

Footrot in sheep and goats

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Footrot is a contagious bacterial disease of sheep and goats, caused by the organism *Dichelobacter nodosus* (*D. nodosus*) in association with a number of other bacteria. With full expression, virulent footrot is a severe, debilitating disease with significant economic loss from reduced wool growth and quality, poor ewe fertility, poor growth rates, losses from blowfly strike, and reduced value of sale sheep. In infected flocks, there are also significant costs associated with the control of the disease.

The NSW Footrot Strategic Plan

In 1988 the NSW sheep industry adopted the NSW Footrot Strategic Plan as a program directed at the eradication of virulent footrot (footrot). The Plan is overseen by an industry-based steering committee (NSW Footrot Steering Committee) with responsibility for setting the direction and monitoring the progress of the Plan.

Since 1988 significant progress has been made with the control of footrot in NSW, with large areas of the State now gazetted as footrot Protected Areas (flock prevalence below 1%).

In 1991 it was estimated that footrot was costing the NSW sheep industry A\$42.6m p.a. That figure is now below A\$3m p.a., but footrot is still a significant disease. Eradication programs are continuing in flocks where footrot has been detected, and producers need to be vigilant to keep the disease out of clean flocks.

Footrot – the disease

Development of footrot in sheep

The development of footrot in sheep depends on both infective and environmental factors.

Infective factors

The bacterium *D. nodosus*:

- is the only bacterium that will cause footrot;
- will not survive in the environment for more than 4 days even under the most favourable conditions;
- may persist for many years in the feet of infected sheep, even under dry conditions;
- will not invade dry healthy feet;
- will only establish if conditions are right for the development of dermatitis between the claws.

Footrot is introduced into a clean flock by the introduction of infected sheep.

Environmental factors

The three main environmental factors necessary for a footrot infection to establish and then transmit from sheep to sheep are:

- an average daily temperature of 10°C or higher for 4–5 days; and
- adequate moisture; and
- adequate pasture length or pasture density to make feet susceptible to infection.

Footrot will not spread under hot, dry conditions.

In southern NSW the main footrot seasons are spring, wet autumns and mild winters. In northern NSW, however, summer rainfall is a determining



factor and conditions suitable for spread are less predictable.

Lesion development

The development of footrot lesions depends on:

- the presence of *D. nodosus* and the particular strain involved,
- host susceptibility (younger sheep are generally more susceptible than older sheep, merinos are generally more susceptible than crossbreds)
- environmental factors (see above),
- predisposing infection with other bacteria between the claws.

Strain differentiation

There are many strains of *D. nodosus* and they vary in the severity of the disease they cause. In many flocks, several strains of *D. nodosus* may exist.

Benign strains usually cause lesions that are transient in nature with minimal economic loss. Infection with benign strains is termed 'benign footrot'.

Virulent strains usually cause chronic and severe lesions associated with lameness, loss of production and, in severe cases, mortalities. Infection with virulent strains is termed 'virulent footrot'.

The term 'footrot', when used in the context of notification, control and eradication, means 'virulent footrot'.

The photographs in the footrot scoring photo guide illustrate the progress of the disease from an inflammation between the claws to severe underrunning with a highly virulent strain.

In warm moist conditions, inflammation between the claws (score 1 and score 2) can develop into typical virulent footrot (score 3 and score 4) within 2 weeks if virulent strains of *D. nodosus* are present.

In the absence of virulent strains, lesions will not normally progress to the more severe form of the disease, even in the warm, moist conditions that are ideal for spread. However a small percentage of sheep affected by benign strains, especially younger naïve sheep, may sometimes develop scores 3 and 4 lesions. Most of these will resolve without treatment when pastures dry off.

The clinical expression of the disease is strongly influenced by any treatments given, and by the environmental conditions at the time. In cold conditions or dry situations, virulent footrot may not develop into the typical score 4 lesion, but

may remain at score 2 or score 3. However, when these sheep are moved to warm wet conditions, the disease will develop.

Distinguishing between the forms of footrot

Benign footrot

In benign footrot, the main lesion is an inflammation of the skin between the claws, referred to as interdigital dermatitis (score 1 and score 2).

Benign footrot is indistinguishable clinically from *interdigital dermatitis* and early virulent footrot. The interdigital skin between the claws is moist and inflamed, and the horn at the heel may slightly underrun.

A high percentage of the flock can be affected but only under favourable conditions.

Usually more than one foot is affected.

Significant lameness is possible, especially in heavy sheep (rams and pregnant ewes) where the weight aggravates the lameness, particularly when sheep first stand up after resting.

The disease can disappear spontaneously without treatment, especially in dry weather or when sheep are moved to dry pasture.

In some circumstances lesions may progress to score 4 in a small proportion of the flock. These score 4 lesions are usually limited in severity (less soft tissue necrosis) compared with those of virulent footrot, and regress without treatment.

Virulent footrot

Virulent footrot should be considered in any flock where sheep show score 4 lesions or where a significant proportion show underrunning (score 3). The arbitrary level of more than 1% of sheep showing score 4 lesions may be a useful guide, but should not be used as an exclusive criterion for diagnosing virulent footrot.

Under warm, moist conditions, sheep show a severe and progressive separation of the soft and hard horn from the soft tissues underneath, often involving the whole of the sole (score 4) and extending up the wall (score 5).

The disease develops rapidly in conditions favourable to its spread and expression. Within 7–14 days, inflammation between the claws (score 2) can develop into advanced underrunning (score 4).

Under conditions favourable to the spread and expression of footrot, more than 10% of sheep can show advanced underrunning (score 4 and score 5), with lesions persisting if treatments are not undertaken.

Usually both claws are affected, and often more than one foot.

Severe lameness is a feature of virulent footrot.

The disease is capable of causing significant production losses (including loss of bodyweight of over 10% and half a kilogram in wool production).

In dry conditions or following footrot treatments all the above typical signs can be effectively suppressed. Detection of virulent footrot in these circumstances may be very difficult.

Chronic virulent footrot

Chronic virulent infections have an overgrown horn which is misshapen – the soft tissue underneath is destroyed.

The lesion has a black, tarry appearance and is subject to flystrike. There are serious animal welfare considerations if the disease progresses to this stage.

Dealing with footrot

Regulatory requirements for virulent footrot

In NSW, virulent footrot is a notifiable disease under the Stock Diseases Act 1923. This means there is a legal obligation on occupiers of land, owners of stock, persons in charge of travelling stock, and veterinarians or other persons consulted about stock, to notify an inspector under the Act (employed by the Rural Lands Protection Board) within 48 hours of it first coming to their knowledge

that stock are diseased. Regulatory action may result if virulent footrot is not notified.

Notification when lameness is first observed will allow an early diagnosis of the cause of the lameness. It is important to make an accurate diagnosis of virulent footrot before embarking on a costly eradication program.

Once virulent footrot is diagnosed, the flock will be quarantined and the owner/occupier will be required to sign an 'undertaking' outlining conditions which must be followed to eradicate the disease. As part of the undertaking, the owner/occupier is obliged to develop an **approved footrot eradication program** that is to be carried out within an agreed time. This program must be approved by the local District Veterinarian (DV) and requires full documentation of the procedures to be followed.

The eradication program will be reviewed at regular intervals, and if progress is considered unsatisfactory, regulatory action may then be taken. The use of accredited footrot contractors to assist with eradication programs is strongly encouraged.

Destock or on-farm eradication?

Before embarking on an on-farm eradication program, destocking of the whole flock is an eradication option that should be seriously considered. The progress with the NSW Footrot Strategic Plan has made destocking a more attractive option in many areas where there is now a ready source of clean restocker sheep.

Distinguishing between footrot and foot abscess

'Foot abscess' includes both heel abscess and toe abscess. There are a number of features distinguishing footrot from foot abscess:

Footrot	Heel abscess	Toe abscess
Usually affects more than one foot.	Usually affects one hind foot, which is carried.	Usually affects front feet.
No swelling.	Swelling – usually spreading the toes.	Swelling is not a feature.
No pus discharge, but a black-grey slime-like substance may be present	Creamy-white pus discharge.	May be pus/fluid from point of toe when pared/trimmed.
Heat may be present in some cases.	Hot to touch, particularly at the site of the swelling.	May be hot to touch.
Lesions have a putrid odour and may be flyblown.	Lesions can have a slight odour, but are rarely flyblown.	Odour distinct from footrot. Lesions may be flyblown.
Spreads rapidly to sheep of all ages, including lambs, when conditions are favourable.	Usually confined to heavy sheep, e.g. rams and pregnant ewes.	Affects all classes of sheep.
No break in the coronet skin, but separation of the inner sensitive horn and outer hard horn.	Abscess usually breaks out at the coronet or in the interdigital skin. Resolving abscess-defined area granulated.	Abscess usually occurs under the horn at the front of the toe. May open in a line above the coronary band. Can cause separation of front half of sole in chronic cases.

Footrot scoring guide



Normal foot

There is normal skin between the claws, with no reddening or inflammation and no loss of hair. There is no exudate present.



Score 1

Slight to moderate inflammation with some erosion between the claws. There is no underrunning or erosion of the skin or horn.



Score 2

The skin between the claws is inflamed and raw. This condition may involve part, or all, of the soft horn on the inside of the claws. There is no underrunning of the horn.



Score 3a

Separation of the skin horn junction, with underrunning extending no more than 5 mm.

Footrot scoring guide



Score 3b

Underrunning no more than halfway across the heel or sole.



Score 3c

More extensive underrunning of the heel or sole but not extending to the outside edge of the sole of the claw.



Score 4

The underrunning extends to the outside edge of the sole of the claw and involves hard horn.



Score 5

This is a severe form of the disease involving the sole, with extensive inflammation and underrunning of the hard horn of the hoof.

On-farm eradication programs

If eradication via an inspection and treat/salvage/cull program is the preferred option, there are three phases.

1: Control phase - before and during the spread period, to reduce the level of infection in the flock to the stage where eradication becomes feasible.

2: Eradication phase: involves the detection and removal of all infected sheep in the flock during the non-spread period.

3: Surveillance phase: involves surveillance of the whole flock to ensure the disease has been eradicated, and preventing reinfection.

Points to consider when undertaking an on-farm eradication program

Rely on the experts. An on-farm eradication program that is undertaken under the close supervision of an experienced veterinarian (District Veterinarian or private practitioner), with assistance from an accredited footrot contractor or a RLPB inspector, has the best chance of succeeding.

There are no shortcuts to eradication. Relying on cheap treatments, or missing treatments or inspections, will result in failure. Keeping infected animals that do not respond to early treatment will also result in the breakdown of the program.

The eradication program must be planned. Plan your eradication program in consultation with your veterinarian as early as possible in the year. Allocate suitable periods of time to carry out control and eradication programs in the flock. Prepare contingency plans following the eradication phase in case the disease breaks out in one or two mobs. Allocate separate areas of the property for clean mobs and infected mobs, with separate handling facilities wherever possible.

Maintain facilities. Eradication is assisted by having sound fencing and good facilities for the handling, inspection and treatment of sheep.

Do not attempt an eradication program while the disease is still spreading. The disease will spread at a faster rate than it can be cured, so little will be achieved. Seek advice from your veterinarian on the time that spread is likely to occur in your district.

The major effort should be on the clean sheep. Many graziers consider sheep to be clean on the basis of one examination. In most flocks some infected sheep will be missed. Unless detected at subsequent examinations, these sheep will spread infection in the next footrot season.

Footrot is eradicated by culling, not curing, infected sheep. The sooner treatment of infected

sheep can be terminated in non-spread conditions and replaced by culling, the better the chances of eradication.

Slaughter all infected sheep as soon as possible. While infected sheep remain on the property, they are a threat to clean sheep. Many eradication programs fail because infected sheep stray into a clean flock or because graziers spend too much time trying to cure infected sheep and not enough time ensuring that clean sheep are, in fact, clean.

Watch for the carrier animal. Under dry conditions, some apparently normal sheep can carry virulent strains of the organism as a small pocket of infection in the claws. These sheep may not be lame, but they can still cause a breakdown in the flock when conditions are suitable for spread.

Treatment makes infected sheep harder to detect. Any treatments applied during the eradication phase, e.g. footbathing, antibiotics, can make detection of sheep that are not totally cured much more difficult.

Dry conditions makes infected sheep harder to detect. Footrot usually cannot be considered eradicated until the flock goes through a season conducive to spread without showing evidence of the disease.

Prevent reinfection. Do not neglect the likelihood of reinfection from introduced sheep or from neighbouring properties. Quarantine all introduced sheep for as long as possible to ensure freedom from footrot.

Phase 1: Control phase

The control phase should be used before and during the spread period to reduce the number of infected sheep that will need to be culled during the eradication phase. Spread of footrot can be controlled, and number of infected sheep can be reduced, by footbathing, paring and vaccination.

Footbathing

Traditional footbathing alone will not eradicate footrot, but it can reduce the challenge to susceptible sheep during the spread period if sheep are treated regularly. A well-designed footbathing program will minimise the number of sheep that need to be culled at subsequent eradication inspections. Footbathing is not advisable in non-spread periods as it will delay or mask the expression of footrot in carrier sheep. The **two main preparations** available are:

Zinc sulphate. Sheep should be treated every 5–7 days by walking them through a 10% zinc sulphate

solution in a footbath at least 6 m long. Holding sheep in the bath for 15 minutes, followed by drying on concrete or grating, will cure a significant number of sheep.

Radiccate®. This is a copper-based footbath solution. Sheep should be held in this solution for 15 minutes, and then allowed to dry for 1 hour on concrete or grating. Treatment must be repeated in 1–2 weeks. Good cure rates can be expected in a significant number of sheep. This product has an advantage of creating an artificial non-spread period between treatments, allowing inspections to continue even when environmental conditions are conducive to spread.

Formalin. This was once widely used as an external disinfectant but is no longer recommended due to occupational health and safety (OH&S) concerns, and the potential for masking lesions in carrier sheep.

Paring

Minimal paring of feet may assist penetration of footbath chemicals but it is preferable to postpone paring until the first eradication inspection at the end of the spread period. Some paring will be necessary to determine the presence of lesions during the eradication phase.

Vaccination

Commercial vaccines are not readily available and can only be used with the permission of a DPI Senior Regional Animal Health Manager (SRAHM). Vaccines generally give a short period of protection (8–12 weeks), and timing of doses before a spread period is critical.

Phase 2: Eradication phase

Before an eradication phase is considered, the disease should have been controlled during the spread period and the prevalence of infection reduced to minimise the number of sheep that will need to be culled.

Remember that footrot is eradicated by culling, not curing.

Consider immediately destocking mobs that have significant numbers of infected animals on the first inspection.

An alternative, particularly when the proportion of infected animals is low, is to immediately cull those animals on each inspection.

Only attempt to treat when culling is not an option, e.g. lambs/weaners, high value animals.

Procedure

Examine all feet of all sheep in the flock. Make a decision on whether to:

- cull infected mobs, or
- cull individual infected sheep, or
- treat infected sheep.

An 'infected foot' is any foot that the operator is not sure is free of footrot. Consider 'doubtful' feet as infected.

Reinspect all feet of all sheep in 3–6 weeks and cull infected sheep. There is no second chance for sheep treated on the first round.

Repeat the previous step every 3–6 weeks until there have been two successive clean inspections, with no infected sheep found.

Branding of all sheep as they are inspected is an important part of the eradication program. Branding provides a means of identification to separate clean and suspect sheep, plus it can be a check to ensure all sheep have been presented for inspection.

Minimal paring to return feet to normal shape and to assist with exposing deep-seated infection is necessary during an inspection. From an animal welfare point of view, radical paring causing lameness should be avoided. Taking the time to pare feet correctly at first inspection will pay off at subsequent inspections in an eradication program, as assessment will be quicker and more accurate.

Treatments

Where a **decision is made to salvage animals** by treatment and inspection, the following treatments are available.

Footbathing: (see above)

Antibiotics: These are only available through your veterinarian. Seek advice on which product is most suited to your eradication program. Generally the sheep's feet must be kept dry (e.g. on grating) for up to 12 hours after treatment. Appropriate withholding periods must be observed before sending sheep to slaughter.

Paring the feet to expose infection and facilitate footbathing or antibiotic treatment is recommended.

Do not spend time trying to cure sheep that have not responded to an initial treatment. Sheep that fail to respond to treatment, either antibiotics or footbathing, are often very difficult to cure and should be culled.

Phase 3: Surveillance phase

The surveillance phase is for early detection of any breakdown in the eradication program, having a contingency plan to deal with any breakdown, and for preventing reinfection from strays or introductions.

Inspect your flock regularly for any signs of lameness during autumn, winter and early spring.

Seek advice from your veterinarian on the cause of any lameness detected.

If a breakdown is detected, implement your contingency plan to confine the infection to a part of the property, and take immediate steps to eliminate the problem.

Preventing reinfection

Once the disease has been eradicated from the flock, prevent reinfection by minimising the risk from strays and introductions.

Introduced sheep should only come from a flock known to be clean, and where the owner of that flock is prepared to sign a **Footrot Vendor Declaration**. You should request a signed declaration from the vendor before taking delivery of the sheep.

In addition, check the sheep carefully on arrival.

If possible, keep the introduced sheep in isolation and monitor them closely until they have passed through a spread period without showing any signs of footrot.

Developing a comprehensive on-farm biosecurity program that addresses straying onto and off your property, and the risk of disease from introductions, is strongly recommended. Talk to your veterinarian.

Footrot in goats

Unfortunately, footrot in goats does not behave in the same way as in sheep. **It is impossible to distinguish between the benign and virulent strains of the disease by clinically examining a number of goats.** The benign forms of footrot may cause severe underrunning in goats, and the virulent forms may cause only inflammation between the claws, with little or no underrunning. In goat herds, a laboratory test may be used to assist in differentiating between benign and virulent footrot.

However, in footrot eradication programs, goats have to be treated in the same way as sheep, and any lesions in goats must be viewed with suspicion. **Goats can carry the virulent form of footrot between properties and can infect sheep under suitable environmental conditions.**

Footrot in cattle

D. nodosus infection does occur in cattle, but nearly all the cases that have been investigated are due to benign footrot. **Where cattle and sheep are both carried on a property, benign footrot will not be eradicated from the sheep flock.**

Virulent footrot organisms have occasionally been isolated from cattle in other states, but there are no reports in NSW despite the presence of cattle on many properties from which footrot has been eradicated. Owners should discuss with their veterinarian the role of cattle when planning an eradication program.

During spread periods, cattle movements should be considered as a possible method of mechanical transfer of the footrot organism between paddocks.

Further inquiries

- District Veterinarians (Rural Lands Protection Boards)
- Footrot Rangers (Rural Lands Protection Boards)
- Accredited Footrot Contractors
- Private veterinarians
- DPI veterinarians

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