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New developments in FOOTROT control

By R. B. Richards, Veterinary Pathologist, L. J. Depiazzi, Laboratory Technologist, and R. V. R. Gwynn, Regional Veterinary Officer, Albany Regional Office

The eradication policy for footrot in sheep adopted by the Western Australian Department of Agriculture has produced an overall decline in the number of properties with the disease. Our knowledge of the disease has improved substantially as a result of research conducted at the Albany Regional Veterinary Laboratory in recent years. Laboratory tests now assist stock inspectors and veterinary officers to distinguish between different forms of footrot and to quarantine and eradicate accordingly.

The recent discovery of more effective footbathing solutions by officers of the Victorian Department of Agriculture will greatly assist further eradication procedures.

Western Australia’s sheep industry can now be optimistic that the level of footrot will remain low.

Background

The Department of Agriculture has maintained a programme of footrot eradication since 1949. In the early years the number of properties with the disease and held in quarantine frequently exceeded 100, but since 1979 this number has been reduced to single figures (Table 1).

Before 1974, properties with all forms of footrot were quarantined. However, since 1974 only those properties with the virulent form of footrot have been quarantined. The 1974 policy change was based on evidence that scald, or benign footrot, was little more than a nuisance, compared with the severely debilitating effects of virulent footrot. Also, benign footrot was found to be widespread in cattle.

The decision to eradicate footrot has resulted in significant savings to the sheep industry. The figures are ‘better than they look’ when we consider the increase in sheep numbers in the higher rainfall, more footrot-prone areas of the South-West in the past seven or eight years.

Recently, increased numbers of stock have been imported from the Eastern States, particularly following the severe drought in New South Wales and Victoria in 1982. Consequently the chance of importing the disease in the last decade has been far greater than in the 1950s when interstate stock movements were minimal.

Three forms of footrot

For many years only the virulent and benign (scald) forms of footrot were thought to occur. Both forms begin as an inflammation of the skin between the digits.
**Virulent footrot** is a severe, progressive disease which will eventually cause shedding of the damaged hoof if untreated. Sheep with virulent footrot suffer severe lameness, loss of appetite and profound weight loss. The disease is highly contagious and usually affects a large proportion of the flock.

**Benign footrot**, or scald, is very mild by comparison. The disease progresses slowly and does not cause under-running (separation of the sole from the tissue underneath) of the sole and outer wall of the hoof as does the virulent form. Sheep with scald are only mildly lame. Their grazing ability is unimpaired, they retain their appetite and the lesions heal spontaneously.

**Intermediate footrot**, a new form of the disease, was discovered in Western Australia for the first time in October 1982. The disease is intermediate in severity between virulent and benign.

Extensive comparative studies at the Albany Regional Veterinary Laboratory have shown that the disease is slowly progressive. It involves the sole and heel of the foot but does not extend into the lateral wall even when warm moist conditions prevail. The lesion is more extensive than benign footrot and does not heal as rapidly. However, it does not produce the severe lameness of virulent footrot.

Despite extensive studies here and in the Eastern States the virulent form of footrot has not been found in cattle. However, the benign form is common in cattle.

**Causes of footrot**

Footrot is caused by the combined effect of many bacterial organisms. Some of the bacteria cause the disease, others aggravate the condition. More than ten bacterial species may be found in an established footrot lesion. Three of these bacteria—*Bacteroides nodosus*, *Fusobacterium necrophorum*, and *Corynebacterium* species—co-operate to start the disease when the weather is warm and moist. Some damage to the interdigital skin is also necessary for the organisms to enter the foot.

*F. necrophorum* and *Corynebacterium* species are ubiquitous animal pathogens living on the skin and in the faeces of domestic stock. However, *B. nodosus* is found only in foot infections of cloven hooved animals. Footrot can be eliminated from the farm by eradicating those *B. nodosus* strains that cause the more severe lesions.

**Table 1. Properties in quarantine for all forms of footrot in Western Australia as at 30 June from 1953 to 1983.**

<table>
<thead>
<tr>
<th>Year</th>
<th>No. of props.</th>
<th>Year</th>
<th>No. of props.</th>
<th>Year</th>
<th>No. of props.</th>
<th>Year</th>
<th>No. of props.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1956</td>
<td>124</td>
<td>1963</td>
<td>9</td>
<td>1973</td>
<td>13</td>
<td>1983</td>
<td>0</td>
</tr>
<tr>
<td>1957</td>
<td>81</td>
<td>1964</td>
<td>16</td>
<td>1974*</td>
<td>25</td>
<td>1984</td>
<td>7</td>
</tr>
<tr>
<td>1958</td>
<td>61</td>
<td>1965</td>
<td>4</td>
<td>1975</td>
<td>27</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1959</td>
<td>28</td>
<td>1966</td>
<td>39</td>
<td>1976</td>
<td>11</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>1967</td>
<td>50</td>
<td>1977</td>
<td>15</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>1968</td>
<td>41</td>
<td>1978</td>
<td>12</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>1969</td>
<td>26</td>
<td>1979</td>
<td>4</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Policy changed to include only virulent footrot.

**Intermediate strain identified.**

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The research

The aim of footrot research in Western Australia has been to isolate and identify the more potent strains of *B. nodosus*. It is now known that the severity of a footrot outbreak in sheep relates to certain characteristics of *B. nodosus*. For example, the organism has fine hair-like structures, called pili, which are required for the establishment and progression of the foot lesion.

The organism also produces the enzyme protease which breaks down protein in the sheep’s hoof. Research in this State has shown that the protease activity of virulent and intermediate strains is stable, while that of benign strains is relatively short-lived (Table 2). The enzymes are not only functionally different but, as New Zealand research has shown, they are composed of different enzyme subunits.

Research at Albany has recently identified an additional invasive factor of *B. nodosus*. This factor promotes the invasion of tissues in the foot and is more active in virulent than in intermediate or benign strains.

The protease characteristics and the invasive factor together form the basis of a laboratory test that can distinguish the three clinical forms of footrot (Table 3). This test is now used to examine the potential virulence of *B. nodosus* strains isolated from sheep.

A rapid footrot virulence test is required because of the relatively slow development of the disease. Several weeks may elapse before a minor lesion develops into virulent footrot and severe lameness. The application of virulence tests may reduce the spread of the more virulent forms of the disease from property to property as quarantine restrictions on stock movements can be quickly put into effect.

The present footrot virulence test takes about ten days to perform because of the slow growth rate of *B. nodosus* in laboratory culture. Increasing the growth rate to speed up the detection of virulent and intermediate strains of *B. nodosus* is a current aim of our footrot research.

Recent advances in treatment and control

Considerable advances have been made in recent years in the development of much more reliable and effective footrot vaccines. Unfortunately they still cannot be relied on to protect all susceptible animals against infection. Vaccines are used mainly in the Eastern States to reduce the level of infection so that control is feasible.

Because of the very low level of disease in Western Australia, together with the risk of masking infection and creating carrier animals, the use of vaccines is prohibited, except with the approval of the Department of Agriculture’s Chief Veterinary Officer.

Another advance in control is the development, by the Victorian Department of Agriculture, of a foot-bathing formulation based on zinc sulphate and containing a substance which allows the active ingredient to penetrate the hoof.

The main claim of this new formulation is the rapid reduction of lameness in sheep, thus reducing the production losses seen with footrot. The major drawback is that its use is time consuming. Sheep have to stand in a footbath for one hour.

Other treatments involve the use of antibiotics by injection and direction application. These are costly and very time-consuming to use.

All treatments are only useful aids in controlling the disease. They are used mainly in areas where eradication is not possible.

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**Table 2. Protease activity increases for virulent and intermediate strains of *Bacteroides nodosus* but decreases for benign strains during heat treatment.**

<table>
<thead>
<tr>
<th>Strain</th>
<th>Virulence</th>
<th>Protease stability (% change of protease activity)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1A</td>
<td>Virulent</td>
<td>+20</td>
</tr>
<tr>
<td>2A</td>
<td>Virulent</td>
<td>+28</td>
</tr>
<tr>
<td>1B</td>
<td>Intermediate</td>
<td>+36</td>
</tr>
<tr>
<td>2B</td>
<td>Intermediate</td>
<td>+17</td>
</tr>
<tr>
<td>1C</td>
<td>Benign</td>
<td>+39</td>
</tr>
<tr>
<td>2C</td>
<td>Benign</td>
<td>-44</td>
</tr>
</tbody>
</table>

**Table 3. Protease stability and invasive factors used to distinguish virulent, intermediate and benign strains of *B. nodosus*.**

<table>
<thead>
<tr>
<th>Strain</th>
<th>Protease stability</th>
<th>Invasive factor</th>
</tr>
</thead>
<tbody>
<tr>
<td>Virulent</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>Intermediate</td>
<td>+</td>
<td>-</td>
</tr>
<tr>
<td>Benign</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>
The policy of the Western Australian Department of Agriculture continues to be one of eradicating footrot from the State’s flocks and preventing the introduction of footrot from interstate and overseas. All properties with outbreaks of virulent and intermediate footrot are placed under quarantine and sheep movements from them are restricted until eradication has been achieved.

All stock imported from footrot areas are under surveillance quarantine until they have been through a complete spring and show no sign of the disease.

The ability to eradicate footrot in this State is aided by long, dry summers allowing the healing of affected feet at a time when conditions are not suitable for disease spread.

Eradication of the disease from an affected property is carried out mainly in two ways.

- Selling all sheep on the property for slaughter and leaving the property de-stocked for a short period.
- Close examination, including foot paring, of all feet of all sheep on the property. The aim is for at least two and preferably three inspections during summer. At these inspections, sheep with affected feet are identified, removed from the flock and sent for slaughter.

The farm is released from quarantine if an inspection in late spring or early summer reveals no lesions.

Cattle are no longer considered to be involved in the spread of virulent footrot and are not subjected to quarantine restrictions.