A survey of the control and financial impact of footrot in the New Zealand Merino industry

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ABSTRACT

A survey was sent to 869 Merino farmers in New Zealand in August 2001 seeking information about the prevalence of footrot, treatment and control measures applied, their related costs, and estimated production losses attributable to the disease. There were 304 respondents to the survey and they farm approximately 43% of the Merino sheep in New Zealand. Footrot was reported to be present in 59% of the respondents' flocks with 6.4% of the sheep infected by footrot at the time of surveying. Foot bathing, culling of affected sheep and breeding for footrot resistance in flocks were the preferred control measures. Footrot treatment was calculated to cost $1.67 per Merino sheep per year with an additional $1.77 per sheep attributed to losses in animal production. Assuming the respondents are representative of the New Zealand Merino industry, the total cost of footrot to this industry was estimated to be in excess of $11 million annually.

Key words: survey; Merino; footrot; prevalence; production losses; impact.

INTRODUCTION

Footrot is a contagious bacterial infection of ruminant hooves spread by the Gram-negative, anaerobic organism, *Dichelobacter nodosus* (Beveridge, 1941; Egerton *et al.,* 1969). Infection commences with an inflammation of the interdigital skin near the heels, which may subsequently lead to separation of the horn from the soft tissues as a result of inflammatory destruction of the epidermal matrix. This results in varying degrees of lameness and animal morbidity (Beveridge, 1941; Egerton, 1989; Stewart, 1989).

Footrot mainly affects sheep, but can also affect goats, cattle and deer. Infected sheep experience difficulty in walking restricting their ability to graze, resulting in decreased live-weight gain, reduced wool growth/quality and decreased lambing percentages (Stewart, 1989). The odorous nature of footrot can attract flies resulting in flystrike in the hoof, and this may be transferred to the belly region of the sheep (Glynn, 2003).

The most recent detailed survey of footrot in New Zealand was undertaken in the early 1980s (Meat & Wool Economic Service of New Zealand, 1983). This paper reports a survey of the Merino industry, with emphasis on the types of footrot control and treatment used and the associated production losses and costs.

MATERIALS AND METHODS

Data collection

Eight hundred and sixty-nine New Zealand Merino farmers as listed on the 2001 Moore-Gallagher N.Z. Merino growers' database, were selected for the survey. This database is a mailing list of farmers who have sold Merino wool and as a consequence paid a levy to Merino N.Z. Inc. A questionnaire and a covering letter detailing the need for the survey and requesting the help of the growers, along with a pre-paid reply envelope, were mailed to these growers in August 2001. There was no follow-up letter.

The questionnaire requested information on property size and the numbers of ewes, hoggets, wethers and rams in the respondent's flock. Information was also sought on the prevalence of footrot, timing and methods of treating infected sheep, quantities of chemicals/materials used, labour requirements for treatment; capital input into treatment facilities, and estimates of production loss (losses of live weight and fleece weight, reduction in wool quality, numbers of lambs and sheep culled because of footrot).

Indicative market prices in 2001 for formalin and zinc sulphate, and market values of different types of sheep were obtained from Wrightson Limited (Christchurch, New Zealand). Indicative prices of footrot vaccines and antibiotics were obtained from 'The Vet' Pat Brooks Associates (Oamaru, New Zealand). The average price for fine wool sold in New Zealand during the 2001-2002 season ($16.39/kg) was used in the analysis of the survey data (Meat and Wool Innovation Ltd., 2002).

Data analysis

Data collected from individual respondents were entered into Microsoft® Excel spreadsheets for analysis. The data were analysed by summation, deriving frequency estimates and mean values where appropriate for various recorded measurements. Costs were calculated on a per sheep and per farm basis.

RESULTS

Of the 869 Merino growers sent the survey, 304 (35%) responded. These respondents farmed 1,421,464 sheep that comprised 724,910 ewes (50.9%), 349,617 hoggets (24.6%), 334,956 wethers (23.6%) and 11,981 (0.8%) rams (Table 1). This represented approximately 43% of the estimated 3,300,000 Merino sheep in New Zealand (Meat & Wool Economic Service, 2001). The

number of responding farms in all regions with exception of the Mackenzie Country and Otago/Southland (being the North Island, Nelson/West Coast/Marlborough and Canterbury regions) responded in numbers approximately equal to their representation on the mailing database. The response rate for Otago/Southland was higher (34.7% of Merino farms in New Zealand according to the database and 46% of the total respondents to the survey) and the rate for the Mackenzie Country was lower (21.6% of farms and only 8.4% of respondents).

Prevalence of footrot

Seventy-eight percent (237/304) of the respondents reported having had footrot in the past five years, however, only 59% (178/304) believed that they had footrot at present. The footrot prevalence during the preceding two years was estimated to be 7.7% for ewes, 5.6% for hoggets, 4.5% for wethers and 5.5% for rams, giving an overall weighted average of 6.4% for Merino sheep in New Zealand (Table 1).

TABLE 1: Merino sheep reported by the respondents as at 30th June 2001.

Category	Number of sheep	Number of sheep affected by footrot	Prevalence of infection (%)
ewes	724,910	55,522	7.7
hoggets	349,617	19,640	5.6
wethers	334,956	15,090	4.5
rams	11,981	660	5.5
Total	1,421,464	90,912	6.4

Control and treatment of footrot

There was a range of measures used for treatment and control of footrot. The most commonly used methods included foot bathing (77% of respondents), foot paring (52%), vaccination (18%) and the use of antibiotics (39%). There was also a number of other obscure remedies suggested by farmers (including the use of parsley as a dietary supplement to enhance the immune response), although none of these have been investigated scientifically. Treatments were typically not used exclusively, with several methods usually being employed together on the same property.

Formalin and zinc sulphate were used extensively in footbaths with 38,300 litres of formalin and over 223,390 kg of zinc sulphate used annually by the respondents. Approximately 155,500 sheep were vaccinated annually, with 68% of these vaccinated once and 32% twice annually. Forty-one percent of vaccinations took place in spring, 15% in summer, 32% in autumn, and 12% in winter. Of the 39% of infected sheep treated with antibiotic, 70% were treated with lincospectin and 27% with penicillin or streptomycin. The Otago region was found to have a particularly high rate of antibiotic use.

Of the respondents who treated for footrot, 62% did on a regular planned basis, with most (30%) of the remaining farmers treating when some sheep became lame.

The respondents indicated that foot bathing (preferred by 30% of the respondents) and culling/breeding (preferred by 41%) were the two most effective methods for treatment and prevention of footrot (Table 2). Seventy-six percent of the respondents indicated they would be willing to invest in new technology for the management of footrot. For example, the respondents indicated that they would be willing to pay, on average, $279 more for a ram tested and found to be more naturally resistant to footrot.

TABLE 2: Preferred methods of treating and controlling footrot by the respondents.

Treatment/control method	Preferred by respondents (%)
culling and breeding	41
footbathing	32
paring	13
vaccination	9
antibiotic treatment	6

Cost of treatment and control

The quantities of chemicals, vaccines and antibiotics used, labour input, capital input and additional expenses for treating and controlling the disease by the respondents are shown together with their calculated costs in Table 3. Treatment and control costs totalled $2,368,525 per annum for the respondents.

Production losses caused by footrot

The average loss in greasy-fleece weight per head for those sheep affected by footrot was estimated by the respondents to be 0.3 kg for ewes, 0.2 kg for hoggets and 0.2 kg for wethers. The total annual wool weight loss was then calculated to be 23,603 kg of greasy-fleece, or 16,523 kg of clean wool at average yield of 70%. The respondents indicated that footrot also decreased the quality of the wool produced resulting in a slight downgrade in price for the respondents. The cost of a slight downgrade for the 2001 season was advised by CRT Primary Wool (Christchurch) to be approximately a 5% loss in clean wool value, or $0.82/kg. From these figures it was calculated that the annual cost of wool weight and wool quality loss to the respondents was approximately $488,404 (Table 4).

TABLE 3: Estimated annual costs of footrot treatment and control in the respondent's flocks.

Items		Quantity used	Unit cost ($)	Total cost ($)
Zinc sulphate		223,390 kg	1.10/kg[a]	245,729
Formalin		38,300 L	3.23/L[a]	123,709
Vaccines	once per yr	106,280 doses	0.72/dose[b]	76,522
	twice per yr	49,220 doses x 2	0.72/dose[b]	70,877
	lincospectin	24,555 doses	1.35/dose[b]	33,149
Antibiotics	penicillin-streptomycin	10,610 doses	2.40/dose[b]	25,464
	others	305 doses	2.25/dose[b]	686
Other treatment methods				262,591
Capital value of equipment used [c]		$1,038,255	15%/year[d]	155,738
Hours of labour	farmer	18,806 h	30/h[e]	564,180
	employee	25,037 h	30/h[e]	751,110
Additional expenses				58,770
Total				2,368,525

[a] 2001 prices at Wrightson Limited, New Zealand
[b] 2001 prices for a 50 kg sheep obtained from 'The Vet' Pat Brooks Associates
[c] Including pens, footbaths, shears, cradles, etc
[d] Estimate of capital depreciation per annum for footrot treatment equipment
[e] Estimate of the hourly cost of labour

The weighted average of the decline in lambing percentage for those sheep affected by footrot was estimated by the respondents to be 8.25%. This corresponded to 4581 lambs lost or a cost of $274,834 in any one season. There were estimated to be 16,096 ewes, 6,416 hoggets, 4,400 wethers, 1,764 lambs/replacements and 572 rams killed/culled due to footrot per annum. By multiplying these figures by the differences between the market values and the residual values for different types of sheep, the annual cost to the respondents for sheep culled/killed was calculated to be $1,757,470. Footrot also resulted in additional deaths of 6,653 sheep per annum for the respondents. The cost of these additional deaths was calculated to be $399,180, by multiplying the 6,653 deaths by an average of the 2001 market prices of $60 for Merinos obtained from Wrightson Limited, as there was no residual value and whole stock market value was lost (Table 5).

Estimated financial impact of footrot on the New Zealand Merino industry

Aggregating the expenditure on treatment and control, and the losses in production, it was estimated that footrot cost $4,889,223 to the respondents per year, which equated to $3.44 per sheep. If it is assumed that the average incidence of footrot for non-responding Merino producers was similar to that for the respondents, a crude estimate of approximately $11.4 million loss per annum can be derived for the New Zealand Merino industry (Table 6). This figure is conservative in that it does not account for costs incurred by live-weight loss following footrot infection, although it can be assumed that this will be a minor cost as the main role of the Merino is wool production.

DISCUSSION

Survey results revealed that ovine footrot was prevalent on the properties of the respondents, with an estimated 59% of flocks and 6.4% of Merino sheep affected. While some error is likely to have been introduced by the over and under representation of Merino farmers in the Otago and Mackenzie regions among the respondents to the survey, these estimates are similar to those reported by the then New Zealand Ministry of Agriculture and Fisheries in the early 1980s of 6.2% of sheep infected (Meat & Wool Economic Service of New Zealand, 1983). Currently the disease is estimated to cost approximately $11.4 million per annum for the New Zealand Merino industry, confirming that it is still endemic and economically significant in New Zealand.

TABLE 4: Estimated annual loss in wool production and wool quality in respondents flocks attributable to footrot.

Category	No. of infected sheep	Greasy fleece loss (kg)		Clean weight loss (kg)[a]	Total loss[b]	Average fleece weight[c] (kg)	Cost of style downgrade[d] ($/kg)	Total loss
		Per head	Total					
Ewes	55,522	0.3	16,657	11,660	$191,107	2.88	0.82	$131,120
Hoggets	19,640	0.2	3,928	2,750	$45,072	2.88	0.82	$46,382
Wethers	15,090	0.2	3,018	2,113	$34,632	3.24	0.82	$40,091
Total			23,603	16,523	$270,811			$217,593

[a] Converted from greasy fleece weight using a yield of 70%
[b] Calculated based on the average price of $16.39/kg for the 2000-2001 seasons clean 18 micron wool (Meat and Wool Innovation Ltd., 2002)
[c] Clean and including loss in weight due to footrot estimated by the respondents
[d] Based on a loss of 5% in the clean 18 micron wool price ($16.39/kg) for an average slight downgrade discount, as advised by CRT Primary Wool for the 2000-2001 season

TABLE 5: Estimated annual loss associated with sheep culled/killed and deaths in respondents flocks attributable to footrot.

Sheep		**Number**	**Market value[a] ($)**	**Residual value[a] ($)**	**Loss in value ($)**	**Total loss ($)**
Culled	ewes	16,906	55	20	$35	591,710
	hoggets	6,416	80	15	$65	417,040
	wethers	4,400	45	20	$25	110,000
	lambs/ replacements	1,764	60	15	$45	79,380
	rams	572	300	20	$280	160,160
Additional deaths		6,653	60	0	$60	399,180
Total						1,757,470

All values are per head
[a] Averages of 2001 Merino prices as advised by Wrightson Limited, New Zealand

TABLE 6: Estimated annual cost of footrot to the respondents and prediction of the cost to the New Zealand Merino industry.

Item	Cost ($)		
	Per respondent	Per sheep	N.Z. Merino industry[a]
Treatment and control	2,368,525	1.67	5,511,000
Decrease in wool weight	270,811	0.19	629,000
Decrease in wool quality	217,593	0.15	495,000
Drop in lambing percentage	274,834	0.19	627,000
Sheep culled and additional deaths	1,757,470	1.24	4,092,000
Total	4,889,233	3.44	11,354,000

[a] Based on an estimate of 3,300,000 Merino sheep as at 30 June 2000 (Meat & Wool Economic Service, 2001)

The reported prevalence and impact of footrot may be under-estimated due to the dry weather conditions experienced prior to this survey. The presence of recent droughts can be confirmed by the below normal rainfall in many Merino farming districts throughout New Zealand in 2001 (National Institute of Water and Atmospheric Research, 2002). On the other hand, care should be taken in extrapolating the results drawn from the respondents over the whole industry. It is possible that those who returned the survey forms were predominantly prepared to do so because they had footrot on their farms, thus biasing the results.

It was of concern that only approximately 30% of sheep vaccinated were treated in the recommended manner with a second booster shot. Additionally, 41% of vaccinations took place in spring, suggesting reactive use of the vaccine and not the preferred proactive use. Considering that veterinary consultation is required before obtaining the vaccine, this suggests that veterinarians and farmers need to receive more instruction in correct footrot vaccine use.

Rational antibiotic usage is acceptable as a method of control and plays an important part in footrot treatment, especially under some specific situations such as when a high proportion of the flock is affected or with valuable animals such as rams. However, the potential hazard of antibiotic resistance and the linkage between eating antibiotic contaminated products and disease in humans (Stefan, 1997; Clark, 2000; Loeb, 2000) should be considered before this technique is employed extensively. The use of some popular antibiotics such as lincospectin for footrot control is not recommended by the manufacturers and is an 'off-label' use. While current New Zealand Animal Remedy Legislation is silent on the 'off-label' use of antibiotics, the continued use of antibiotics as a regular farm management tool is not desirable.

Extensive use of footbathing may create a problem with disposal of the footbath solutions. If the chemicals are found to accumulate in the environment, affect water quality, ecosystems, or public health, the dumping of these chemicals into drains, or on farmland will be unacceptable and the further use of these chemicals in footbathing may become restricted. Used chemicals would then need to be stored, and transported to appropriate places for disposal. This would incur further cost.

The high level of chemical, antibiotic and vaccine use is unlikely to be sustainable in the long term, reinforcing the need for new approaches to footrot control. The majority of growers answering the survey would be willing to invest in new technology for the management of footrot. For example, they would be willing to pay a premium for a ram tested to be more naturally resistant to the disease. This suggests breeding for resistance may be an important control strategy for the future given that selection for footrot resistance in Merinos has already occurred (Patterson & Patterson, 1991) and the recent marketing of gene marker for footrot tolerance by Lincoln University. Forty one percent of the respondents already prefer culling and/or breeding as their management method for footrot control, suggesting selecting for heritable resistance to footrot may be quite acceptable if developed as a control strategy.

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