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Eradicating virulent footrot from Western Australia

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ERADICATING VIRULENT FOOTROT FROM WESTERN AUSTRALIA

Western Australia has a unique opportunity to eradicate virulent footrot from the State's sheep flock, with only 62 properties or 0.6 per cent of sheep properties currently in quarantine. The majority of Western Australian flocks are now free of virulent footrot, with targeted on-farm and abattoir surveillance used to detect the remaining properties affected by the disease. Bob Mitchell reports on how farmers, industry, and government are working together, with research playing an important part in the eradication campaign.

What is footrot?

Footrot is a seasonal disease that affects sheep and goats, mostly in spring. The main signs are lameness, loss of body condition, and changes in the foot. Foot damage (lesions) range from reddening and moisture between the toes to destruction of the horn of the hoof. In moderate to severe cases, a pungent odour is noticeable.

There are two types of footrot. **Virulent footrot** is defined as infection with protease stable (S) strains of the bacterium *Dichelobacter nodosus*, which is identified by the gelatin gel (protease) test. **Benign footrot** is defined as infection with unstable (U) strains of *D. nodosus*.

Detection

Flocks infected with virulent footrot are generally detected in the spring and early summer months by farmers reporting lame sheep and inspectors carrying out checks on neighbouring flocks. Agriculture Western Australia inspectors carry out targeted district surveillance inspections of flocks and are also present at some livestock sales and abattoirs.

It is impossible to diagnose whether benign or virulent footrot is present if only mild lesions are seen, therefore laboratory tests are required. Skin scrapings from lesions between the toes of affected sheep are submitted to the National Footrot Reference Laboratory at Albany for the isolation of *D. nodosus* bacteria.

The gelatin gel (protease) test and the zymogram test are used to differentiate between stable (S) and unstable (U) strains of *D. nodosus*. These tests identify differences between the protease enzymes produced by different types of *D. nodosus*. It is these enzymes which help to destroy the soft horn and tissue of the hoof.
Type of footrot
- Benign footrot ('U' strains)
- Virulent footrot ('S' strains - mild)
- Virulent footrot ('S' strains - more virulent)

Footrot lesion scores
- 1 & 2 (occasionally 3, rarely 4)
- 1, 2, 3 (occasionally 4 and 5)
- 1, 2, 3, 4 and 5

Table 1 – Scoring system developed to help categorise lesions seen with footrot.

A scoring system has been developed to help categorise lesions seen with footrot. Score 0 is for a normal foot, score 1 is used for very mild changes, and score 5, the highest score, is for very severe lesions (see Table 1).

Why eradicate virulent footrot?

- Biological feasibility

It is technically feasible to eradicate virulent footrot from Western Australia because the bacterium, which causes this disease:
- Lives only on the skin between the toes and in the hoof
- Does not survive off the hoof longer than two weeks, even in the muddiest environment, and is killed within a few hours by dry conditions and exposure to air
- Has a limited host range – sheep and goats are the main animals, with cattle very rarely infected (though cattle can be readily infected with benign strains)
- Can be differentiated into virulent or benign strains using diagnostic tests.

- Good progress to date

In the late 1940s, before the footrot eradication activity, it is estimated that more than 15 per cent of all sheep flocks in Western Australia were infected with virulent footrot, with prevalence much higher in the south-west footrot-prone areas. Most infections were associated with strains of *D. nodosus* that caused major production losses and a serious animal welfare problem.

After the introduction of different types of virulent footrot through importation of large numbers of sheep from the Eastern States after the 1982-84 drought, the number of properties in quarantine rose steadily to peak at 293 (760,000 sheep) in May 1991 (see Figure 1).

The peak coincided with the introduction of targeted surveillance of high-risk properties during spring months for the early identification of properties with infected sheep. Since 1991, the number of quarantined properties has been reduced to 62 (168,000 sheep).

The goal is to eliminate virulent footrot from all sheep and goat flocks in Western Australia by 2004. No attempt is currently made to eradicate benign footrot under this activity.
Owners of quarantined properties are obliged to either destock their property for at least two weeks or undertake a summer eradication program (regular inspections where sheep with suspicious lesions are removed from the property within 14 days).

In some cases, virulent footrot cannot be eradicated in one season. In recent years, 50 to 65 per cent of properties on which summer eradication was attempted were successful in their first year. However, on most other properties, one or two mobs retained the infection after one season.

While the property must remain in quarantine, the progress already made in the first year greatly assists in reducing costs and increasing the chances of eradication by the end of the second year. Where eradication has not been achieved over two seasons, it is policy to insist that the remaining infected mob(s) and direct contact sheep be removed.

Most sheep flocks and goat herds in the State are now free from virulent footrot. In Western Australia, 0.6 per cent of the State's 9000 sheep properties are currently in quarantine for virulent footrot (see Figure 2). In comparison, about 12 per cent of properties in New South Wales and at least 20 per cent of Victorian properties are infected.

- **Economic advantage**

Economic analyses of the footrot eradication activity in Western Australia shows that, for every dollar spent, there is a three-dollar return to industry.

- **Detection and surveillance improved**

Over recent years, detection of virulent footrot has steadily improved. Since 1997, abattoir monitoring has increased. Between September 1998 and January 1999, there were 673 lines of sheep examined at three abattoirs. Cost-effectiveness for detection of previously undetected virulent footrot has improved.
In addition there are now data to support the contention that *D. nodosus*, whether benign or virulent, rarely establishes in sheep in the Wheatbelt.

**Climate suited**

The Mediterranean climate of southern Western Australia is suited to on-farm footrot eradication. The hot dry summer makes it difficult for *D. nodosus* to survive, but sheep with pockets of infection in their feet must be identified and culled.

**Interstate precautions effective**

There are few interstate movements of stock and all stock are stringently checked before shipment and at the point of entry. Without the strict entry controls, the risk of introducing virulent footrot from the Eastern States would be relatively high. The risk assessment published in 1998 estimates that, with the current four control strategies, virulent footrot is expected to enter Western Australian sheep flocks from New South Wales about once every 20 to 40 years.

With our current low levels of disease, eradication of virulent footrot is feasible.

**Strong industry support**

The following organisations are represented on the Footrot Eradication Campaign Advisory Committee:

- Agriculture Western Australia
- Western Australian Farmers Federation
- Pastoralists and Graziers Association
- Western Australian Livestock Salesmens Association
- Stud Merino Breeders Association
- Australian Association of Agricultural Consultants
- Local Footrot Community Groups.

FOOTROT ERADICATION is an industry-supported activity achieving a State-wide footrot-free flock for Western Australia’s sheep industry.

**Research, laboratory and field achievements**

Active teams have played key roles in the eradication project. Several activities have assisted greatly in gaining a better understanding of *D. nodosus*.

The ability to isolate *D. nodosus* has been progressively enhanced and the Albany Footrot Laboratory is now also the National Footrot Reference Laboratory. Reliable and efficient laboratory tests are conducted and the results are reported promptly.

In 1997/98 a total of 1820 specimens from suspect footrot properties were handled. The laboratory also continues to provide support to footrot research, with 1385 “research” samples cultured in 1997/98.
Three zymogram types have been found for stable (S) strains – S1 and the less common strains S2 and S3.

Eight different zymogram types of unstable (U) strains have been found – U1 to U8. U1 is the main type in Western Australia. The U5 type has been found in about 1.0 per cent of laboratory submissions and a very small number of these (known as 'hot' U5 strains) have been associated with severe disease similar to virulent footrot.

If the U5 strain is isolated from sheep, the property must be quarantined to determine if a 'hot' U5 strain is present. If this is confirmed, the owner must eradicate the disease by the same approach used to eradicate virulent footrot caused by S strains. Properties with only 'mild' U5 strains are released from quarantine. So far, only three properties in Western Australia have been found to have 'hot' U5 strains.

There is a spectrum of virulence in strains of *D. nodosus*. The breed of sheep also influences expression of lesions, with Merino sheep more susceptible than British breeds.

- **The 5 site ecology trial**

The trial, led by Dr Laurie Depiazzi, showed that the same S strain of *D. nodosus* could cause different levels of disease on different properties under different climatic conditions. The trial was conducted over three years, with expression of the disease ranging from minor clinical signs to very severe damage.

It is important that farmers understand the interaction between the animals, the environment, and the strain of bacteria. The expression of lesions in one flock in a dry district may be much less than the potential expression of virulent footrot in other districts with the same strain.

**Future challenges and priorities**

It is vital that all new infections are detected as soon as possible in order to minimise further spread. The two main sources of infection are stray sheep from neighbouring properties and the purchase of infected sheep (particularly when multiple lines are bought from saleyards).

The rare 'hot' U5 strain has the potential to produce severe lesions, signifying the possibility of an additional virulence factor (factor X) in that strain (but not present in the 'mild' U5 strain) that has not yet been discovered. This factor is currently being researched in Western Australia, which may lead to a third level of diagnostic tests in addition to the gelatin gel and zymogram tests.

Research is also being undertaken to identify a genetic fingerprint from DNA. Nicky Buller is leading a project where the genes in *D. nodosus* can be separated. In the future, it should be possible to say whether strains are closely related. This will assist in tracing work.
A three-year collaborative trial with CSIRO, two universities, and three other agriculture agencies in the Eastern States used gene probes and monoclonal antibodies in an attempt to develop a quick, cheap, and reliable test for virulent footrot. The basic research from that work has been continued in Western Australia by Dr Depiazzi and Peter Jelinek, with a PCR test, based on those gene probes used in ecology studies involving several U5 strains of *D. nodosus*.

A project is also continuing to assess how zinc sulphate footbathing (well known to decrease the welfare problem resulting from footrot lameness) might be used to enhance summer eradication success. Led by Dr Depiazzi and Peter Jelinek, the project is looking at how to decrease the percentage of sheep later culled by carefully paring feet in late spring and then using footbathing over five consecutive days.

This, and other methods to improve on-farm footrot eradication efforts, are evaluated and included as recommendations in revised extension papers.

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![Pulsed Field Gel Electrophoresis](image)

*Shows strains with the same DNA pattern (see left); and two strains that are different, although quite closely related (see a, b).*