

In order for sheep to efficiently convert forages to meat and wool, the condition of their feet must not become a limiting factor. The growth of sheep's feet in temperate climates requires trimming and related care every four to six months.

Foot growth is affected by breed of sheep, soil moisture and soil characteristics. Sheep grazed on rocky, dry soil may not require the extent of foot care needed for sheep on soil that is free of rocks and higher in moisture content.

Trimming Feet

An illustration of an untrimmed and a properly trimmed foot is shown in Figure 1. The foot should always be trimmed from the heel to the toe to remove excess growth of the "horny" portion of the hoof (Figure 2).

Figure 1. An untrimmed (l) and a properly trimmed (r) foot



Some points to consider in the trimming process:

1. Combine foot care with other operations, such as worming, shearing, etc. Many producers trim feet before flushing and combine the operation with worming and vaccinations. Also check the feet at lambing when the ewe is closely confined.
2. Avoid periods of stress such as late pregnancy or extremely hot weather.
3. The feet of sheep coming in from pastures with heavy dew or rain on them will be softer and easier to trim.
4. Sheep which show abnormal foot growth should be identified for closer observation and/or culling.

Figure 2. Always trim the foot from the heel to the toe.



Diseases of the Sheep's Feet

Several diseases result in limping or reduced mobility in sheep. The producer should become familiar with the characteristics which distinguish each of these so they may be properly treated.

Foot Abscess

This disease is characterized by swelling of the soft tissues immediately above the hoof and, in advanced cases, draining abscesses in this area and between the toes. Foot abscess is caused by bacterial infection of damaged foot tissue. Any conditions, such as grazing stubble, etc. which increase foot irritation result in a higher incidence of the disease.

The front feet are most commonly affected. Infection may be limited to one foot or to one half of the foot.

Affected sheep should be isolated, their feet inspected and trimmed and the infection cleaned and treated with anti-bacterial compounds. Once the infection site is clean, it will normally begin to heal.

Foot Scald

Foot scald is characterized by a softening of the area between the toes and is usually associated with wet pastures or damp bedding. It is a form of superficial dermatitis associated with the conditions and microorganisms which may also result in foot rot. Sheep will become slightly to moderately lame depending on the stage of infection. The forefeet are more often affected than the rear feet.

Treatment should consist of moving the sheep to a dry area, trimming the feet carefully and using a topical treatment on the feet of 10% zinc sulfate in water (1/4 pound in 1 quart of water).

Failure to treat foot scald may lead to foot rot when conditions favor such development (see "Contagious Foot Rot").

Laminitis

The lameness related to laminitis is caused by inadequate blood flow in the foot. This effect of founder (or grain overload) is normally associated with digestive problems resulting from excessive intake of grain, which usually masks the effect on the feet. Such animals usually die before the feet become involved. Recovered animals may exhibit unusual foot growth and/or permanent lameness.

Feeding management is the key to prevention of founder and laminitis.

Contagious Ecthyma

The lameness caused by contagious ecthyma is the result of vesicles (blisters) appearing on the skin near the top of the hoof wall. Simultaneous vesicles appear on the mouth and other areas on the sheep's body. The resulting lesions can be treated by applying an ointment containing a broad-spectrum antibiotic to the affected area.

The disease can be prevented by vaccination. Since humans can contract sore mouth (orf), care should be taken to prevent infection when treating infected sheep.

Other considerations when limping or lame sheep are observed are physical injury, foreign material between the toes, arthritis or other joint problems, corns on the feet and acute mastitis.

Contagious Foot Rot in Sheep

Contagious foot rot is an age-old malady of sheep and currently a major production problem in many areas of the United States. Foot rot is generally more prevalent in temperate climates. However, the disease has become widespread and of more recent concern to western producers, especially in the intermountain area.

Foot rot is one of the most economically devastating diseases of sheep. The disease is considerably easier to prevent than to control or eradicate.

Eliminating the disease in affected flocks requires a strong commitment to strict treatment practices. Dedication required for such an effort ultimately determines the success of foot rot control.

Cause and Disease Process

Foot rot is caused by an interaction involving two types of bacteria that grow in the absence of oxygen. *Bacteroides nodosus*, bacteria that can live only in the animal's foot, can be eradicated from the flock. If *B. nodosus* is not present, foot rot will not occur. *Fusobacterium necrophorum*, which helps *B. nodosus* penetrate the skin and tissues, is a normal inhabitant of soil and sheep manure and is always present where sheep are raised.

In the usual course of infection, skin between the toes becomes wet, macerated and infected by *F. necrophorum*. Then, *B. nodosus* is able to become established in the deeper layers of the skin where it produces an enzyme that liquefies tissue protein around it. By this means, the infection separates the heel, sole and wall of the hoof from their attachments to the foot, causing inflammation, lameness and odor. Other bacteria may also be present and contribute to the inflammation.

Diagnosis

Lameness is usually the most obvious symptom of contagious foot rot, although not all sheep with early infection become lame. One or more feet may be affected at the same time. The first visible lesion is a moist, reddened area between the toes. Subsequently, the infection spreads under the sole and wall of the hoof and a characteristic foul odor is present.

Not all lame sheep have foot rot; therefore, feet should be closely examined before reaching conclusions. When the cause of the lameness is uncertain, consult with your veterinarian.

Transmission

The primary organism causing foot rot is spread from infected sheep to moist soil and back to noninfected sheep. The disease is most commonly introduced into a clean flock by the purchase of infected sheep. Other modes of transmission include mixing with an infected flock, letting infected strays enter the flock or the use of corrals, watering areas, trails or trucks within a few days following an infected flock.

Ideal environmental conditions for transmission occur when the soil temperature is 40° to 70° F and soil or bedding stays wet. Any factor which causes injuries to the feet will increase the likelihood of infection.

The *B. nodosus* organism does not survive longer than two weeks in the soil. However, it may remain in the hooves of carrier sheep for extended periods of time.

Some infected sheep may seem to recover, but unless they have been properly treated and the infection eliminated, foot rot will appear during the next wet season.

Prevention

Producers who do not have contagious foot rot in their flocks should be aware that it is much easier and less expensive to prevent than to deal with the disease after it becomes established in the flock.

Thus, producers must make every effort to maintain the foot rot disease-free status of their sheep.

Several management practices minimize chances of introducing contagious foot rot into a clean flock:

1. **Never buy sheep infected with foot rot.** Avoid buying apparently clean sheep from infected flocks. Avoid buying sheep at sale yards where clean and infected sheep are penned together.
2. **Avoid common-use trails and corrals where infected sheep have traveled or have been penned during the preceding two weeks.**
3. **Insist on proper cleaning and disinfection of commercial vehicles before transporting sheep.**
4. **Assume all new additions to your flock are infected with foot rot.** Always isolate new animals for at least two weeks, trim all feet immediately upon arrival, treat feet of new sheep following trimming and re-examine periodically during the quarantine period (see "Treatment of Infected Sheep").

Control

Effort may be directed toward temporary control of the disease or toward complete eradication. Under certain circumstances and/or during certain times of the year, temporary control may be the only

realistic solution. However, eradication is possible and eventually should be the goal of every producer.

Treatment of Infected Sheep

1. Vaccination: Use of vaccines can significantly decrease the spread of foot rot in flocks where the causative organism(s) are of the same serotypes as those contained in the vaccine.

Vaccines also may be helpful as a treatment. The usual dosage schedule calls for two doses given subcutaneously behind the ear four to six weeks apart. The last dose should be given two weeks or so before a seasonal outbreak is anticipated, since the immune stimulation is of short duration. Vaccination can be useful during an outbreak. Vaccines are most beneficial when used in conjunction with other foot rot control measures such as hoof trimming and foot bathing.

Foot rot vaccines currently used are manufactured in Australia and New Zealand and contain eight serotypes of *Bacteroides nodosus* isolated in those two countries. These vaccines may not always be as effective in the U.S. where more than 20 serotypes of *B. nodosus* are known to occur. When field tested in U.S. flocks, their effectiveness has been reported to range from 0% to 100%. However, in most large vaccination trials, flocks infected with the same or similar *B. nodosus* serotypes as those contained in the vaccine had efficacy values ranging from 60% to 80%.

Tissue reactions at the sites of injection have been common. Some sheep have developed large lumps which have abscessed and drained before healing. This adverse reaction makes the use of present products questionable in market lambs and purebred show sheep. As with all biologics, the manufacturer's instructions for storage and use should be carefully followed.

2. Foot bathing: Use of walk-through foot baths of 10% zinc sulfate or 10% copper sulfate every fifth to seventh day will greatly reduce the spread of foot rot to normal animals. Enforced daily self-foot bathing with 10% zinc sulfate also reduces spread and will help most infected animals recover. The foot bath can be situated between food and water. These methods will not "cure" carriers or those with severe undermining of the hoof unless their feet are carefully trimmed (see section on "Medications").

Plans for foot baths are available from your local Cooperative Extension Service office.

3. Foot soaks: 10% zinc sulfate can be used for prolonged soaking of feet for a more effective treatment. Addition of a wetting agent or detergent containing sodium laurel sulfate will aid in the penetration of the chemical into the hoof.

Trimming the infected feet is recommended, but a significant number of untrimmed infected hooves will respond.

Formalin must not be used for soaks as it will severely burn the feet (see section on "Medications").

4. Dry chemicals: 10% zinc sulfate in lime can be placed in a box between feed and water to reduce spread of foot rot. This is particularly useful during freezing weather when a solution would freeze. This method is not effective for treatment of diseased animals (see "7. Topical medications").

5. Trimming: Many medications are effective when properly used, but to maximize their effect, the foot must be thoroughly trimmed to expose all infected tissue. No treatment will work if the medication can't reach the infection. All diseased, dead and undermined hoof areas must be pared away to allow medication and air to reach causative organisms. Topical medications should be sprayed on immediately after trimming, and animals should then be foot bathed.

Foot trimmers should be cleaned thoroughly and dipped in disinfectant after trimming an infected hoof.

6. Dry pens: Feet must have prolonged exposure to moisture for foot rot to develop. The drier and less confined the sheep, the slower the spread of foot rot. If infected sheep can be placed in a dry area (which has been free of sheep for two weeks) after treatment, the treatment will be considerably more effective.

7. Topical medications: These are medications sprayed or painted on the feet just after trimming or when foot bath facilities are unavailable. *Trimming is essential for topical medications to be effective.* Ten percent zinc sulfate in water, 10% copper sulfate in vinegar or two parts copper sulfate in one part pine tar and 10% formalin in water have been shown to be the most effective topical treatments. Antibiotics in alcohol solution have also been reported to be from 50-90% effective under these conditions:

- feet were thoroughly trimmed,
- medication was applied once, and
- sheep were held in a dry area.

All of the above medications (except pine tar) can be applied with an aerosol hand sprayer, and 5 to 10 ml will be needed per infected foot. (For mixing directions, see section on "Medications.")

8. Antibiotics: The use of systemic antibiotics or antibiotics in the foot is expensive and of limited success. After treatment, the sheep should be held in a dry area for at least 24 hours to give the medication time to work.

The best control of this disease can be obtained through the use of combinations of treatments. Vaccination, foot soaking of the entire flock at five- to seven-day intervals and separation of limping animals for trimming and hour-long foot soaks, for example, would be an excellent combination. Another recommended control method using a combination of treatments would be enforced self-footbathing and separation of infected sheep which do not respond within 14 days. Those separated could be treated by trimming and soaks.

Treatment Schedule

First Week: Carefully and thoroughly trim all feet on all sheep. Separate any sheep which show evidence of having or having had foot rot. Distorted, extremely hard hooves, small dry pockets, loose or separated hoof wall and/or a strong, sweetish, sickening odor are all indications of foot rot. If bleeding occurs early in the trimming, examination of the tissues is particularly difficult. Turn the animal loose and retrim later after the bleeding has stopped.

Foot bathe sheep which show no evidence of foot rot, and place them in a dry area that has been free from sheep for at least a week. Permanently identify affected sheep; then, foot soak using zinc sulfate with detergent for one hour and keep them isolated from all other sheep.

Second Week: Treat affected sheep for the second time. Observe the unaffected sheep closely for signs of lameness. Any lame sheep should be examined immediately. If the cause is determined to be foot rot, all sheep in that group should again be trimmed and examined as before.

Fourth Week: Carefully trim and examine the affected group. Those that are lacking any signs of foot rot at this point can be returned to the clean group. Those that have remained infected should be culled at this point. If this is not practical, further trimming and foot soaking can be employed.

If the numbers are few, individual sheep can be treated very effectively following these steps:

- Fill a bootie made from a plastic bag with zinc sulfate and detergent-soaked cotton or wool.

- Tape the bag onto the foot under the dew claws.
- Leave it on no longer than two days.

As long as the sheep area remains dry, any remaining foot rot will remain quiescent. Be especially observant after sheep are exposed to moisture (irrigation, rain or snow).

This is an excellent time to retrim and examine feet of all sheep. If this job is put off and limping sheep are suddenly observed, remember the first sheep to show signs are the carriers. They should be removed immediately. Don't wait any longer to examine the rest of the flock. Isolate the affected animals, foot bathe clean sheep and return them to a clean area.

Vaccination and/or antibiotics can be used in conjunction with this schedule at any point. If the weather or pens are not dry when this effort is started, vaccination of all the animals at the beginning and three to four weeks later is recommended as it will help reduce spread.

If the weather or pens are not dry during this control effort, the clean group should be examined and trimmed every 10 to 14 days until no new cases are found for three examinations.

After completing the treatment schedule, watch the flock closely for several months to ensure that some cases of foot rot were not overlooked.

Summary

- Trim • Treat • Isolate • Cull.

Eradication

Eradication uses the same methods outlined above, but requires more commitment, perseverance and willingness to cull. An initial increased expense in labor and facilities will be required, but will pay off many times over in the long run.

Even dedicated use of the above control methods will not eliminate all carriers from a flock. Therefore, to eradicate foot rot, it is essential to have facilities for keeping infected animals isolated and to cull animals with recurring foot rot infection.

Medication

Foot Baths: Zinc sulfate is available in the following forms:

Zinc sulfate (monohydrate) ($Zn SO_4 \cdot H_2O$) containing 35.5% zinc. Zinc sulphate (heptahydrate) ($Zn SO_4 + 7H_2O$) contains 22.7% zinc. A 10% solution = 8 pounds in 10 gallons of water. (Hot water will hasten dissolving.)

Copper sulfate ($CuSO_4$, Bluestone, Blevitriol) (10% solution = 16 pounds in 20 gallons of water). Hot water will hasten dissolving. Addition of some vinegar will aid dissolving in hard water. It should not be put in metal containers as it is quite corrosive. Copper and zinc are very toxic if ingested by sheep.

Store any unused solution in an area inaccessible to animals.

Foot Soaks: Zinc sulfate 10% (mixed as above) plus a wetting agent high in sodium laurel sulfate 0.2% vol./vol. (2/3 cup per 20 gallons).

Dry Baths: Zinc sulfate 10% in lime = 10 lbs agricultural grade zinc sulfate in 90 lbs lime. Mix well.

Topicals:

1. Zinc sulfate, 10% in water ÚÚ 1/4 lb in 1 quart of water.
2. Copper sulfate, 10% in vinegar ÚÚ 1/4 lb in 1 quart of vinegar.
3. Copper sulfate in pine tar ÚÚ 2 parts of copper sulfate in 1 part pine tar.
4. Oxytetracycline solution in alcohol ÚÚ add 25.69 grams (one packet) of Terramycin soluble powder

to 1/2 cup of water; add alcohol to bring solution to 2 quarts.

5. Penicillin solution in alcohol ÚÚ (10,000 units/ml) mix 5 million units of potassium penicillin G with 10 cc water and add the solution to a pint of alcohol.

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