram breeders. In future the programme will be commercially funded.

The benefits of adoption of this technology have not been quantified and no review of the programme from the perspective of ram breeders has been undertaken, although a 2001 study (Davies, 2001) established the costs of footrot to the New Zealand merino industry, and therefore the potential benefits to that industry alone, to be of the order of nine million dollars annually.

The research that is the subject of this paper has updated the estimates of the costs of footrot obtained in 2001 (Davies, 2001) and made initial estimates of the changes that have resulted from adoption of the FGMT. However, as the FGMT has only recently been available and the oldest sheep sired by rams proved by the FGMT to be footrot tolerant are four tooths, only a small proportion of commercial farmers believe that their flocks are already experiencing benefits from the technology. Consequently the estimates of changes must be regarded as indicative only. The research also investigated the views of breeders on the programme and its future direction.

1.2 Study Methodology

The study was conducted in four stages, with stages 3 and 4 being carried out concurrently. The stages were:

- Stage 1: Two case studies were conducted on commercial merino properties that had been involved with the FGMT programme at the outset, to gain understanding of the potential impacts of the technology and to assist in designing the questionnaire for Stage 3.

- Stage 2: Personal interviews with a small sample (11) of stud sheep breeders to gain understanding of the extent to which their operations have changed as a result of the availability of the Footrot Gene-marker Test. The information obtained during these interviews was used in designing the questionnaires to be used in Stages 3 and 4 and for validating and expanding the results of the Stage 4 ram breeders' survey.

- Stage 3: Postal survey of all commercial merino and mid-micron commercial farmers to determine the extent of footrot during the past three seasons and the management practices, chemical volumes etc. required to control and manage it. This questionnaire was pilot tested on local farmers before dispatch. Approximately 2,200 questionnaires were sent out, although it was recognised that many people on the lists were no longer farming or were entered on lists under more than one entity. Consequently the response

rates to the surveys were calculated on the basis of the numbers of sheep farmed by survey respondents as described in Section 2, rather than as proportions of total individuals surveyed.

- Stage 4: Postal survey of all stud breeders (76 in total) presently using the Footrot Gene-marker Test, to determine the impacts of the technology on their businesses and their views on the programme to date and its future.

The postal surveys were sent out in October 2004 and reminder letters sent to non-respondents at two fortnightly intervals. Responses received before December 20 were included in the survey.

In Stage 3, growers were asked about their involvement with the programme, the incidence of footrot on their properties, and about the costs and production losses associated with footrot during the last three seasons. Those who had not experienced footrot at any time were asked to complete information on stock numbers and return their questionnaires so that estimates of the proportions of sheep infected could be made. Growers who were involved with programme and who had already seen significant impacts on the severity and impacts of footrot on their properties were asked to compare the most recent season with others that have been similar climatically in order to provide early estimates of the likely impact of the technology. It is recognised that this approach is subjective and relies heavily on farmers' perceptions of change. However, the case studies in Stage 1 had indicated that farmers with serious footrot problems amongst their stock have given its costs and the impacts of the FGMT programme considerable thought. Consequently, it was considered that their estimates of its impacts would be valuable for an early analysis of the potential benefits of the technology.

DISCLAIMER

The estimates of the costs of footrot and potential benefits of the Footrot Gene-marker Test have been based entirely on the information provided by farmer respondents to the survey, some of which has been of a subjective nature.

Most data on the economic costs of footrot and benefits of the technology were obtained in physical rather than financial terms and converted to current dollars using the assumptions detailed in Appendix 1. Estimated costs and production losses were used to calculate the total impacts of footrot, and the FGMT programme, per survey farm and per sheep carried on survey farms. Using these estimates, several potential scenarios describing differing levels of uptake of the technology were evaluated in order to estimate the total annual costs of footrot and potential returns to the FGMT programme.

Because of the extent of duplication and overlap on the lists of growers provided, it was found that some respondents to the mid-micron survey farmed mostly merino sheep and vice versa. Consequently, the responses were analysed according to whether they were from dominantly merino (more than 50 percent of sheep farmed were merino) or dominantly mid-micron farmers, irrespective of the list from which names were originally taken.

1.3 Organisation of the Report

The results of the merino commercial farm survey are reported in Section 2 and those of the mid-micron commercial farm survey in Section 3. Section 4 describes the results of the ram breeders' survey and the case studies carried out at the beginning of the research are discussed in Section 5. In Section 6 a scenario-based industry-wide economic analysis is presented.

The cost and price assumptions used are detailed in Appendix 1 and Appendix 2 contains the questionnaires sent out to growers and ram breeders.

Chapter 2
Results of the Merino Commercial Farm Survey

2.1 Response Rate

As discussed in Section 1.2 the number of merino farms in New Zealand is not known with certainty, and the extent of duplication, and inclusion of those no longer farming, in the lists provided for the survey meant that estimation of the response rate on a farm basis is not possible. Growers on both the merino and mid-micron lists farm both breeds of sheep. Consequently, for purposes of analysis, the response rate was based on the total number of merino sheep farmed by all respondents (i.e. those on dominantly merino and dominantly mid-micron farms) as a proportion of the national merino flock. The 2003 referendum held by the New Zealand Wool Board during the process of distributing its assets to the meat and wool sector was completed by an estimated 95 percent of growers who farmed 2.79 million merino sheep. Extrapolation from this figure provides an estimate of 2.94 million merino sheep in total, of which 1.37 million are farmed by survey respondents, which constitutes a response rate of 45.1 percent.

2.2 Farm Numbers, Sheep numbers and Distribution

In total 247 responses were received from farmers whose sheep flocks are dominantly merino. The numbers of these farmers who responded to the survey, and the geographic locations of their properties, are shown by footrot status of their flocks in Table 1.

Table 1
Numbers and locations of dominantly merino properties

Region	Dominantly merino farms		Merino sheep nos on dominantly merino farms	
Nelson/West Coast	2	(0.81%)	1,740	(0.14%)
Marlborough	40	16.19%)	18,3305	(14.69%)
Canterbury	67	(27.13%)	288,898	(23.16%)
MacKenzie	33	(13.36%)	213,701	(17.13%)
Otago	102	(41.30%)	558,442	(44.77%)
Southland	1	(0.40%)	1,010	(0.08%)
North Island	2	(0.81%)	350	(0.03%)
Total	**247**	**(100%)**	**1,247,446**	**(100%)**

The largest group of respondents farm in Otago (41 percent), followed by Canterbury (27 percent), Marlborough (16 percent) and the MacKenzie Country (13 percent). The proportion of total sheep in the MacKenzie is significantly higher than the proportion of total farms included in the survey (17 percent compared with 13 percent), while in Marlborough the proportion of sheep is lower than the proportion of farms.

Nine percent of respondents are commercial ram breeders and 19 percent breed rams for their own use.

This section of the report covers the responses forwarded by farmers whose flocks are dominantly merino. As Table 2 shows, these properties run 94 percent of all merino sheep reported by respondents to both surveys. The average number of sheep per farm on dominantly merino farms is 5,984, significantly higher than the number run on the average mid-micron farm.

Table 2
Total sheep on properties included in the survey

Sheep breeds	Dominantly merino Farms (000)		Dominantly mid-micron Farms (000)		Estimated total (000)*
Merino	1,248	(94.0%)	80	(6.0%)	1,327
Mid-micron	76	(4.1%)	1,797	(95.9%)	1,874
Other	154	(40.7%)	225	(59.3%)	379
Total	**1,478**	**(41.3%)**	**2,100**	**(58.7%)**	**3,579**
Av sheep per farm (hd)	**5,984**		**3,315**		**4,064**

* Differences in totals are the result of rounding error.

2.3 Footrot Status of Surveyed Farms

Seventy five percent of dominantly merino farmers who responded to the survey reported that they had experienced footrot on their properties at some time, as Table 3 shows, but 13 percent had not had stock infected with footrot since before 2001/02. More than a third of respondents had experienced footrot in their merino sheep every year.

Table 3
Footrot status of surveyed farms

Seasons in which footrot experienced	% of farms
No experience of footrot	34.8%
Pre 2001/02 only	12.6%
Pre 2002/03 only	3.3%
Each of the last five seasons	35.5%
Other combinations of seasons	13.8%
Total	**100.00%**

Overall, 67 percent of respondents have experienced a lower level of footrot during the past three seasons, which have been dry in many merino–farming areas, than during the previous three and for 44 percent the incidence of footrot has been a lot lower than previously. Thus the costs of footrot estimated by this study may be expected to be lower than the long-term average costs reported by Davis (2001). On only 13 percent of farms has footrot been worse in recent seasons as Table 4 shows.

Table 4
Footrot incidence during the last three seasons on properties that have experienced footrot at some time

Footrot level in last 3 seasons compared with previous 3 seasons	Farms Not using FGMT	Farms using FMGT No diff	Farms using FMGT Diff seen	All Affected Farms
Lot lower	44.3%	42.1%	50.0%	44.4%
Little lower	22.8%	23.7%	28.6%	23.7%
Similar	27.8%	21.1%	21.4%	25.3%
Little higher	5.1%	13.2%	0.0%	6.7%
Lot higher	6.3%	5.3%	0.0%	5.3%

The average percentage of sheep infected with footrot during the last three seasons on all farms surveyed, including those that have never experienced footrot, was four percent while almost nine percent of sheep on farms that have experienced footrot at some time have been infected in recent seasons (see Table 5). The proportion of sheep affected on farms that can already see a difference is significantly higher (at the one percent level) than on other farms.

Table 5
Sheep affected by footrot during the last three seasons

Sheep affected during last 3 seasons	Farms Not using FGMT	Farms using FMGT No diff	Farms using FMGT Diff seen	All Survey Farms*
Average total sheep per farm	5,453	6,387	6,576	5,984
Average affected sheep per farm	284	341	876	238
Total sheep affected on survey farms	28,446	14,666	15,776	58,888
Affected sheep as % of total sheep on all survey farms	5.2%	5.3%	13.3%	4.0%
Affected sheep % of total sheep on survey farms affected in the last three seasons	7.1%	8.5%	15.5%	8.8%

* Averages include properties that have not experienced footrot.

2.4 Knowledge and Use of the Footrot Gene marker Test

The FGMT results are now used as a ram selection criterion by 25 percent of the farmers surveyed who farm 28 percent of the sheep on dominantly merino farms, as Table 6 shows. Of those who do not use the test results but have experienced footrot at some time, 61 percent are aware of the FGMT. While the results reported by farmers who are already able to see a difference in footrot incidence as a result of using the FGMT are indicative of change, this group is as yet too small to see statistically significant changes. Twenty four percent of those who have not yet seen a difference as a result of using the FGMT would have been unable to do since they have not had footrot in their stock during the last three seasons.

Table 6
Use of the Footrot Gene-marker Test

Use of FMGT	Farms without footrot	Farms with footrot not using FGMT	Farms with footrot using FMGT No Diff	Farms with footrot using FMGT Diff seen
Total farms	86	100	43	18
% of farms	34.8%	40.5%	17.4%	7.3%
% of sheep	36.5%	36.9%	18.6%	8.0%

Of those who do not use the test but are aware of it, 20 percent do not do so because footrot has not been an issue for them, 46 percent said they do not use it because their ram breeder does not offer this service, 12 percent do not consider footrot to be an issue, eight percent reported that they do not do so since all their ewes are put to a terminal sire, and eight percent are in the process of changing sheep breeds. There was no consistency in the remaining responses.

Amongst respondents who use the FMGT as a selection criterion, 34 percent do not use the test score but do discuss the footrot tolerance of selected rams with their ram breeders. Forty six percent set a maximum acceptable score of which the most commonly accepted score was 3/3 (16 percent), while 43 percent have a preferred score but accept that other factors may outweigh this. Of these, the largest group prefers 1/1 rams (10 percent). The maximum and preferred scores of respondents who use the FGMT results as a selection tool are shown in Table 7.

Fifty percent of those who use the FGMT and have already seen a difference reported that the FGMT score is their most important ram selection criterion, 36 percent regard it as the second most important criterion while the rest consider it to be the third most important factor in selecting rams. More emphasis is placed on footrot tolerance in ram selection by this group than by those who use the technology but do not consider it to have had a significant impact as yet. Of these, 20 percent rank it first amongst selection criteria, 30 percent rank it second and 30 percent rank it third.

Table 7
Selection criteria based on the FGMT
(Percentage of respondents who use FGMT results)

Score	Maximum criterion	Preferred criterion
1/1	1.6%	9.8%
1/2	4.9%	6.6%
1/3	13.1%	3.3%
1/4	1.6%	0.0%
2/2	3.3%	9.8%
2/3	4.9%	4.9%
2/4	0.0%	0.0%
3/3	16.4%	8.2%
Total	**45.9%**	**42.6%**
Proportion who talk to breeder	**34.4%**	

Note: Total adds to more than 100 percent as some respondents have adopted both preferred and maximum scores.

Amongst respondents who use the FGMT results as a ram selection criterion, only 18 farmers (17 percent) reported that they are able to see a difference in the incidence or severity of footrot in their flocks as yet. Of those who cannot yet see a difference, 60 percent attribute this to insufficient footrot-tolerant stock and 13 percent to drier than usual conditions.

Table 8 shows that on properties on which a difference can already been seen as a result of using the FGMT, the majority (61 percent) have been involved with the programme since its introduction and run four tooths sired by footrot tolerant rams. Almost all of the others joined the programme in its second year. On farms where no difference has been seen yet only 32 percent run four tooth sheep that have footrot tolerant sires.

Table 8
Oldest stock with Footrot Tolerant Sires

Oldest stock with footrot tolerant sires	Farms using FMGT No diff	Farms using FMGT Diff seen
Lambs	13%	0%
Hoggets	19%	0%
2 tooths	35%	39%
4 tooths	32%	61%

Amongst those respondents who use the FGMT as a selection criterion but have yet to see a difference, 38 percent remain hopeful of a major impact in future and 54 percent believe that the use of the test will have some impact. Eight percent are hopeful but not confident that there will be an impact none reported that they are not even hopeful. The average time expected before a difference is evident is 6.7 years.

2.5 Costs of Footrot Prevention and Control

Survey respondents who are not using the FGMT or who have yet to see a difference as a result of using the test were asked to document the average level of footrot control and prevention measures that have been used on their properties during the last three seasons. The cost assumptions used in converting costs expressed in physical terms to financial terms are presented in Appendix 2. Those who have seen a difference were asked to provide both the costs in 2003/04 and the costs in *previous seasons that were similar in weather and other conditions that affect footrot* in order to ensure that differences seen in this season reflected differences due to the FGMT, rather than differences resulting from a dry season. This data has provided an estimate of the current costs of footrot on all dominantly merino properties (affected to some extent by the introduction of FGMT) and shows the difference on properties that have already experienced the impact of the FGMT. The results of this are summarized in Table 9.

As Table 9 shows, the current labour costs associated with the control and prevention of footrot are the largest element of this cost ($2,564 on average on farms that have experienced footrot). On average 128 hours of labour are used in controlling and preventing footrot on affected farms with the largest proportion devoted to "footbathing and other". The costs of labour on farms not using the FGMT are significantly lower than on other properties. This reflects in part the fact that 32 percent of these properties have not had footrot during the last three seasons, compared with 18 percent of those that have, are using the test but have yet to see a difference. The cost of labour on non-user properties that have experienced footrot in the last three seasons is $2088 compared with $483 on non-user properties that have no recent experience of footrot.

The cost of animal health remedies is also significantly lower on farms not using FGMT overall, although on non-user properties that have experienced footrot during the last three seasons costs are comparable, at $1,434, with those experienced by farms using the technology that have yet to see a difference. The costs of zinc sulphate and/or formalin ($734 on average on affected farms) are the largest element of chemical cost, followed by the costs of vaccines ($268 on average).

The average total current costs of footrot prevention and control on properties reported as having experienced footrot is $4,545 per year or $0.78 per head. The average cost on all predominantly merino properties surveyed is estimated as $2,963 or $0.50 per head.

Although the sample of farms that have experienced a difference as a result of using FMGT is not large enough for statistically valid comparisons to be made, the differences between the levels of cost experienced in the last season and those experienced in similar seasons in the past validate the differences reported by the owners of the case study farms described in Section 5. A reduction of 50 percent in total costs has been experienced, despite the fact that the oldest stock on these properties that have been bred from footrot-tolerant sires are four tooths. Had those farms not experienced this difference, the average cost over all farms surveyed is estimated to have been $3,230.

Farmers who have seen a difference report marked reductions in the use of chemical methods of controlling and preventing footrot. The proportion of these farmers using formalin has declined from 44 to 17 percent, while vaccine is used on 28 rather than 56 percent of properties and 16 percent fewer properties use antibiotics. A fifty three percent reduction in the volume of animal health remedies has been experienced on these properties.

Table 9
Cost of Footrot Prevention and Control on dominantly merino farms

	Farms Not using FMGT	Farms Using FGMT No diff	Farms Using FGMT Diff seen (past)*	Farms Using FGMT Diff seen (now)	All affected farms (now)
Farms using zinc sulphate	61.7%	73.2%	83.3%	83.3%	67.2%
Farms using formalin	9.6%	48.8%	44.4%	16.7%	20.8%
Farms using footbath chemicals	72.3%	81.0%	100.0%	88.9%	76.5%
Average cost of footbath chemical per survey farm	$687	$862	$1,059	$694	$734
Farms vaccinating	14.9%	43.9%	55.6%	27.8%	24.1%
Average cost vaccine per survey farm	$254	$156	$1,541	$610	$268
Farms using antibiotics	38.3%	61.0%	44.4%	27.8%	43.2%
Average cost of antibiotic per survey farm	$85	$491	$414	$122	$198
Total cost animal health remedies	$1,026	$1,509	$3,013	$1,425	$1,200
Average other expenses per survey farm	$178	$2,391	$1,131	$286	$781
Labour					
Hours per farm footparing	26.6	134.6	34.3	28.6	55.7
Hours per farm vaccinating	1.5	4.7	6.5	2.0	2.4
Hours per farm footbathing and other	51.8	113.3	120.2	68.9	70.1
Average hours per farm	79.9	252.6	161.1	99.5	128.2
Average labour cost per farm	$1,598	$5,051	$3,221	$1,990	$2,564
Total average cost per survey farm	$2,803	$8,952	$7,366	$3,701	$4,545
Total average cost per sheep	**$0.52**	**$1.40**	**$1.12**	**$0.56**	**$0.78**

* Past seasons similar in climate and other factors influencing the incidence of footrot.

2.6 Production Losses Attributable to Footrot

Although the costs of footrot prevention and control are comparatively easy for farmers to estimate, estimating production losses is much more difficult in a dynamic farming system where a range of environmental and management conditions affect farm production levels. Many of the farmers surveyed did not identify specific production losses, but noted that they believed that production was affected although they were unable to quantify losses. The proportions of farmers who identified specific types of production losses are shown in Table 10 and their estimates of production losses in Table 11. On all farm types the most common losses are associated with high levels of culling, followed by stock deaths and losses in wool production.

Table 10
Proportions of farmers reporting production losses on dominantly merino farms

Loss Type	Farms Not using FGMT	Farms using FMGT No diff	Farms using FMGT Diff seen (past)	Farms using FMGT Diff seen (Now)	All Survey Farms*
Wool volume	28.0%	46.5%	55.6%	33.3%	21.9%
Wool quality	16.0%	23.3%	44.4%	38.9%	13.4%
Deaths	49.0%	58.1%	77.8%	77.8%	35.6%
Culling	49.0%	62.8%	83.3%	88.9%	37.2%
Lamb production	17.0%	32.6%	50.0%	22.2%	14.2%

* Averages include survey properties that have not experienced footrot.

The loss estimates provided are recognized as being subjective estimates only but, in the absence of data from controlled trials, are the best that are presently available. An aspect of loss not captured by this analysis is the loss due to the diversion of management time from improving animal production to footrot treatment and control measures. On affected farms an average of 128 hours or 3.5 working weeks is diverted from other tasks to this purpose, which almost certainly affects production levels to some extent, although this cannot be quantified in the context of the research.

The average value of production losses across all dominantly merino farms surveyed (including those that have not had footrot) is estimated to be $4,403 or $0.74 per head while on affected farms production losses are estimated to be $5,748 or $0.99 per head.

Amongst properties that are not using FMGT, only those that have experienced footrot during the last three years reported production losses, as would be expected. On these properties, production losses of $5,652, or $1.05 per head have been experienced.

Almost 50 percent of those who had already experienced a difference in the severity of footrot as a result of the use of footrot tolerant rams believe that there are further gains to be made as higher proportions of their flocks are sired by these rams.

Table 11
Impacts of footrot on farm production on dominantly merino farms

Production Losses	Farms Not using FGMT	Farms Using FGMT No diff	Farms Using FGMT Diff seen (past)*	Farms Using FGMT Diff seen (now)	All Affected Farms (now)
% sheep with wool loss	11.3%	18.8%	54.2%	19.8%	14.2%
Loss per animal affected (kg)	0.52	0.68	0.58	0.61	0.57
Average value wool lost per farm	$2,408	$6,195	$15,779	$6,025	$3,824
Average value of quality loss per farm	$144	$222	$1,658	$567	$212
Average deaths per farm attributable to footrot	33	36	49	23	33
Average value of deaths per farm	$710	$767	$1,065	$498	$701
Average animals per farm culled for footrot	88	147	310	127	108
Average value of animals culled for footrot per farm	$427	$919	$5,961	$2,314	$770
Average lambs per farm with reduced live-weights	23	46	89	46	32
Average reduction per affected lamb	4.7	5.5	4.1	2.5	4.7
Average value of reduced lamb weights	$178	$406	$594	$187	$241
Total value of production loss per survey farm	**$3,867**	**$8,508**	**$25,057**	**$9,592**	**$5,748**
Average value of production loss per head	**$0.72**	**$1.33**	**$3.81**	**$1.46**	**$0.99**

* Past seasons similar in climate and other factors influencing the incidence of footrot

2.7 Total Value of the Impacts of Footrot and the FGMT on Dominantly Merino Farms

The total impact of footrot per affected farm is estimated to be $10,293 or $1.77 per sheep (see Table 12). On all survey farms the total impact is estimated to be $7,314 or $1.22 per head at present. However, it is estimated that in the absence of the FGMT the total impact on all survey farms during the past three seasons would have been $8,103 or $1.35 per head.

Until the effects of the FGMT were felt, the financial impacts of footrot on properties on which a difference has been seen were higher than on properties not yet experiencing benefits from use of the FGMT. This is likely to explain in part why these farmers were early adopters of the FGMT technology.

Table 12
Total impacts of footrot on returns on dominantly merino farms

	Farms Not using FMGT	Farms Using FGMT No diff	Farms Using FGMT Diff seen (past)	Farms Using FGMT Diff seen (now)	All Affected Farms (now)
Total average cost per survey farm	$2,803	$8,952	$7,366	$3,701	$4,545
Average cost per sheep	$0.52	$1.40	$1.12	$0.56	$0.78
Production loss per survey farm	$3,867	$8,508	$25,057	$9,592	$5,748
Average cost per animal	$0.72	$1.33	$3.81	$1.46	$0.99
Total impact of footrot per survey farm	**$6,670**	**$17,459**	**$32,423**	**$13,293**	**$10,293**
Total impact of footrot per sheep	**$1.24**	**$2.73**	**$4.93**	**$2.02**	**$1.77**

2.8 Ranking of Animal Health Threats on Merino Farms

Footrot was ranked as the most important threat to animal health on their properties by the largest group of respondents who had experienced footrot (39 percent), followed by internal parasites which were ranked as the most serious threat by 32 percent, as Table 13 shows. The proportion of respondents who ranked footrot amongst the three most significant threats to animal health was also greatest, at almost 80 percent compared with 62 percent who ranked internal parasites in the "top three". Amongst those who have already experienced a difference in footrot severity since adopting the FGMT as a ram selection criterion, 50 percent said it had declined at least one place in the ranking and a further 20 percent consider that they are nearly in that situation.

Table 13
Ranking of threats to animal health on merino farms

Animal Health Threats	1	2	3	4	5	Top three
Footrot	38.46%	21.37%	19.66%	8.55%	4.27%	79.49%
Internal parasites	31.62%	23.93%	6.84%	5.98%	1.71%	62.39%
Flystrike	3.42%	11.97%	14.53%	11.97%	2.56%	29.91%
Johne's Disease	9.40%	6.84%	10.26%	7.69%	0.85%	26.50%
Drench resistance	5.13%	2.56%	2.56%	0.85%	0.85%	10.26%
Lice	1.71%	14.53%	13.68%	5.13%	4.27%	29.91%
Other	10.26%	17.09%	18.80%	14.53%	13.68%	
Total	**100.00%**	**98.29%**	**86.32%**	**54.70%**	**28.21%**	

Chapter 3
Results of the Mid-Micron Commercial Farm Survey

3.1 Response Rate

The estimated response rate of 62.5 percent to the survey of dominantly mid-micron farmers has not been based on the Wool Board referendum data since it is believed firstly that the referendum data included young crossbred sheep whose wool fibre diameter fell within the range defined as "mid-micron" and secondly because of changes in the numbers of mid-micron sheep since that time. The Chair of Mid-micron Wool New Zealand Inc. (Stephen Field) estimates the total numbers of mid-micron sheep farmed at present to be approximately three million and the response rate and estimates of total economic costs and benefits have been based on that estimate.

3.2 Farm Numbers, Sheep numbers and Distribution

Responses were received from 634 farmers who farm dominantly mid-micron flocks. Table 14 shows the numbers of sheep farmed and geographic location of properties farmed by growers who responded to the survey.

Table 14
Numbers and locations of dominantly mid-micron properties

Region	Dominantly mid-micron farms		Mid-micron sheep nos on dominantly mid-micron farms	
Nelson/West Coast	7	(1.1%)	13,204	(0.7%)
Marlborough	67	(10.6%)	131,836	(7.3%)
Canterbury	334	(52.7%)	877,650	(48.8%)
MacKenzie	20	(3.2%)	99,456	(5.5%)
Otago	108	(17.0%)	380,634	(21.2%)
Southland	37	(5.8%)	106,380	(5.9%)
North Island	61	(9.6%)	188,263	(10.5%)
Total	**634**		**1,797,423**	

The largest group of respondents farm in Canterbury (53 percent), followed by Otago (17 percent) and Marlborough (11 percent). The proportion of sheep farmed in Canterbury is slightly lower than the number of farms, which is mirrored by the higher proportion in Otago.

The properties defined as dominantly mid-micron for the purposes of this study run 96 percent of the mid-micron sheep farmed by all respondents. Commercial ram breeders comprised seven percent of respondents while 15 percent breed rams for their own use.

3.3 Footrot Status of Surveyed Farms

Footrot has been experienced at some time on the properties of 55 percent of dominantly mid-micron farmers who responded to the survey. Table 15 shows that a further 34 percent have experienced footrot in each of the past five seasons while 8.5 percent have not experienced footrot in their flocks since before 2001/02.

Table 15
Footrot status of surveyed farms

Seasons in which footrot experienced	% of farms
No experience of footrot	44.8%
Pre 2001/02 only	8.5%
Pre 2002/03 only	3.3%
Each of the last five seasons	33.8%
Other combinations of seasons	9.6%
Total	**100.0%**

The relative levels of footrot experienced in recent years on dominantly mid-micron farms are shown in Table 16.

Table 16
Footrot incidence during the last three seasons on properties that have experienced footrot at some time

	Farms Not using FGMT	Farms using FMGT No diff	Farms using FMGT Diff seen	All Affected Farms
Lot lower	42.6%	42.1%	66.7%	45.6%
Little lower	20.7%	17.1%	23.8%	20.3%
Similar	30.3%	34.2%	7.1%	28.2%
Little higher	6.4%	6.6%	2.4%	5.9%
Lot higher	5.9%	6.6%	2.4%	5.6%

A lower level of footrot has been experienced on 66 percent of footrot-affected properties affected during the past three seasons, which have been dry in many areas. Consequently, the costs of footrot estimated by this study can be expected to be lower than the long-term average costs, which was also the case in the analysis of the merino industry. A particularly dramatic reduction in footrot was reported by farmers using the test who had already seen a difference. Ninety percent of these respondents reported a lower incidence of footrot during the last three seasons compared with approximately 60 percent of other respondents. Worse footrot has been experienced on 11.5 percent of properties in recent years.

Over all farms surveyed, including those that have never been infected with footrot, the average proportion of sheep infected was three percent, while on farms that have experienced footrot during the last three seasons, the proportion of affected sheep was six percent (see Table 17).

Table 17
Sheep affected by footrot during the last three seasons

Sheep affected during last 3 seasons	Farms Not using FGMT	Farms using FMGT No diff	Farms using FMGT Diff seen	All Survey Farms*
Average sheep per farm	3275	3795	3962	3315
Affected sheep per farm	150	262	234	103
Nos of sheep affected	33,205	21,489	10,778	65,472
Average % of total sheep on all survey farms	4.6%	6.9%	5.9%	3.1%
Average % of total sheep on farms affected in the last three seasons	5.2%	7.3%	6.2%	5.9%

* Averages include properties that have not experienced footrot.

3.4 Knowledge and Use of the Footrot Gene marker Test

Ram selection criteria adopted by 20 percent of mid-micron farmers surveyed now include footrot tolerance. These respondents farm 23.5 percent of the sheep on dominantly mid-micron farms, as Table 18 shows. Of those who have experienced footrot on their properties but do not use the test results (64 percent), 57 percent are aware of the test but elect not to use it. Amongst those whose use the technology and have already seen a difference, 30 percent make the FGMT score their first ram selection criterion and 50 percent regard it as the second most important criterion. They regard footrot tolerance as a more important criterion than those who use the technology but do not consider it to have had a significant impact as yet. Amongst these, 10 percent rank it first amongst selection criteria, 34 percent rank it second and 34 percent rank it third.

Table 18
Use of the Footrot Gene-marker Test

Use of FMGT	Farms Without Footrot	Farms With footrot Not using FGMT	Farms With footrot using FMGT no difference	Farms With footrot experiencing difference
Total farms	284	222	82	46
% of farms	44.8%	35.0%	12.9%	7.3%
% of sheep	41.9%	34.6%	14.8%	8.7%

Of those who do not use the test but are aware of it, 41 reported that they do not do so because their ram breeder does not offer this service and 22 percent do not do so because footrot has not been a problem recently or is not a major issue. For 13 percent other breeding objectives are more important while five percent use only a terminal sire and five percent are changing their sheep breeds.

Forty one percent of those who use the FGMT do so by establishing a maximum score that they are prepared to accept. For the largest group (18 percent) this score is 1/3 while nine percent accept 3/3. Forty five percent have a preferred score that they aim for provided other factors do not outweigh the footrot score. Like merino growers, the largest group prefers 1/1 rams. Amongst respondents who use the FMGT as a selection criterion, 29 percent discuss the footrot tolerance of selected rams with their ram breeders rather than directly using the test scores. The maximum and preferred scores of respondents who use the FGMT results as a selection tool are shown in Table 19.

Table 19
Selection criteria based on the FGMT
(Percentage of respondents who use FGMT results)

Score	Maximum criterion	Preferred criterion
1/1	3.1%	18.8%
1/2	4.7%	3.1%
1/3	18.0%	8.6%
1/4	0.8%	0.0%
At least one "1" in score	0.8%	4.7%
2/2	1.6%	6.3%
2/3	0.8%	1.6%
2/4	2.3%	0.8%
3/3	8.6%	1.6%
Total	**40.6%**	**45.3%**
Proportion who talk to breeder	**28.9%**	

Note: Totals add to more than 100 percent as some respondents have adopted both preferred and maximum scores

Fifty six percent of the respondents who use the FGMT results as a ram selection criterion are able to see a difference in the incidence or severity of footrot in their flocks already. Of those who cannot yet see a difference, 58 percent attribute this to insufficient footrot-tolerant stock, 18 percent to drier than usual conditions and the remainder to other causes.

On properties on which a difference can already been seen as a result of using the FGMT, most (82 percent) report that they now run four tooths sired by footrot tolerant rams while the remainder have two tooths bred for footrot tolerance. Although the FGMT programme was officially extended to the mid-micron industry a year later than its introduction to the merino industry, several large- scale ram breeders were using the technology as part of the initial scheme, explaining the proportion of mid-micron commercial farms that already have four tooths sired by footrot tolerant rams. On farms where no difference has been seen as yet 34 percent have only lambs or hoggets sired by footrot-tolerant rams as Table 20 shows.

Table 20
Oldest stock with Footrot Tolerant Sires

Oldest stock with footrot tolerant sires	Farms using FMGT No diff	Farms experiencing Diff seen
Lambs	12%	0%
Hoggets	22%	0%
2 tooths	29%	18%
4 tooths	37%	82%

Most (63 percent) of those using the technology but not yet experiencing its benefits are confident of some impact in the future and 16 percent are confident of a major impact. Sixteen percent are hopeful of some impact and six percent have little faith that the technology will be effective. Respondents who have yet to see a difference, but expect to do so, believe that another 5.8 years on average will be required for that difference to be significant.

3.5 Costs of Footrot Prevention and Control

Table 21 shows the costs of control and prevention of footrot on each of the categories of mid-micron properties surveyed. The labour costs associated with the control and prevention of footrot comprise 58 percent on average of the total costs of footrot control on surveyed farms, but are significantly lower than the labour costs incurred on predominantly merino properties. On average 48 hours of labour are used in controlling and preventing footrot on affected mid-micron farms (compared with 128 hours on dominantly merino farms), with the largest proportion devoted to "footbathing and other".

The costs of zinc sulphate and/or formalin ($370 on average on affected farms) are the largest element of chemical cost, followed by the costs of vaccines ($139 on average).

The average total cost of footrot prevention and control during the past three seasons on properties reported as having experienced footrot is $1,665 per year or $0.48 per head. The average cost on all predominantly mid-micron properties surveyed is estimated as $919 or $0.28 per head.

Mid-micron farmers who do not use FGMT report significantly lower expenditure on footrot control than those who use FGMT but have not experienced any difference as yet. Although those farms in this group who have experienced footrot during the past three seasons (74 percent of farmers experiencing footrot but not using the FGMT) do report a higher average level of expenditure than those who have not, the costs they report are still significantly lower than for other groups at $1,511 per farm.

Table 21

Cost of footrot prevention and control on dominantly mid-micron farms

	Farms Not using FMGT	Farms Using FGMT No diff	Farms Using FGMT Diff seen (past)*	Farms Using FGMT Diff seen (now)	All affected farms (now)
Farms using zinc sulphate	46.0%	54.5%	65.2%	50.0%	48.8%
Farms using formalin	44.0%	38.6%	50.0%	28.3%	40.7%
Farms using footbath chemicals	66.7%	79.3%	95.3%	69.8%	70.3%
Average cost of footbath chemical per survey farm	$279	$542	$1,756	$501	$370
Farms vaccinating	18.5%	13.6%	26.1%	15.2%	16.9%
Average cost vaccine per survey farm	$97	$218	$389	$204	$139
Farms using antibiotics	37.5%	26.1%	26.1%	8.7%	31.1%
Average cost of antibiotic per survey farm	$50	$80	$252	$3	$51
Total cost animal health remedies	$425	$840	$2,397	$708	$560
Average other expenses per survey farm	$68	$414	$30	$0.00	$140
Labour					
Hours per farm footparing	9.2	24.3	101.3	11.0	13.0
Hours per farm vaccinating	3.0	6.5	9.9	4.0	4.0
Hours per farm footbathing and other	23.8	45.5	76.5	42.0	31.2
Average hours per farm	36.0	76.3	187.8	57.0	48.2
Average labour cost per farm	$719	$1,526	$3,756	$1,141	$964
Total average cost per survey farm	**$1,213**	**$2,782**	**$6,184**	**$1,849**	**$1,665**
Total average cost per sheep	**$0.37**	**$0.73**	**$1.56**	**$0.47**	**$0.48**

*Past seasons similar in climate and other factors influencing the incidence of footrot

On farms on which the results of using the FGMT are visible, the differences between the levels of cost experienced in the last season and those experienced in similar seasons in the past are large, with a total reduction of 70 percent on average reported by respondents from these properties. Marked reductions in the use of chemicals for footrot prevention and control have been experienced on these farms with the numbers of farms using zinc sulphate and formalin declining by 23 and 42 percent respectively and the total volume of footbath chemicals declining by 70 percent. The number of farmers using footrot vaccine has declined by 42 percent and the quantity used by 48 percent, while antibiotic use has declined by 99 percent as 67 percent of those who used it in the past have stopped doing so.

3.6 Production Losses Attributable to Footrot

As discussed in Section 2.6, the loss estimates provided are subjective estimates only but, in the absence of data from controlled trials, are the best that are presently available. Table 22 shows the proportions of farmers experiencing production losses of different types while Table 23 documents the changes in animal production levels attributed to footrot by surveyed farmers.

Table 22
Proportions of farmers reporting production losses on dominantly mid-micron farms

Loss Type	Farmers Not using FGMT	Farmers using FMGT No diff	Farmers using FMGT Diff seen (past)	Farmers using FMGT Diff seen (Now)	All Survey Farmers*
Wool volume	7.7%	12.2%	17.4%	6.5%	4.7%
Wool quality	6.3%	14.6%	19.6%	6.5%	4.6%
Deaths	42.8%	53.7%	52.2%	37.0%	24.6%
Culling	55.0%	75.6%	73.9%	47.8%	32.5%
Lamb production	18.9%	37.8%	26.1%	11.2%	12.3%

* Averages include properties that have not experienced footrot.

Like merino properties, mid-micron properties have experienced the greatest losses attributable to footrot in the extent of early culling required, followed by deaths and wool volume losses. The average value of production losses across all dominantly mid-micron farms surveyed (including those that have not had footrot) is estimated to be $958 or $0.29 per head compared with $1,735 or $0.50 per head on affected farms.

Amongst farmers not using the FGMT, only those who have experienced footrot during the last three seasons reported production losses. On these properties, the losses, at $3,492 per farm or $1.07 per sheep are similar on to those who have experienced footrot in the last three years amongst farmers who have adopted the FGMT but seen no difference as yet ($3,926 or $1.03 per head).

Table 23
Impacts of footrot on farm production on dominantly mid-micron farms

Production Losses	Farms Not using FGMT	Farms Using FGMT No diff	Farms Using FGMT Diff seen (past)	Farms Using FGMT Diff seen (now)	All Affected Farms (now)
% sheep with wool loss	4.6%	1.6%	38.8%	11.6%	4.6%
Loss per animal affected (kg)	0.43	1.50	0.58	0.29	0.66
Average value wool lost per farm	$269	$380	$3,173	$471	$322
Average value of quality loss per farm	$5	$42	$33	$7	$14
Average deaths per farm attributable to footrot	12	23	19	5	14
Average value of deaths per farm	$399	$761	$618	$174	$454
Average animals per farm culled for footrot	30	100	121	19	45
Average value of animals culled for footrot per farm	$594	$1,483	$1,864	$333	$768
Average lambs per farm with reduced live-weights	20	68	54	16	31
Average reduction per affected lamb	3.7	3.6	4.3	2.5	3.5
Average value of reduced lamb weights	121	396	363	54	177
Production loss per survey farm	**$1,389**	**$3,062**	**$6,051**	**$1,039**	**$1,735**
Average production loss per head	**$0.42**	**$0.81**	**$1.53**	**$0.26**	**$0.50**

3.7 Total Value of the Impacts of Footrot and the FGMT on Dominantly Mid-micron Farms

The total impact of footrot per affected farm is estimated to be $3,400 or $0.97 per sheep (see Table 24). On all survey farms the total cost is estimated to be $1,877 or $0.57 per head at present. However, in the absence of the FGMT it is estimated that the total cost on all survey farms would have been $2,555 or $0.70 per head.

Table 24
Total impacts of footrot on returns on dominantly mid-micron farms

	Farms Not using FMGT	Farms Using FGMT No diff	Farms Using FGMT Diff seen (past)	Farms Using FGMT Diff seen (now)	All Affected Farms (now)
Total average cost per survey farm	$1,213	$2,782	$6,189	$1,854	$1,665
Average cost per sheep	$0.37	$0.73	$1.56	$0.47	$0.48
Production loss per survey farm	$1,389	$3,062	$6,051	$1,039	$1,735
Average cost per animal	$0.42	$0.81	$1.53	$0.26	$0.50
Total impact of footrot per survey farm	**$2,602**	**$5,844**	**$12,240**	**$2,893**	**$3,400**
Total impact of footrot per sheep	**$0.79**	**$1.54**	**$3.09**	**$0.73**	**$0.97**

3.8 Ranking of Animal Health Threats on Mid-micron Farms

Footrot was ranked as the most important threat to animal health on their properties by the second largest group of respondents who had experienced footrot (18 percent) while internal parasites were ranked as the most serious threat by 31 percent. However, the proportion of respondents who ranked footrot in the top three most serious threats was higher (60 percent) than internal parasites (see Table 25). Amongst those who have already experienced a difference in footrot severity since adopting the FGMT as a ram selection criterion, 61 percent said it had declined at least one place in the ranking and a further 6 percent consider that they are nearly in that situation.

Table 25
Ranking of threats to animal health on mid-micron farms mid-micron farms

Animal Health Threats	1	2	3	4	5	Top three
Footrot	18.1%	23.2%	18.5%	10.4%	6.9%	59.8%
Internal parasites	31.3%	15.4%	4.6%	1.9%	1.5%	51.4%
Flystrike	11.6%	10.0%	10.8%	3.9%	0.8%	32.4%
Johne's Disease	6.2%	5.0%	2.7%	4.6%	1.2%	13.9%
Drench resistance	5.8%	1.9%	0.8%	1.2%	0.4%	8.5%
Lice	0.4%	6.6%	5.8%	4.6%	2.7%	12.7%
Total	**100.0%**	**93.1%**	**74.5%**	**44.8%**	**23.6%**	

Chapter 4
Results of the Ram Breeders Survey

4.1 The Postal Survey

4.1.1 Response rate

A list of 78 ram breeders involved with the FGMT programme was obtained from the programme's project manager. Of these, two were subsequently found to have given up ram breeding and a third had not yet used the test. Thirty nine merino breeders and 34 breeders were sent postal questionnaires or interviewed personally by the researcher during October and November 2004. During the personal interviews the questionnaire sent to postal survey participants was completed and additional views sought.

In total forty eight valid responses were obtained of which 24 were merino ram breeders, 19 were mid-micron ram breeders and three breed both merinos and mid-micron rams. The response rate to the ram breeders' survey was 64 percent.

Ram breeders who responded to the survey sell approximately 2238 merino rams, 2007 mid-micron rams and 145 other rams to an estimated 560 clients each season. Twenty three farm in Canterbury, 14 in Otago, eight in the Mackenzie Country and four in Marlborough.

4.1.2 Use of the Footrot Gene-marker Test in Stud Breeding

Stud sires

All respondents had tested stud sires at the outset and the largest group (61 percent) had selected a maximum acceptable score (i.e. the highest number combination) and culled all those with poorer scores than the selected value. The score above which the largest group had culled was 3/3 as Table 26 shows.

Table 26
Maximum acceptable scores for stud sires

Maximum acceptable score	% breeders who culled to a score
1/1	7%
1/3	20%
3/3	47%
Higher than 3/3	13%
Other	13%
Total	**100%**

Twenty four percent had considered all their stud sires to have acceptable scores. Strategies to improve scores included corrective mating of poor scoring rams to ewes with better scores (14 percent), and purchase of at least one ram with a low score to improve the flock average (24 percent). Only ten percent had decided that no action was required with respect to rams with poor scores. (Note: 30 percent of respondents had pursued more than one course of action to improve the footrot tolerance of their stud sire flocks).

Eighty-two percent of respondents are still working towards a better maximum score amongst their stud sires. As Table 27 shows, almost a third of these are aiming for a FGMT score of 1/1 for all stud rams, and 71 percent are aiming for a maximum acceptable score of 1/3 or better.

Table 27
Desired scores for stud sires

Desired maximum score	% breeders who intend to improve
1/1	34%
1/2	17%
1/3	20%
Better than 3/3 other	11%
3/3	14%
Higher than 3/3	3%
Total	**100%**

Other stud stock

Table 28 shows that only 35 percent of breeders have tested stud ewes and on average fewer than half their ewes have been tested to date. A number of those interviewed and those who returned postal surveys had tested some ewes at the outset to help clarify their understanding of the status of their flocks, while others were testing two tooth ewes as they joined the stud flock. Most (87 percent) of breeders test sale rams and the majority of rams are tested. Thirty seven percent of those who have purchased stud sires have had at least some of them tested after purchase.

Table 28
Testing stock other than stud sires

Animals tested	% breeders who test	Average % stock tested
Stud ewes	35%	45%
Sale rams	87%	75%

4.1.3 Communication with clients regarding the FGMT

Five of the ram breeders who responded to the survey are not selling rams at present or are selling them through another breeder and so are excluded from the following analysis. The majority (60 percent) of breeders who sell rams supply all potential ram purchasers with information on the footrot scores of sale rams and a further 21 percent provide this data to clients who specifically ask for it. Twelve percent of breeders do not supply actual scores but do discuss footrot tolerance with clients who wish to do so. Only one ram breeder reported that he advised clients not to bother with footrot tolerance when selecting rams. Fifty seven percent of those who sell rams had supplied information on the test to clients (often a copy of the background paper sent out by the programme) with newsletters.

4.1.4 Breeders' perceptions of client attitudes and understanding

The largest group of clients (32 percent) was perceived by ram breeders as having no interest in the results of the FGMT test when selecting their rams. This result was heavily influenced by a small number of breeders selling large numbers of rams. Twenty three of the forty eight breeders surveyed reported that the majority of their clients either sought rams with scores better than 3/3 or required score data but did not only select the best rams based on that data. According to breeders, almost twenty percent of clients now actively seek rams with FGMT scores of 3/3 or better, which is a higher percentage than was indicated by the results of the commercial farm surveys. However, it is possible that breeders include in this group growers who actively seek advice on the issue of footrot tolerance and are likely, therefore, to be purchasing rams with scores of 3/3 or better. A third of breeders (11 percent of rams sold) consider that demand for footrot tolerant rams is likely to increase in wetter-than-average seasons. Sixty five percent of breeders (44 percent of rams sold) reported that the majority of their clients have experienced drier than average conditions during the last three seasons.

Table 29
Clients use of FGMT test results in ram selection

Method of using the FGMT scores	% of clients
Seeking only rams 3/3 or better	19.3%
Require score data but not only best rams	22.3%
Do not seek score but interested	26.5%
Not interested	31.8%
Total	**100.0%**

Forty percent of clients were perceived by their ram breeders as having a good understanding of the footrot gene-marker test, 32 percent were regarded as having some, but not compete understanding, of the test and 28 percent as having little understanding.

4.1.5 Future involvement with the FGMT programme

Ninety percent of ram sellers intend to continue testing all stud sires. Of these 32 percent intend to do so for five to ten years, 29 percent intend to do so indefinitely (although a third of these added "provided it is economic to do so", and 29 percent do not know how long they will continue testing. Ten percent expect to continue testing for up to five years. Twenty three percent (11 breeders) intend to start or continue testing stud ewes but only seven knew for how long they expected to do so. The average time for which stud ewes will be tested was five years. Sale rams will continue to be tested by 69 percent of ram sellers although the largest group of these (34 percent) does not know for how long they will continue to do so. Twenty eight percent expect to continue to do so indefinitely or for the foreseeable future, and 24 percent for five to ten years.

Five respondents expressed concern about the ending of funding for the programme. They considered that the programme is extremely valuable but that increasing costs at this stage may limit its uptake. Two of those who hoped to continue testing indefinitely qualified this by saying that if costs increase too much they will have to consider testing fewer stock.

Three of those who had set a finite period for testing stud sires explained that they intended to test until all their test results meet the criterion they have set and they are confident that the footrot status of their flocks has stabilised.

Two respondents noted that that if links between this programme and genetic testing for parasite resistance are established, involvement and support would increase markedly.

4.1.6 Overall Rating of the FGMT Programme

Forty-nine percent of ram breeders rated the FGMT programme as "very valuable" and 35 percent rated it as "valuable". Fourteen percent considered it to be of "some use" while none of those surveyed considered it to be of "little or no use.

Ram breeders consider that at this stage clients generally value the programme less than they do. They estimate that only 17 percent of clients regard the test as very valuable, 41 percent as "valuable" and 22 percent as "of some use", while they believe 20 percent consider the test to be of little or no use".

4.2 The Personal Interviews

Eleven ram breeders were interviewed personally for the study and while almost all were supportive of the FGMT programme, their levels of, and reasons for, involvement, and views on the importance of the programme were extremely diverse. The information obtained from these was used to design the postal survey, and much of it was included with postal survey data.

Eight of the breeders interviewed were completely committed to the FGMT programme and considered it to be of major importance to the industry. One of these is a very well known North Canterbury farmer whose own pioneering work in the area over many years was a catalyst for the programme. For three others severe footrot problems in their own commercial flocks, as well as those of their clients, had been a spur to early involvement in the programme, while the remaining four regarded footrot as a major problem industry-wide, with two describing it as "the single biggest problem". Several expressed the view that it is important for stud breeders to lead the industry in endorsing new technologies of this type. However, most spoke also of the need to balance working towards footrot tolerance with maintaining other breeding objectives and several had worked actively to incorporate the good attributes of a poor scoring ram into their flocks then improve the footrot scores of progeny by testing and culling.

Two breeders were involved in, and committed to, the programme more because they consider that once technology of this type is available, demand inevitably grows. They have adopted the technology to ensure that they are able to meet demand from clients as it develops and to ensure that their businesses continue to be seen as offering clients the full range of information offered by others. For both, other breeding objectives may over-ride a relatively poor footrot score in selection of stud sires.

One interviewee expressed significant reservations about the programme because of the absence of data from controlled trials over three to five years. Although he continues to be involved he will not risk jeopardising other breeding objectives in order to advance footrot tolerance at this stage although he would not use a ram with a FGMT score worse than 3/4 "unless it is brilliant in other respects". His concerns relate primarily to the lack of technical information and data from controlled trials showing the differences in economic terms between flocks of varying footrot scores. The desirability of validated trial data and more detailed information on different strains of footrot and the sensitivity of different alleles to these were also mentioned by three other interviewees. He is concerned that farmers may assume that the technology is a "silver bullet" and neglect the management and hygiene issues which are an important part of footrot control and prevention.

Several interviewees were aware that some growers are making more rapid progress towards reducing the severity of footrot on their properties than might usually be expected when evaluating the success of breeding objectives, and three had experienced rapid progress in their own commercial flocks. For ram breeders the time taken for stud flocks to improve their footrot tolerance status depends to a large extent on the status of the flock at the outset. One breeder whose scores were particularly poor anticipates that it will take ten years for significant improvement.

The potential link between the FGMT technology and the identification of gene-markers for parasite resistance was mentioned by most of those interviewed, who felt that establishment of this link would be of enormous benefit to the industry.

Interviewees on properties where footrot is a problem spoke of having gained the confidence to cull heavily for footrot as a result of the programme.

The cost of the programme was discussed by most interviewees. Those who have made footrot tolerance a major issue and are charging clients differential prices for rams with good FGMT scores reported that "so far clients have not gibbed", but several of those not yet at this stage expressed concerns about the costs of testing as funding comes to an end and the willingness of clients to meet the extra costs of testing. For several the number of animals tested may be dependent on cost.

Other issues mentioned by only one or two interviewees include:

- The possibility of holding more workshops and sending out more regular "user-friendly" information that can be passed on to clients. Education of farmers was seen by several as the key to increasing adoption of the technology.

- The need to monitor the impacts of increasing use of gene-marker technologies to address animal health and other farming issues, on the genetic base and ensure that no unintended effects are developing.

Chapter 5
The Case Studies

As the first stage of a study intended to estimate the current costs of footrot to the merino and mid-micron industries, case studies were undertaken on two North Canterbury farms that have been buying rams that have been genetically tested for footrot since the introduction of the Footrot Gene-marker programme in 2001.

Both properties are located in inland North Canterbury, close to the Southern Alps and experience higher rainfall than coastal areas of the region. On both, the footrot problem at the time when the farmers made the decision to test the genetic tolerance of their rams was so severe that a breed change was being seriously considered.

The major difficulty in estimating the costs of footrot is that the incidence of the disease varies very markedly between seasons, with many properties experiencing a high incidence of the disease in wet years but little or no problem in dry seasons. For the purposes of the case studies, both farmers were asked to think back over a range of seasons before 2001 and estimate an "average" level of costs and production losses.

5.1 Case Study One

The first property carries approximately 17,000 stock units in total, comprising 8,350 merino sheep stock units, 1,190 half-bred sheep stock units and 7,460 beef cattle stock units.

For a number of years before his involvement with the Footrot Gene-marker programme Farmer 1 had been culling sheep badly infected with footrot, but had been making little or no progress towards a more footrot-tolerant flock. The reasons for this were obvious when the results of genetic testing of his rams in 2001 showed that he had been buying in rams with scores of 4/4 and 4/5, countering any gains that were being made through his breeding-ewe culling programme. He took the step of culling all rams with scores worse than 3/3, approximately one third of his existing number, but retained some 3/3 rams in the short term since the availability of rams with established high footrot tolerance was low. Ram purchases in that year were no higher than usual. Since adopting the technology he has purchased only rams with scores of 1/3 or better.

In the years preceding the adoption of genetic testing, footrot control and treatment is estimated to have comprised as much as 7.7 percent of cash farm expenditure. Provided wool prices were high enough to sustain it, all stock were vaccinated with Footvax once and the ewes were vaccinated twice, an operation which took approximately nine days of farm labour and is estimated to have cost just over $12,900 in today's dollars. All sheep were regularly "tipped" for footrot and paring infected feet took approximately four weeks' work for four farm staff, adding to costs by $12,800. In addition, approximately 1,000 doses of antibiotic were used annually at a cost of $1,170, and all stock were put through zinc sulphate footbaths whenever they were in the yards, using a tonne of zinc sulphate annually. The total direct costs of footrot control and prevention at that time is estimated to have been $27,500.

Today, since all hogget, two tooth and four tooth ewes and wethers on the property have been sired by footrot-tolerant rams, and older sheep have been culled rigorously for footrot, the costs of prevention and control have declined dramatically. Neither Footvax nor antibiotics are now required and the time spent on tipping and foot paring has declined by 75 percent to twenty person-days. Zinc sulphate usage has remained at the same level. In total, the costs of footrot control and treatment have declined by $23,700 to $4,000.

The footrot control strategy included not only treatment of infected animals and vaccination and foot-bathing to prevent and control infection, but also a rigorous culling policy. Approximately 200 ewes were culled each year because they were particularly prone to footrot. Today all animals requiring footrot treatment during the season are marked and culled, but the number has declined to fifty per year. The major effect of this has been an increase of approximately 130 in the number of prime lambs available for sale. There has also been a small increase in the number of ewes sent to the works rather than dying or being killed on-farm, and improvement in the quality of other cull ewes. The total value of this change at today's prices is estimated to be $9,400.

In addition to the direct costs of treating and controlling footrot, the severity of the footrot problem was impacting badly on farm production levels. Farmer One believes that these impacts were felt mostly in the quantity and quality of wool produced, rather than through a significant reduction in lambing percentage, although he acknowledges that since footrot has ceased to be a major threat on his property other issues negatively influencing lambing percentage may have disguised an increase caused by reduction in footrot. The loss of total wool production is estimated to have been 0.5 kilograms per head over one third of the flock on average, which would cost around $15,500 at today's prices. The change in wool quality since increasing the footrot tolerance of the flock has been a decline in the number of bales of short discoloured wool from 20 bales per season to approximately a quarter of a bale and a decline in tenderness, particularly of hogget wool, increasing farm revenue by $3,600. In total an increase in revenue of $28,500 has resulted from the progress toward footrot-tolerance experienced to date.

For Farmer One, using footrot tolerance as a major selection criteria for the rams he buys for four years, combined with a policy of culling other stock that require footrot treatment has reduced farm costs by almost $24,000 and increased revenue by $28,500. This represents a net gain of approximately $5.50 per sheep stock unit carried. The use of vaccines and antibiotics has declined, his farm staff is required to spend 75 percent less time (60 person days per year) on a very unpleasant task, and the stress on animals both of infection and foot paring is markedly reduced. In the light of the gains made in only four seasons, Farmer One is confident that while the property is now in a "control" phase, requiring some foot-paring and continuation of regular culling of infected animals and foot bathing, given another four years and one really dry year, eradication will be possible. He believes that all commercial farmers in areas where footrot is a problem should be ensuring that they purchase rams only from breeders who can supply data on the footrot scores of rams for sale.

5.2 Case Study Two

The second case study property grazes 5,500 sheep stock units, comprising 60 percent merino and 40 percent mid-micron sheep out of a total of 10,000 stock units. The remainder of the stock are beef cattle.

Although footrot was so severe that Farmer Two was considering changing sheep breeds, footrot was not a major culling criterion because there was no evidence that it would provide long-term benefits in terms of increased tolerance. When he joined the Footrot Gene-marker programme the average score of the rams on the property was 3/3 and he elected to cull all those with scores lower than 1/3. Since that time he has purchased only rams with scores of 1/2 or better since that time. Ewes that show serious infection with footrot (approximately 20 out of 400 culled in total) are now culled, but Farmer Two acknowledges that he could cull harder still.

Before joining the programme the hoggets on this property were vaccinated in the majority of years and the ewes vaccinated less frequently. It is estimated that approximately 2000 doses of Footvax were used per season on average, at a cost of $1,600 including labour. The extent of foot paring was lower than in Case Study One, accounting for approximately one person month on average at a total cost of almost $4,000. All stock were put through a foot bath of zinc sulphate every time they went through the yards, at a cost of $640, and around 600 doses of antibiotic were administered on average, costing $700. The total direct costs of footrot control and prevention on this property were approximately $6,800 per year.

With all hoggets, two tooths and four tooths on the property now having been sired by rams selected for a high degree of footrot tolerance, and a policy of culling ewes seriously infected by footrot, control expenditure has declined to include only a reduced use of zinc sulphate foot baths (approximately $400 per year).

The financial effects of reduced farm production as a result of footrot are estimated to have been higher than the direct costs of control on this property also, although every effort was made to use prevention and control strategies to minimise the production impacts. Farmer Two has seen a significant increase (five percent) in lambing percentage as a result of the better health and higher body weights of a large proportion of the flock. At today's prices this represents an increase in farm revenue of $8,700. While he has also observed an improvement in wool quality since adopting the programme, this is difficult to quantify because of other factors including a change in bloodlines over the same period.

The total change in net revenues, (excluding the value of any improvement in the wool clip) on Property Two is estimated to be $15,000, or almost $3.90 per sheep stock unit carried, in today's terms. For Farmer Two the programme has provided the evidence he required to embark on a culling programme for footrot with confidence that significant genetic gains can be made. In addition, farm management is much easier now that stock movements are not limited because of the necessity to quarantine pastures on which infected stock had grazed. The complexities of managing the quarantine system limited the farm's ability to achieve other production objectives, which can now be given greater priority.

5.3 Conclusion

Adopting the Footrot Gene-marker Test programme has enabled both the case study properties to continue with fine-woolled sheep breeds in an area where footrot is a significant threat to animal health. Even though footrot-resistance tested rams have sired fewer than half the sheep farmed, the gains in terms of reduced costs and increased revenue have been extremely high. The reduction in use of chemical animal health products has been considerable (almost nineteen thousand doses of Footvax and sixteen hundred doses of antibiotic in total). Animal welfare has been improved both by improving animal health and by removing the need for a painful surgical process, and workers have been largely relieved of possibly the most unpleasant task on the sheep-farming calendar. On the basis of the information obtained in these case studies, the potential benefits of increased resistance to footrot in the national merino and mid-micron flocks may be expected to be very large.

Chapter 6
Industry-Wide Economic Analysis

6.1 Total Annual Costs of Footrot in the Merino and Mid-Micron Industries

Table 30 shows the aggregated costs of footrot on survey farms in 2003/04, and the cost to the merino and mid-micron industries as a whole that have been extrapolated from survey data.

Table 30
Industry costs of footrot in 2003/04

	Merino	Mid-micron	Total
Total sheep (million)	2.94	3.00	5.94
Control cost per $/head	$0.50	$0.28	$0.39
Production loss $/head	$0.74	$0.29	$0.51
Total cost $/head	$1.23	$0.57	$0.90
Total cost per year on survey farms ($ million)	$1.82	$1.19	$3.01
Total cost per year industry ($ million)	$3.62	$1.70	$5.32

The total cost of footrot on the dominantly merino farms surveyed, including farm working expenses associated with footrot control and prevention and production losses attributable to the impacts of footrot on animal health, is estimated to be 1.82 million dollars in 2003/04. In that year footrot costs for most farmers who have experienced footrot were lower than usual and the impacts of the FGMT were already being felt on seven percent of farms.

This can be assumed to be the "bottom-line" estimate of the total costs of footrot on New Zealand's dominantly Merino farms, if all non-respondent farms are footrot free. In fact the true cost, even in a "low-footrot year" will lie between this estimate and an estimate made by extrapolating from survey farms to all dominantly merino farms i.e. by assuming that the average costs incurred on survey farms are the average costs on all dominantly merino farms. If the average cost of footrot control and value of production losses per head is $1.23 then, on this basis, the total cost of footrot to the merino industry is estimated to have been $3.62 million in 2003/04.

Davies (2001) provides a higher estimate of the total costs of footrot, at a time when the disease incidence was greater, of 9.2 million dollars or $3.54 per sheep, almost three times the estimate obtained in this study. At that time 60 percent of respondents reported that they presently had footrot in their stock, and 80 percent had experienced footrot at some time, while only 44 percent of respondents to the 2004 survey presently reported footrot amongst their stock and 65 had experienced it at some time.

In 2001 treatment costs were estimated to be $1.63 per head on all properties compared with $0.50 in 2004 and the value of lost production to be $1.92 per head compared with $0.74. While differences in market prices and calculation methods complicate the relationship between the values of production losses in the two studies, the costs of control are more directly comparable and support the assumption that the estimates obtained in the present study of the costs of footrot and, therefore, the potential benefits of the FGMT are conservative.

The total cost of footrot on dominantly mid-micron farms is estimated to be $1.19 million, from which a total industry cost of $1.70 million can be extrapolated. Thus the total cost of footrot in merino and mid-micron sheep in 2003/04 is estimated to be $5.32 million.

6.2 Potential Value of the Footrot Gene-marker Programme

6.2.1 Potential Economic benefits of the FGMT programme

In order to estimate the potential value of the FGMT programme four scenarios were defined. It is accepted that the estimates described in this section are "order of magnitude" only given the extent of the assumptions required.

The scenarios are:

- Scenario One: Long term footrot incidence continues at low levels of last three seasons. The only growers who adopt and benefit from the technology are growers included in the survey who are already using the test. It is assumed that survey non-respondents have not adopted the FGMT. The benefits accruing to those who have already realised significant benefits do not increase further but those who have yet to realise significant benefits do over the next three years until total costs of footrot on their farms have been reduced by the same proportion as those who have already experienced significant reductions. The costs of the FGMT programme have been included in the year in which they were incurred and it has been assumed that the on-going costs will be covered by the commercial cost of ram testing ($30) from 2004/05. The number of rams tested has been estimated on the basis that a commercial merino flock runs 60 ewes per ram, puts 80 percent of ewes to a replacement sire and replaces 20 percent of rams annually. On mid-micron farms it has been assumed that 100 ewes are run per ram. Ram testing rates have been estimated on the basis of the responses to the ram-breeders' survey.

- Scenario Two: The benefits accruing to survey farmers in Scenario One are assumed to extend to the industry as a whole i.e. the proportion of surveyed farmers who have adopted the technology is the same as the proportion in the industry as a whole. Ram testing charges have been increased by the same proportion as the number of ewes affected.

- Scenario Three: All farms that have experienced footrot adopt the technology over the next five years and the benefits, capped at the level experienced by survey farmers who have already experienced significant benefits, stabilise in 2013/14. Ram testing charges have been increased by the same proportion as the number of ewes affected.

- Scenario Four: All farms that have experienced footrot adopt the technology over the next five years and by 2013/2014 the costs of footrot in the New Zealand merino and mid-micron industries have been eliminated. Although the number of ewes involved is the same as the number in Scenario Three, ram testing costs are likely to be higher if this level of benefit is to be achieved and have been increased by the same proportion as the benefits in order to reflect this.

Table 31 shows the net present values of the FGMT programme to 2013/14 under each of the scenarios, and the annual net benefit by 2013/2014

Table 31
Net benefits from the FGMT programme

	Annual net benefit 2013/14 $ million	NPV (.075) $ million	NPV (.10) $ million
Scenario 1	1.5	8.5	7.3
Scenario 2	2.8	16.2	13.9
Scenario 3	4.0	20.2	17.1
Scenario 4	6.3	28.4	23.9

The total government and industry contribution to the FGMT programme during its development period has been $385,000 (GST exclusive). This has been considerably exceeded by the benefits realised on survey farms in 2003/04 alone, an estimated $770 thousand dollars.

The Net Present Value of Benefits (NPV) of implementing the FGMT programme until 2013/14, discounted at 10 percent, is estimated to be between seven million dollars under Scenario 1 and 24 million dollars under Scenario 4, even if climatic conditions continue to be unfavourable for the disease organism in many areas as they have been during the last three seasons. The annual benefits in 2003/04 dollars by that time are estimated to be between 1.5 and 6.3 million dollars.

While the assumption of Scenario 4 that the FGMT will completely eliminate the costs of footrot may be regarded as optimistic, the assumptions regarding adoption levels implicit in Scenarios 1 and 2 are contrastingly pessimistic. The extent of commitment to the programme expressed by the majority of ram breeders means that most growers will purchase footrot tolerant rams in the medium term whether they intend to do so or not and adoption will, therefore, increase in the medium term. Consequently, the level of benefits accruing to the project, even under the low cost assumptions of continuing dry weather, is more likely to be between those estimated for Scenarios 3 and 4 than those estimated for Scenarios 1 and 2.

However, climatic variation and, consequently, variation in the severity of footrot infections is inevitable, and the benefits of the technology will be greater in years when rainfall is higher than it has been in many areas from 2001/02 to 2003/04. As Davies (2001) demonstrated, these costs are very much higher in seasons when footrot incidence is greater.

In addition, the estimates of benefits are based on the differences seen to date by farmers able to see some impacts of their involvement with the test. Many of these are confident that as greater proportions of their stock are bred for footrot tolerance those benefits will continue to increase.

Thus, although the estimates based on this study suggest that the returns to the investment in the FGMT programme are potentially high, the conservative assumptions used in the analysis have ensured that estimated returns are considerably lower than may be reasonably expected in the medium term.

6.2.2 Potential environmental benefits of the FGMT programme

On properties that have experienced a difference in the severity of footrot as a result of involvement with the programme the changes are already very marked, as Table 32 shows. On these properties the use of antibiotics, vaccine and formalin has been reduced by approximately two thirds although, particularly on merino properties, the use of zinc sulphate footbaths as a preventative hygiene measure has not declined by such a large proportion.

Table 32
Reductions in chemical use on farms where a difference has been experienced
(2003/04 use as percentage of previous use in similar seasons)

Chemical	Dominantly merino farms	Dominantly mid-micron farms
Zinc sulphate	25.9%	54.5%
Formalin	67.7%	77.2%
Vaccine	67.3%	55.1%
Antibiotic	66.1%	99.0%

Because the farmers who have already experienced a difference in the severity of footrot amongst their sheep were originally the heaviest users of footrot control and treatment chemicals, the reductions they have experienced have significantly affected total chemical use amongst all survey farms already, despite the fact that the majority have yet to experience change. Table 33 shows the levels of chemicals used to control and prevent footrot on survey farms in 2003/04 and in similar seasons in the past.

Table 33
Total reductions in chemical use over all survey farms

Chemical use per 1000 sheep	Dominantly merino farms			Dominantly mid-micron farms		
	Total vol (Present)	Total vol (Past)	% decline	Total vol (Present)	Total vol (Past)	% decline
kg zinc sulphate	59.7	63.5	5.9%	27.8	31.9	12.9%
litres formalin	10.4	11.0	5.4%	11.9	19.1	37.8%
Dose vaccine	49.7	76.3	34.9%	32.9	40.9	19.4%
Doses antibiotic	14.2	16.6	14.6%	3.7	4.9	23.7%

References

Davies, S. (2001). *Report and Summary of the Survey "The Control and Financial Impact of Footrot 2001"* (Unpublished report).

Lincoln University (2004). *Farm Financial Budget Manual 2004.* Applied Management and Computing Division, Lincoln University.

Appendix 1
Cost and Price Assumptions

PRODUCT PRICES

Prices for products used in footrot control and prevention were taken from the Lincoln University Financial Budget Manual in almost all cases. Where prices for specific products were not available from this source they were obtained directly from local firms supplying these products. Note: All prices in the Budget Manual are exclusive of GST.

LIVESTOCK PRICES

Because of the study covered a range of regions and sale practice it was not possible to do more than use "typical prices" for livestock culled or dead as a result of footrot and for the reduction in lamb weights experienced. These prices were estimated on the basis of a range of published prices and discussion with a local agricultural consultant,

It was assumed that for each prematurely culled ewe or wether, an additional 1.15 replacement lambs would be kept and the value of these sold as store stock was included as a cost. The cost was assumed to be $45 for merino lambs and $55 for mid-micron lambs. The sale value of a ewe in poor condition as a consequence of footrot was assumed to be $30 and of a wether, $20.

WOOL PRICES

The average prices for merino and mid-micron wool for 2003/04 were calculated from data on wool prices by wool diameter and wool diameter by breed included in the Wool Statistical Handbook (Tectra, 2004). For merino wool this was estimated to be $7.61 per greasy kilogramme and for mid-micron wool the estimated greasy price was $4.21 per kilogramme.

Estimates of the reduction in wool value with declining soundness were obtained from Peter McCusker (Pyne Gould Guinness Wool Representative) who stressed that these relationships will fluctuate with the supply and demand of wool types. His estimates of the differences between sound and tender wools follow:

- 18 micron and finer — Up to 50 percent decline (35 percent used)
- 18.5 – 22 micron — 20-30 percent decline (25 percent used)
- 23-19 micron — 10 percent decline (10 percent used)

Part tender wools are difficult to value and at times may receive no price penalty. As a general rule they are discounted by approximately half the difference between sound and tender, and this ratio was used in the current study.