

PUBLICATION 1481

# SHEEP DISEASES


## IN CANADA



630.4  
C212  
P 1481  
1972  
(1986 print)  
c.2



Agriculture  
Canada



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# **SHEEP DISEASES**

## **IN CANADA**

**Health of Animals Branch**

**CANADA DEPARTMENT OF AGRICULTURE  
PUBLICATION 1481**

**PUBLICATION 1481**, available from  
Information Services, Agriculture Canada, Ottawa K1A 0C7

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Cat. No. A63-1481/1981E ISBN: 0-662-11411-6  
Reprinted 1981 4M-3:81

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# INTRODUCTION

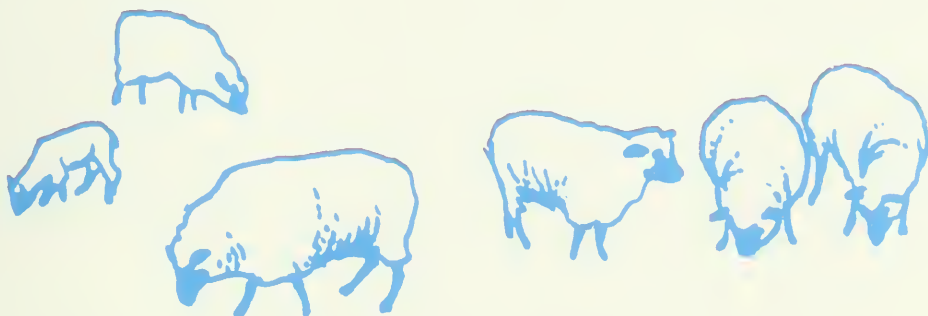
The Animal Pathology Division of the Canada Department of Agriculture has been carrying on investigations into diseases of sheep for many years. As part of these investigations, a large number of carcasses, tissues and other materials have been examined to determine the nature of diseases affecting sheep in different parts of the country. Based on this experience, information has been assembled which it is believed has special application in Canada. This publication has been prepared especially for persons who are interested in raising sheep.

The maintenance of a healthy flock is essential to efficient sheep production. The value of an individual sheep in a commercial flock may not be great, but the protection of the flock against disease begins with that individual. All measures to prevent disease must apply, therefore, to every animal in the flock. The smaller the flock, the easier it is to watch the sheep carefully and to provide necessary treatment in case of trouble. With large commercial flocks it is much more difficult to observe each individual animal and so be aware of the early signs of disease. Failure to detect the presence of disease at its onset is often one of the great weaknesses in sheep management.

Sheep are susceptible to many diseases. Some diseases affect only part of a flock; others, being highly infectious, spread quickly through a flock and are sometimes carried to neighboring flocks, causing extensive disease outbreaks.

It is important to remember that disease is often the result of the interaction of several factors, only one of which is the disease-producing agent. Disease of young lambs may occur because lambing takes place in sheds where adequate sanitation is impossible. The spread of infection may be facilitated by holding bands of sheep on the same ground night after night. Also, sheep may suffer from parasitism through lack of abundant good feed, from infrequent change of grazing ground or from neglect in the use of suitable worm medicine.

The purpose of this publication is to inform sheep owners of the characteristics of the more common diseases and infestations of sheep. The information given here is in no sense intended to replace the service and advice of trained veterinarians.



# EXTERNAL PARASITES

Various species of insects attack sheep, causing annoyance, loss of condition, and, sometimes, death. For the most part this suffering and economic loss is preventable through a knowledge of the habits of the insects, the symptoms of the diseases they cause, and the application of sound control measures. Some important conditions caused by external parasites are discussed below.

## SHEEP KED

The sheep ked (*Melophagus* sp.) is a wingless insect, commonly but incorrectly named the sheep tick. This parasite is prevalent wherever sheep are raised. It lives in the wool of sheep, specially in the regions of the neck, shoulder, belly and thigh. The insect feeds on blood, which it secures by piercing the skin with its mouthparts. Heavy infestations cause unrest and consequent unthriftiness. Keds also cause breakage in the wool fibers, resulting in soiled wool and losses from low grading.

The sheep ked spends its whole life on a sheep and is incapable of breeding elsewhere. The adult ked has been known to live as long as 18 days when detached from a sheep, but usually the survival time is shorter than this. Most sheep become infested by direct contact with other sheep, but some pick up keds left by infested animals in sheds and paddocks. Lambs commonly pick up keds from their infected dams.

Affected animals may be treated with sprays, dips or dusts containing rotenone, organochlorine compounds (such as toxaphene or methoxychlor), organophosphorus compounds (such as malathion, ronnel or coumaphos) or other approved preparations. Sprays and dips are more effective than dusts. The key to their effectiveness lies in the addition of a wetting agent (any common laundry detergent) that carries the active chemical through the wool and into contact with the skin. This agent is usually already incorporated in formulations of insecticides currently registered for this use. During cold weather, it may be necessary to use dusts rather than dips or sprays, to avoid subjecting sheep to undue stress and complications that can follow a thorough wetting.

With some of the earlier preparations, it was necessary to give a second treatment within 14 days to ensure destruction of new keds emerging from puparia. However, when properly used, some of the newer insecticides have considerable residual effect, which enables them to destroy young hatching keds over a period of time and eliminate the need for a second treatment. Modern insecticides coupled with good management allow sheep flocks to be maintained free of keds with a minimum of effort.

Manufacturers' instructions must be followed exactly, and particular attention paid to concentrations and contraindications given on labels.





Figure 1. Sheep ked.

## LICE

Both biting (*Damalinia* species) and sucking (*Linognathus* species) lice infest sheep. In Canada, however, only biting lice are of importance. Sucking lice feed on blood; biting lice sometimes feed on wool fibers, but more often on skin scurf and materials contaminating the wool. The irritation associated with an infestation of lice can be so severe that it seriously interferes with feeding and resting. As a result, animals may be unthrifty and young sheep may be stunted in growth. Infested animals constantly rub against objects and scratch and bite at themselves, so that their wool becomes dirty, ragged and torn.

Once present in a flock, lice spread rapidly. Although most infestation occurs through direct contact, clean sheep sometimes become infested in buildings previously occupied by lousy animals. As lice can live for only a few days off their hosts, they can be controlled best by treating infested animals. It is always advisable to take the added precaution of cleaning out bedding and spraying pens when animals are treated.

The same preparations and methods of treatment recommended for controlling sheep keds are usually equally effective against lice.

## SHEEP NASAL FLY

The sheep nasal fly (*Oestrus* species), often called the sheep nose bot fly, is really a true warble fly and is related to the warble fly of cattle and the bot fly of horses. It is prevalent in all parts of Canada and is active during the summer months. It does not lay eggs, as do other warble or bot flies, but deposits its larvae or maggots directly on or near the nostrils of sheep.

Once deposited, the maggots make their way into the nasal passages and communicating sinuses, irritating the lining membranes. An intense, pussy discharge is present in the nostrils, sometimes in such quantities that it interferes with breathing and causes snuffles. The flies drive sheep frantic. To keep a fly from attacking, an animal will hold its nose in the dust or against other sheep. This interferes with feeding and resting, and prevents the animal from thriving.

Deaths attributed to the sheep nasal fly have usually been found to be caused by diseases that are more difficult to recognize. Nevertheless, in heavy infestations, peculiar nervous symptoms are sometimes seen and heavy losses may occur.

Various methods of controlling the sheep nasal fly have been tried, but none of them is entirely satisfactory. Darkened sheds or pastures with dense clumps of bush offer some shelter in which sheep can escape from the adult fly. Infestations are less severe when such shelters are provided.

## BLOW FLIES

Blow flies (*Lucilia* and *Calliphora* species), although not major pests in Canada, do cause trouble in some regions. They produce a condition known as fly strike, which is an infestation of the skin and subcutaneous tissues of sheep caused by larvae or maggots that feed upon these tissues during their period of growth. Fly strike causes great suffering and often leads to subsequent bacterial infection.

The flies are attracted to sheep by the odors from decomposing fecal matter or discharging wounds, and they deposit eggs or living larvae in these areas. Sheep are struck most frequently in the breech and around the tail where the wool is soiled by urine and feces. Other parts of the body may become affected, especially if wounds are present as the result of accidents or operations such as castration and docking.

An affected sheep usually stands with its head down, refuses to feed, and becomes skinny and weak. Examination reveals a patch of discolored, grayish-brown moist wool and, beneath it, a large, ragged wound exuding a foul-smelling liquid. The larvae or maggots of the blow flies can be seen burrowing into the tissues, where they produce extensive damage. If the disease is allowed to progress, death from the absorption of toxins may follow within a few days.

Fully fed maggots start dropping off struck sheep on the fourth day following a strike. They then pupate in the soil and emerge as adult flies to start another strike.

The affected parts of a sheep must be treated to kill the maggots, promote healing of wounds and prevent reinfection. The wool over an infested area should be clipped, as many maggots as possible removed, and a larvicidal dressing applied. Gasoline, benzene or chloroform may be used to remove maggots. Wounds should then be dressed with a wound dressing that contains a fly repellent.

In areas where fly strike is prevalent, fly-repellent dressings should be applied to all wounds occurring in fly season to avoid infestations of blow flies.

## TICK PARALYSIS

In Western Canada, sheep at times become infested with the Rocky Mountain spotted fever tick (*Dermacentor* species). This tick is capable of causing a disease known as tick paralysis, recognized by progressive, often fatal, paralysis of the limbs. The tick is prevalent in the interior of British Columbia and in southern Alberta, and has been found in southern Saskatchewan, overlapping the western extension of the area where the wood tick is found.

Since many species of tick spend their early life on rodents and other small animals, their control is rather difficult. Sheep should be isolated from known tick-infested areas as much as possible, and periodically in-



Figure 2. Engorged and detached female *D. Andersoni* with flat (unengorged) ticks crawling on her. This clearly shows difference in size before and after feeding.

spected for the presence of these parasites. Sprays and dusts of some of the newer insecticides have been found to protect sheep for the entire tick season.

## MANGE MITES

Mange (*Psoroptes* species) can be a very serious disease of sheep; however, in Canada it has not been a problem for many years.

Signs of mange in sheep include intense itchiness of the affected parts (as indicated by scratching, biting and rubbing), broken appearance of the wool, formation of scabs and thickening of the skin. The severity and location of lesions on the host depend to some extent on the species of mite involved.

Since sheep mange, or "scab," as it is commonly called, is a 'named' (reportable) disease in Canada, all suspected cases should be reported to the nearest office of the Health of Animals Branch, Canada Department of Agriculture, which will supervise the treatment and eradication of this disease.

## INTERNAL PARASITES

Internal parasites have always been a major cause of loss in sheep flocks throughout the world. In Canada, failure to control internal parasites has been one of the main reasons for poor weight gains in growing lambs and, in numerous heavy infestations, has resulted in losses through death. This has been particularly true in Eastern Canada. These losses can be prevented. The cold Canadian winter helps to rid pastures of the young infective stages of the worms, especially larvae of nodular and stomach worms, making control much easier than it is in many other parts of the world.

About 25 different kinds of parasitic worms affect sheep in Canada. Only the few responsible for harmful disease conditions are discussed below. Recommended control procedures and treatments are not described for each disease separately, but in a special section beginning on page 17.

### NODULAR DISEASE (Pimply Gut)

Nodular disease, or pimply gut, is caused by young nodular worms (*Oesophagostomum* species) picked up with grass from contaminated pastures. The worms enter the walls of sheep's intestines where nodules,



Figure 3. Healthy parasite-free animal.



Figure 4. Unhealthy heavily parasitized animal.

or knots, are formed. When present in great numbers the nodules interfere seriously with the health of the sheep. The disease ruins many of the flocks in Eastern Canada and is sometimes found on the west coast. It could also become a problem on irrigated land in the midwestern region where there is sufficient moisture to favor the development of young worms on pasture.

Most eggs and young worms on pasturelands are destroyed by winter weather conditions; but in the intestines of sheep the nodular worms develop to maturity during the winter months and begin laying the eggs that recontaminate pastures each spring. To prevent this recurrence and thereby protect lambs from developing nodular disease, the egg-laying worms in adult sheep must be destroyed before the animals reach pasture in the spring. Winter treatment of breeding flocks is the best way to remove these worms.



Figure 5. Worms collected from large intestine. Upper left, nodular worms.



Figure 6. Worms collected from small intestine, demonstrating great variety in size.

## STOMACH WORM DISEASE

Stomach worm disease is caused by large numbers of 'barber-pole worms' (*Haemonchus* species) in the fourth stomach or abomasum of sheep. It occurs chiefly in lambs in midsummer. The young worms are picked up from grass in the same way as nodular worms. Most of the eggs and worms on pastures are destroyed by winter frost, so that pastures are relatively free from these worms at the start of grazing time. However, untreated sheep can rapidly contaminate a pasture. Winter or spring treatment will remove the adult stomach worm from breeding flocks, minimizing the source of infection so that summer treatment may not be necessary. Flocks should be watched for indications of disease, which



Figure 7. Method of examining the eye of a sheep for anemia (pale membranes) caused by stomach worms.



Figure 8. Bottle jaw in long-standing case of stomach-worm infestation.



may occur as early as July. Since infection can be serious, immediate treatment is called for.

The first signs of stomach worm disease are symptoms of anemia caused by loss of blood due to the blood sucking of the parasites. The animals become unthrifty and the membranes of the eyes and mouth become pale. In some prolonged cases swellings develop under the jaw. This is referred to as bottle jaw. Constipation frequently accompanies the symptoms.

In acute outbreaks, death will occur while animals still look to be in good condition. If some animals die and others have bleached membranes this is evidence of probable stomach worms infection in a flock. The disease is found in Eastern Canada, in sections of British Columbia and in the midwestern provinces on irrigated land and during wet seasons.

## BLACK SCOURS

Black scours may occur in large flocks on limited pasture acreage in the fall of the year. It is caused by almost invisible worms (*Trichostrongylus* species), which accumulate by the thousands in the intestines of sheep. Like nodular and stomach worms, these tiny parasites are picked up from grass. Some of the eggs and young worms are able to survive through the winter months so that pasture is partially infected by them in the spring. Because of this, winter or spring treatment of sheep is not entirely effective in preventing the disease, and flocks should be watched carefully for any signs of this condition.

The onset of the disease is slow, the first symptom being diarrhea, with resulting dirty hindquarters. The wool becomes coarse and dry, and the animals gradually lose flesh. The disease is often complicated by the presence of hookworms, which tend to cause similar symptoms.

The appearance of a scouring disease in late summer or fall, together with general unthriftiness of lambs, is suggestive of this disease. Treatment should be given as soon as the disease makes its appearance.

## LESS COMMON WORM PARASITES

A number of stomach or intestinal worms, acting either singly or in combination, are known to cause troublesome disease. The most common are the thread-necked worm (*Nematodirus* species), the brown or medium stomach worm (*Ostertagia* species), the large-mouthed bowel worm (*Chabertia*) and the hookworm (*Bunostomum* species). Some of these parasites, which may cause scouring and general unthriftiness, overwinter on pasture in greater numbers than the types previously described and therefore are not controlled as well by winter or spring treatment. Of special importance is the *Nematodirus* species, which can over-

winter in sufficient numbers to produce parasitic disease in nursing lambs very early in the grazing season. Symptoms are mushy droppings, soiled buttocks and poor growth. Losses may not occur, but lambs do not finish properly. Treatment is indicated for this condition.

## TAPEWORMS

Tapeworms (*Moniezia* or *Thysanosoma*) are common in many regions of Canada but are usually considered harmless except when present in very large numbers. Segments or portions of tapeworms are frequently seen in the droppings of lambs, and they are often blamed for troubles actually caused by other worm parasites. In great numbers, they are said to interfere with digestion. Healthy sheep are able to throw off most of their tapeworms. Treatment, therefore, is usually not necessary.

## LUNGWORMS

Lungworms (*Dictyocaulus* and *Muellerius* species) are an annoying problem in some flocks. The adult worms live in the air passages of the lungs. They deposit ova, which are coughed up and swallowed by the infested sheep and larvae are passed with the manure. Under favorable conditions of temperature and moisture, the larvae of the *Dictyocaulus* species develop into infected larvae. If infected larvae are eaten by sheep, they penetrate the wall of the intestine, gain entrance to the circulation and finally reach the lungs where they develop into adult worms.

Larvae of the *Muellerius* species require a snail to complete their development. Sheep become infested when grazing by consuming snails infested with the larvae.

Sheep affected with small numbers of worms may not be greatly troubled but heavy infestations can cause unthriftiness, interference with normal lung function, pneumonia and death. Signs of lungworm infection include coughing, weakness, unthriftiness and difficult breathing.

Formerly, treatment for lungworms was unsatisfactory. However, newer drugs are available which are very effective for treatment.

## COCCIDIOSIS

Coccidiosis (*Eimeria* sp.) is a disease of lambs and rarely of adult sheep. It is caused by an infestation with microscopic protozoan parasites called coccidia. The coccidia invade the cells that line the intestinal tract where they may cause a severe inflammation. In the course of their life

cycle in the intestinal cells, they form oocysts, which are passed with the manure. These oocysts, which are very resistant to extremes of weather, are the source of infection for susceptible sheep.

Sheep are frequently infected with this parasite without apparent harm resulting. However, under certain conditions, the parasite seems to become very active. Serious disease and death can result.

Coccidiosis occurs most often in feedlot lambs, usually in the first 2 to 4 weeks of confinement. It is thought that bringing lambs to full feed of fattening rations too quickly contributes to the development of this condition. The first sign may be watery diarrhea, which may contain blood clots. Lambs lose their appetite and become thin and weak. Straining is sometimes seen and pneumonia is a frequent complication. Lambs may die within a few days of the first signs but may recover quickly without benefit of treatment.

Treatment with drugs may be advisable in a severe outbreak and a veterinarian should be consulted. A change of roughage is often beneficial. When possible, well-cured grass hay should be substituted for legume hay or silage until the disease is well under control. The concentrate ration should be reduced or cut off. When the disease is well under control, the return to the fattening ration should be gradual.

An effort should be made to see that feed and water is not contaminated with manure, which may contain the infective form of the parasite. Feedlots should be well drained.

## CONTROL OF INTERNAL PARASITISM

In controlling parasites, it should be realized that there are two primary sources of infection for newborn lambs: first, adult sheep that carry the parasites through the winter and reinfect pasture in spring; and second, pasture that carries residual parasites; that is, the immature stages that survive the winter on the ground and are ready to infect lambs at grazing time. Fortunately, the most harmful species of parasites are largely destroyed by Canadian winter weather, but at certain times and in certain areas some survive in sufficient numbers to produce parasitic disease, particularly in lambs. Some species are capable of laying enormous numbers of eggs so that infection builds up to dangerous proportions very quickly; in others the process is slow, causing only subclinical disease. Warm, moist weather and low, wet or boggy soil favor parasite development. Overstocking and overgrazing should be avoided as they tend to increase the concentration of parasites.

The use of permanent pastures, unless there is extensive range, favors the establishment of residual infection. In some areas grazing cattle over sheep pastures in alternate years has proved an effective and economical method of controlling residual infection. A thorough understanding of the life cycles of the various parasites is necessary to plan control by pasture management.

It has already been mentioned that parasites survive the winter inside adult sheep, and that pastures are cleared of many young infective worms by severe winter weather. The most effective control procedure, there-



Figure 9. Lambs will pick up worms when grass grows.

fore, is to rid the sheep of worms that could reinfect pastures when the sheep are turned out in the spring.

All sheep to be carried over the winter should be treated sometime after the freeze-up and before lambing and, in any case, before the end of freezing weather. The ideal time is late winter. Treatment of a flock at this time will remove most of the worms in the ewes, increase the vigor of the flock and improve the lamb crop. Under certain conditions of very heavy parasite infestations, a fall treatment, followed by a late winter treatment, may be advisable.

It is important to keep sheep and lambs from cropping the spring grass in their winter yards, as it may be contaminated with immature parasites. Unless these precautions are observed, early infection of lambs may result and, since lambs are not usually treated, they can be responsible for introducing infection into clean pastures.

If the method of control outlined above is followed, usually no further treatment is necessary later in the year in the average farm flock. However, in flocks where parasitism is a continuing problem or where climatic conditions favor the development of parasites on pasture, summer treatment will be required. Lambs are the most susceptible members of the flock and should be closely observed for evidence of parasitism.

It has been found that immature stomach worms in a form that resist treatment may overwinter in some adult sheep. These inactive forms may resume their development in the adult sheep at a time following the annual worming. Adult sheep infested with these resistant immature forms

can serve as a source of infection to other sheep or lambs on pasture. This phenomenon is not clearly understood but it could explain the failure of winter treatment to adequately control stomach worms in some flocks.

Symptoms such as anemia, diarrhea, poor weight gains and general unthriftiness, which have been described for specific diseases on previous pages, are indications for treatment. In some cases, it may be necessary to repeat treatments. Supplementary feeding will be helpful, particularly in the fall, since sheep are able to tolerate parasites better when their plane of nutrition is adequate.

## Medication

An accurate diagnosis of the types of worms infesting a flock is essential before treatment is undertaken and essential to the proper choice of a treatment drug. If an accurate diagnosis has not been established, an examination of manure samples, representative of the flock, will give a good indication of the worm burden. This examination can be carried out by a practicing veterinarian or at a veterinary laboratory.

Because a drug in use today may be replaced tomorrow by one that is more effective or safer, no drugs for the treatment of parasites in sheep will be named in this publication. It is recommended instead that the drugs available for treatment be assessed before a worm medication is decided upon. The following should be considered when choosing a drug for parasite treatment:

- The degree of efficacy against the various types of worms. The closer to 100 percent against the important parasites the better, other factors being equal. For most areas of Canada it is essential that the drug used for treatment be close to 100 percent effective against stomach worms, nodular worms and *Trichostrongylus* worms.
- The efficacy against immature forms of the worms, that is, larvae that are migrating in the sheep's body.
- The safety of the drug and the precautions that must be observed when using it.
- The safety of the drug for pregnant sheep.
- The safety of the drug for lambs.
- The method of administration, for instance, whether by pill, liquid or hypodermic injection.

Label recommendations of treatment drugs should be *observed carefully*.

It should also be kept in mind that parasites can develop resistance to the action of a drug, which greatly reduces its effectiveness. This is another reason for yearly evaluation of treatment drugs.

Caution should be exercised when drenching sheep. Although an experienced person can drench sheep with safety, an inexperienced person can cause the death of many sheep by improper drenching. If some of the drench goes into the lungs, it can cause sudden death or a pneumonia to develop. The pneumonia resulting from faulty drenching is usually fatal, though the animal may linger in poor health for weeks before dying.

Special care should be taken to avoid rough handling of ewes in advanced pregnancy, to avoid abortions and lambing problems.

It is well to mark the animals as they are treated, so that if there is an escape animals already treated can be identified. All animals should be treated on the same day. If this is not possible, untreated animals should be kept isolated until they can be treated. Additions to a flock should be treated before being allowed to mix with the flock.

Treated animals, if dosed before pasturing, should be held in their quarters for up to 24 hours (depending on the drug used) to allow the drug to act. This will prevent contamination of pastures, which would occur otherwise. Animals treated during midwinter need not be moved, although it is desirable to clean the stabling quarters 24 hours later to reduce the possibility of exposing lambs to parasites during the remainder of the holding period.

The local veterinarian who is familiar with regional problems can be of valuable assistance in helping to plan a parasite control program.

## DISEASES CAUSED BY BACTERIA

Many diseases caused by bacteria affect sheep. No attempt will be made to describe them all. In this section, only the more serious ones and those that occur in Canada are discussed.

### CLOSTRIDIAL DISEASES

#### Blackleg

Blackleg is caused by *Clostridium chauvei* and is characteristically a wound infection which follows shearing, castrating, docking, or bruising from fighting or parturition. Typically, there is a lesion around the point of entrance of the infection, characterized by purplish discoloration, swell-

ing of the subcutaneous tissues and the presence of fluid. Air under the skin, associated with blackleg in cattle, is not one of the predominant lesions in sheep. In sheep, the skin pits on pressure, indicating fluid rather than air in the tissues. If the lesions occur on the legs, there is extreme lameness, and if in the genital tract, stiffness and a straddling gait. The animals may have a very high temperature, and they usually go down and die within 24 to 48 hours. Recoveries are very rare.

Bacterins are available to immunize sheep against this disease and their use is recommended on those premises where the disease has been diagnosed. Lambs can be given their first injection of bacterin after 8 weeks of age with a booster dose given 4 to 6 weeks after the initial dose. In areas where the disease is usually severe, the administration of a yearly booster dose may have to be practiced.

## Malignant Edema

The term malignant edema has been generally applied to wound infections with *Clostridium septicum*, but *Cl. chauvei* may also be involved. The disease closely resembles blackleg and it is difficult to differentiate the two diseases. One of the differences between the conditions caused by this organism and the malignant edema caused by *Cl. chauvei* is that the edema fluid is blood-stained and the tissues are hemorrhagic or bloody and contain gas. This disease is usually fatal. Bacterin-toxoids are used for immunization in a manner similar to that outlined for blackleg.

## Enterotoxemia

Enterotoxemia (feedlot disease, overeating, pulpy kidney disease) is an acute intoxication resulting from the elaboration of the toxins from *Cl. perfringens* type "D," an organism widely distributed in nature and known to be present in the alimentary tract of many normal sheep. Under conditions favorable to it, the organism multiplies rapidly in the ingesta in the intestine, which provides an excellent environment for the production of the very potent toxins.

Enterotoxemia is an infectious disease; it is also a nutritional problem. A sudden alteration in the food supply, usually from a poor to a rich one, or the ingestion of large quantities of highly nutritive foodstuffs, appears to be necessary to initiate the disease. Lambs on luxuriant pasture, feedlot lambs on heavy grain rations, and young lambs nursed by heavy-milking ewes are those most usually affected.

The most frequently observed symptoms are diarrhea, listlessness, incoordination, convulsions and coma. On occasion, an affected animal will rapidly become progressively weaker and show signs of disturbance

of the central nervous system by circling, throwing back its head, or pushing against some object. Death usually occurs within 8 hours after the onset of symptoms. Under field conditions lambs stricken with enterotoxemia usually die suddenly without symptoms being observed. Mortality of affected lambs is nearly 100 percent, and a flock loss of 25 percent is not uncommon.

Enterotoxemia may be confused with pasteurellosis, coccidiosis, polioencephalomalacia and plant or chemical poisoning. Therefore, an accurate field diagnosis must be based upon the history of sudden deaths in lambs exposed to rich feed and the demonstration of the aforementioned symptoms. Laboratory confirmation is desirable.

Feed consumption may be regulated to control losses caused by enterotoxemia. However, lambs that are very susceptible to the disease may contact it in spite of special feeding management practices.

Sheep can be immunized against this disease by the use of a *Clostridium perfringens* D toxoid or bacterin-toxoid. Pregnant ewes given two inoculations, at 6 weeks and 2 weeks before lambing, will pass sufficient antibodies in their colostrum to protect their lambs until 8 to 12 weeks of age. Lambs not sent to slaughter by this age should be given an immunizing injection after they are 8 weeks of age, followed by a booster injection a month later.

## Tetanus or Lockjaw

Tetanus is a highly fatal disease that results when wounds become infected with a specific organism, *Clostridium tetani*. When it infects bruised tissue, this organism generates a toxin that affects nervous tissue. The tetanus-causing organism may be active in a wound without the usual signs of an infected wound being apparent. *Clostridium tetani* infection may follow castration, docking and shearing. Docking and castrating with rubber bands is thought to favor the development of tetanus infection. Tetanus in very young animals is often a result of navel infection.

Affected animals suffer muscular spasms during which the entire body may become rigid. Frequently, an infected sheep may fall over on its side, with the head pulled towards the top of its back (opisthotonos). Startling an affected sheep may bring on a convulsion. Less severely affected animals show a stiff gait and difficulty in turning, backing and eating.

Treatment is not usually satisfactory but should be considered for a valuable breeding animal and should be under the guidance of a veterinarian.

Sheep can be satisfactorily immunized against tetanus. Pregnant ewes, inoculated with tetanus toxoid, using the procedure outlined above for enterotoxemia, will pass immunity to their lambs through the colostrum. This immunity (called passive immunity) will usually protect the lambs for the first 8 weeks of life after which time the lambs may be stimulated to produce active immunity by inoculation of tetanus toxoid. A yearly booster injection of tetanus toxoid is advisable to maintain a high degree of immunity.



## Other Clostridial Diseases

In addition to the clostridial diseases already described, there are other diseases caused by the clostridium group of organisms. Some of these are braxy, black disease and lamb dysentery. These diseases are troublesome in some sheep raising countries of the world but they are not considered to be of common occurrence in Canada.

## Control of Clostridial Diseases

Most animals infected with clostridial diseases succumb. Treatment usually proves to be disappointing. Frequently animals are found dead without having been noticed sick. It is, therefore, very desirable to protect sheep from these infections by immunization on premises where the diseases have occurred or there is reason to suspect they will occur.

As discussed under the individual diseases, biologics referred to as bacterins, toxoids or bacterin-toxoids are available that are effective immunizing agents against the diseases discussed. Some of the biologics available are so formulated that a single product will immunize against all four diseases (blackleg, malignant edema, enterotoxemia and tetanus).

A sound immunizing program depends on a knowledge of the disease pattern in a particular area, and the use of the proper immunizing biologic in the proper manner and at the proper time. It is, therefore, advisable to consult a veterinarian who understands the local situation to recommend an immunization schedule.

Carcasses of dead animals should not be skinned or opened except as directed by a veterinarian. Preferably, they should be buried deeply on the spot or burned. Carcasses should never be left on the surface as they may be devoured—or dismembered and the dismembered parts carried about—by dogs, coyotes or scavenger birds. Outbreaks of clostridial diseases have occurred after farm dogs dragged limbs of dead carcasses from neighboring fields into stable yards.

The exercising of care, cleanliness, sanitation and antisepsis when clipping, castrating, docking and vaccinating sheep will help to prevent blackleg and malignant edema infections.

## FOOT ROT

The feet of sheep are subject to several diseases. The term foot rot should be reserved for the specific disease that is the most common and important of these. Foot rot may be defined as the contagious disease of a sheep's foot characterized by the separation of a large portion of the hoof from the soft tissues, produced by a spreading infection immediately beneath the horn and caused mainly by the organism *Fusiformis nodosus*.

During wet weather in the spring and fall, and in low wet pastures or muddy corrals, the tissues of the feet become soft. If the infectious agent is present in the soil, it will readily penetrate softened tissues. Muddy conditions alone do not cause the disease. The causative organism must also be present in the soil. Contamination of the ground occurs when infected animals are put on it.

At first a mild inflammation usually affects the soft tissue between the toes and it may spread around the junction between the hoof and the skin. The skin then breaks and the infection spreads downward under the wall and sole, and later these structures separate from the foot. A characteristic foul odor accompanies the process.

Lameness is the first symptom noted. If the disease is allowed to progress, a loss of condition follows. There is seldom any pus formation, and the deeper structures are not directly involved. Lameness is acute, and sheep infected in their front feet feed on their knees. Often more than one foot on the same sheep is infected, and almost always both digits of the foot. The disease is chronic, and sheep left untreated may remain infected for years.

Before treatment is undertaken it is necessary to differentiate foot rot from other conditions causing lameness, such as injury or foot abscesses. If most of the sheep in a flock are infected, diagnosis may be comparatively easy; however, if only a few sheep are slightly infected, then it is necessary that a veterinarian be contacted to assist in making the correct diagnosis.

No treatment will be successful unless all of the infected necrotic hoof is completely pared away from the underlying healthy tissue. This must be done ruthlessly, even if practically all of the horn of the wall and the sole has to be removed.

There are several treatments available, such as dipping infected feet into a 10 percent formalin solution for about 10 seconds or, if many animals are to be treated, they may be run through a footbath containing a 5 percent solution of formalin. Another treatment is to walk infected animals through a 30 percent solution of copper sulfate in a footbath. Treatment with antibiotics known to be active against the causative organism should be considered when deciding on the treatment of choice. As new treatments are continually becoming available, a veterinarian should be called to assist in both the preparation of infected hoofs and the initial treatment of animals.

Although treatment of individual animals showing lameness is essential, this is not sufficient to control foot rot on the farm. The object of treatment and control should be to completely eradicate the infection in as short a time as possible. When a diagnosis has been made, the flock should be quarantined and each animal turned over and inspected thoroughly. If there is any indication of disease in any of the hoofs, each one should be radically trimmed and treated. After animals have been treated they should be turned into a clean area where no sheep have been pastured in the previous 2 weeks. These animals should be examined frequently, and if any further indications of infection are detected their feet should again be pared and treated. If every foot has been thoroughly prepared and treated, the disease can be eradicated in one treatment.

Once the infection has been eliminated from a premises, strict precautions must be taken to avoid its reintroduction. If animals are being

brought onto the premises for the first time it is not enough just to see whether they are lame or not, each animal should be turned over and each foot inspected thoroughly.

## FOOT ABSCESS

Foot abscess is sometimes erroneously referred to as foot rot. It is caused by the organism *Spherophorus necrophorus*. The first sign of the disease is acute lameness and in the early stages, although examination may reveal no obvious lesion, the infected hoof is very hot and painful. Cutting away the horn over the sole may reveal the abscessed area. If the condition is allowed to proceed untreated, the abscess usually forms at the coronary band or in between the digits. At times this causes swelling or suppuration in the leg, often leading to invasion of the tendon sheaths and the joints. Pus may discharge through sinuses in the leg for many weeks.

Although the condition may appear serious at first, it is not as severe as foot rot, as it usually affects only one foot and does not prevent a sheep from grazing. The condition may even eventually resolve itself spontaneously, although it sometimes deforms the foot. If surgery is considered, it should be conservative and limited to the draining of imprisoned pus. Treatment with antibiotics or sulfonamides known to be active against the causative organism may be beneficial.

## PNEUMONIA

Pneumonia is an inflammation of lung tissue, often accompanied by pleurisy. There are many causes of pneumonia, the most common being invasion of the lung by various disease agents such as bacteria, viruses and molds; irritation by parasitic larvae as lungworm larvae and the introduction of foreign material into the lung, for example, faulty administration of a medicinal drench (foreign-body pneumonia). A stressing factor such as shipping or prolonged exposure to inclement weather is often associated with outbreaks of pneumonia (see pasteurellosis).

A rise in body temperature to 105° or 106°F (40.6 or 41.1°C), or more, usually occurs in early pneumonia. Respirations are increased early in the disease but may decrease later. Depression, loss of appetite, coughing, nasal discharge and mouth breathing are common signs.

The type of treatment chosen depends on the cause. The sulfonamides and antibiotics are indicated in those cases due to or complicated by bacterial agents. Where parasitic larvae are involved, appropriate worm medicine should be administered. Pneumonias due to molds and foreign bodies usually do not respond to treatment.

## PASTEURELLOSIS

Pasteurellosis is an acute septicemic disease, usually accompanied by pneumonia. It is often associated with conditions of stress, such as shipping or weaning. Although the bacteria *Pasteurella hemolytica* are most often associated with this disease, *Pasteurella multocida* may be involved also. The exact role these organisms play in causing the disease is not certain, as the nature of pasteurellosis is not completely understood. Some workers think that other disease agents such as viruses are necessary contributory causes of the disease.

For the most part pasteurellosis is a disease of young, mature sheep, but older sheep can also be affected. The disease develops more or less spontaneously and is probably introduced by carriers which harbor the organism in their upper air passages. Animals may also contract this disease when their natural resistance has been lowered, as by exposure to cold or dampness, or nutritional disturbances.

In the acute form of the disease, sheep show marked depression, drooping ears, lack of appetite, discharge from the eyes and nose, coughing, increased thirst, difficulty in breathing and sometimes muscular tremors. Death may occur in 1 to 2 days or not for a week. As many as 50 percent of a flock may show symptoms, but mortality rarely goes above 10 percent.

Infected animals should be separated from others and afforded good feed, bedding and protection from adverse weather. Treatment with antibiotics or sulfonamides active against the causative bacteria may be beneficial, but it is advisable to consult a veterinarian for guidance with treatment.

Since predisposing causes play such a large part in the incidence of pasteurellosis, protection from factors such as bad weather, poor feeding, poor quarters and stress during shipping will go far towards its control. Commercial bacterins are available that are intended to stimulate immunity in healthy sheep against pasteurellosis; however, their value is difficult to determine. Their use is not recommended in exposed or infected flocks, in animals intended for immediate shipment or in animals that have recently been in transit.

## MASTITIS

Mastitis (mammitis, blue bag, inflammation of the udder) occurs rather commonly in both farm and range flocks. It is an infection of the udder which takes a variety of forms depending upon the organism involved. Frequently, abscesses occur, with possible resulting gangrene and death; if gangrene does not follow, these cases may become chronic. Often when the condition is a flock problem the causative organism is *Pasteurella multocida* or *haemolytica*, both of which can be the cause of the generalized systemic condition known as pasteurellosis.

Predisposing causes for mastitis include damage to the udder due

to bruising, sore or cut teats, or a concurrent outbreak of 'sore mouth' in the flock.

The first signs of the disease are the separation from the flock of ewes showing lameness—they carry one leg away from the sensitive udder. During the first day the infected half of the udder is both hot and painful and may be somewhat enlarged and tense. The mastitis usually affects one side only. After the first day the gland may become enlarged and hard and then, depending on the causative organism, may actually become gangrenous with bluish discoloration (blue bag) and slough off completely. In acute cases where the infection spreads to other parts of the body, the temperature of the animal may rise to 105° to 107°F (40.6 to 41.7°C), and the animal dies within 1 or 2 days of showing initial symptoms. In non-fatal cases, the temperature usually returns to normal in 2 to 4 days and the general condition of the ewe is good. However, the infected side of the udder will not recover its function. During these few days, the udder is often so sore that the ewe will not allow a lamb to suckle and the lamb may be lost if it is not orphaned to another healthy ewe.

Frequent stripping is of some value. Medicinal treatments with sulfonamides or antibiotics may also be effective, depending on the type of organism involved. There is no treatment for gangrenous mastitis. Amputation of the udder may save the life of an animal that would not ordinarily recover. When the udder and infected areas of skin have sloughed off, with or without amputation, local medication is of value.

Culling of affected animals is mandatory if half of the udder is lost. It is not necessary, however, to cull just because small lumps can be felt in the dry udder, as ewes showing this change are quite capable of producing normal milk supply during the next lactation.

## ARTHRITIS IN LAMBS

Arthritis in lambs occurs in two forms. One form, suppurative arthritis, is caused by pus-producing bacteria (*Streptococci*, *Staphylococci* and *Corynebacterium pyogenes*); the other, non-suppurative arthritis, by the swine erysipelas organism (*Erysipelothrix rhusiopathiae*). Both forms are common under certain conditions.

It cannot be overemphasized that predisposing causes are more important than the specific infective agents. Infection usually takes place through the navel of a lamb shortly after birth where lambing occurs in dirty, contaminated surroundings. Arthritis can also develop from infection through wounds, such as those caused by castration and docking or when young lambs are earmarked, tagged or tattooed in unsanitary surroundings.

The symptoms are characteristic: lameness, swelling of joints (swelling may be absent in non-suppurative arthritis), carrying a leg, fever, listlessness and depressed appetite. In the non-suppurative or erysipelas arthritis, most lambs recover without treatment within a month of the onset of symptoms; however, some may develop a chronic lameness.



Figure 10. An arthritic sheep, showing deformity in front legs.

In suppurative arthritis there is marked swelling of infected joints and pus in joint cavities. Joints are hot and painful. Frequently systemic infection is present, with abscesses scattered throughout the body. Pneumonia may be a complication. The mortality rate is high and the chances of recovery are poor. Animals that recover are usually left permanently crippled.

A completely satisfactory treatment for arthritis in lambs has not yet been developed. Antibiotic and sulfonamide treatment in dosages recommended by veterinarians is sometimes of value where a laboratory diagnosis has been made. Vaccination is not effective in preventing the trouble; however, if non-suppurative arthritis occurs and is definitely diagnosed, then the use of anti-swine erysipelas serum in lambs shortly after birth will definitely be effective. The serum is not effective against suppurative arthritis, nor can it be used as a treatment for non-suppurative cases.

The best prevention against this condition is good sanitation. Ewes should be lambed in a clean area, preferably on grass. It is important to avoid wound infections by performing castrating, docking, vaccinating and any other operation in a temporary enclosure on clean ground and by keeping animals on clean ground until the wounds have healed over.

Similar precautions should be taken when earmarking, tattooing or tagging sheep. Operating instruments should be sterilized by boiling for at least 10 minutes before use, and rinsed frequently during an operation by dipping them in a container of disinfectant solution. When the condition is a continuing flock problem the prophylactic administration of a suitable antibiotic for the first 3 to 4 days after birth and at the time of docking and castration may prove of value.

## VIBRIOSIS

In sheep, vibriosis (vibrionic abortion) is characterized by abortions. In cattle, on the other hand, the predominant symptom is infertility. The other main difference between the two species is the method of transmission. Vibriosis in cattle is accepted as being venereal and the bull is considered the primary source of infection, whereas sheep are probably infested via the digestive tract and the disease is in no way connected with the actual breeding process.

The disease in sheep is caused by a bacterium called *Vibrio fetus var. intestinalis* and in cattle the organism usually involved is called *Vibrio fetus var. venerealis*. Although the sheep organism may be involved to some extent in late abortions in cattle, the cattle organism does not cause any disease in sheep.

A characteristic symptom of vibriosis in sheep is abortion during the last 6 weeks of pregnancy. There are no symptoms before the abortion; however, there may be some slight swelling of the vulva and a very minor discharge a few days before this occurs. Following the abortion there may be a brown mucopurulent discharge for a few days. In a very few cases a metritis (uterine infection) may follow, but usually a ewe shows little clinical evidence of infection. Laboratory studies indicate that infected animals are rapidly freed from infection after an acute attack that results in abortion.

Diagnosis can be confirmed only by laboratory examination and the demonstration of the causative organism, either in smears or by culture of the stomach content of the aborted fetus or from the afterbirth of a ewe.

The isolation of aborting ewes and the destruction by burning or burying of aborted fetuses and afterbirths is of first importance in controlling the infection. If the disease is known to be present, then it is important that the areas on which ewes are being wintered and lambled be cleaned thoroughly. Any surface standing water should be eliminated and a supply of fresh running water always provided.

No treatment is known at the present time to prevent the occurrence of abortions once the disease has become established in a flock. There is some evidence that ewes of a flock where vibriosis has occurred will not carry the infection to another breeding season and that ewes that have aborted are immune to reinfection.

A bacterin is available that may be of value in preventing the disease in flocks where the disease has appeared in previous years or that might be exposed to the infection.

## LISTERIOSIS

Listeriosis (circling disease) is an acute infectious disease characterized in some cases by nervous symptoms, in others by a generalized infection and in still others by abortion. It is caused by an organism named *Listeria monocytogenes*.

Signs depend on the form the disease has taken. In the nervous type, affected sheep are sluggish, lag behind the flock when it is moved, may not go to the feed trough and, if they do go, eat listlessly, sometimes allowing partly chewed food to accumulate in one cheek. These symptoms may be followed by a discharge from one or both nostrils; one ear may drop indicating paralysis. Initially they may have a very high temperature but soon it falls and often becomes subnormal before death. They may circle in one direction only, and if they go down the head is often drawn to one side or completely back. The animals finally go down—usually about the third day after the onset of symptoms—and are unable to rise; they go into coma and die within a week. The disease is nearly always fatal and a loss of around 2 to 4 percent of a flock in a season is common; however, in some outbreaks deaths have run as high as 10 percent.

In the genital form of the disease, abortions may occur without evidence of sickness in the ewes other than a slight inflammation of the uterus and retained afterbirth.

As the disease may be confused with other forms of infectious abortion and with conditions such as enterotoxemia or brain abscesses caused by other organisms, it is essential that a laboratory diagnosis be obtained. It is good control practice to isolate infected animals and destroy the carcasses of sheep that have died from the disease. The feeding of silage has been associated with outbreaks of this disease and should be considered if a number of cases occur on a premise.

Treatment with sulfonamides and antibiotics has, in general, been unsatisfactory. There are no vaccines available for the control of this disease.

Listeria infection can cause serious, often fatal, disease in man. Extreme care should be taken when handling sheep that might be infected with the disease. Particular care should be taken with aborted fetuses and afterbirths to avoid human exposure to the disease.

## CASEOUS LYMPHADENITIS

Caseous lymphadenitis (pseudotuberculosis) is a chronic disease of adult sheep that appears in all parts of the world where sheep are raised. It is more prevalent in range flocks than in those raised on farms, but is seldom fatal. Most of the information that has been gathered on the frequency of the disease comes from meat inspection statistics.

In Canada, between 2 and 3 percent of the sheep condemned by the Meat Inspection Division of the Health of Animals Branch have been con-



demned because of this disease. It is caused by a bacterium called *Corynebacterium pseudotuberculosis*. The infection apparently gains entrance through wounds caused by such operations as castration, needle punctures or shearing. The disease has also been reproduced in lambs by oral dosing.

Signs of the disease may not appear for several months, but once they appear they become chronic. Many extensively infected animals are in excellent condition. The disease usually affects lymph nodes, particularly those in the chest area. In generalized cases, lesions may also be seen in the lungs, liver, kidneys and spleen.

Affected lymph nodes may be ruptured at shearing, resulting in the shears becoming contaminated with the causative organism. Infection can be introduced into susceptible sheep by this means. In herds where the condition exists, it is good practice to shear the lambs first. There is no known treatment and, although vaccines have been tried, they are of questionable value.

## DISEASES CAUSED BY VIRUSES

### CONTAGIOUS ECTHYMA

Contagious ecthyma (sore mouth, orf) of young sheep and goats is caused by a virus. It is usually observed where large groups of animals are assembled at feedlots and fattening pens, but also occurs in farm flocks and range bands. The disease spreads rapidly.

Early symptoms are somewhat reddened and swollen lips. Later small vesicles or watery blisters appear. These soon become pustules that rupture in a few days, becoming open raw bleeding sores. Scabs form, making it difficult for animals with severe cases to nurse or take food and water from troughs.

If secondary infections do not develop from contamination with other bacteria or fly larvae, the scabs gradually dry up and fall off in 15 to 20 days without leaving scars.

The udder and teats of nursing dams are sometimes infected. This can prevent the young from nursing and lead to caked udder and mastitis. In severe outbreaks, lesions have been observed on the ears, under the tail and inside the thighs. The disease is more severe in lambs under 1 month of age, the first signs of infection often being swelling of the gums.

Humans exposed to infected animals may become infected themselves. The virus usually enters through broken skin on the hands and face.

Sore mouth rarely causes death, except when complicated by secondary infection. Severe cases may prevent the proper intake of food when sheep are in the important growth stage. Thus, malnutrition may lead to unthrifty and stunted animals unsuitable for marketing.

There is no specific treatment for this disease.

In outbreaks of sore mouth, the scabs that drop from lesions contain the virus and can remain infective for many months. Thus, thorough cleaning and disinfection are important in sheds, barns and corrals. Infected pastures or ranges should be kept free of animals for at least a year, if possible. Animals that have recovered from sore mouth are immune for a year or more. In areas where the disease is common, vaccination is sometimes performed at the time of castration and docking. The vaccine is prepared from dried scab from infected animals and applied by means of a swab over a lightly scratched area inside one thigh. This produces a localized infection and stimulates immunity. The scab from a vaccinated animal is just as infectious as that from a natural infection, so that vaccinated animals should not be in contact with unvaccinated animals for at least 3 weeks.

Since sore mouth is a highly infectious and contagious disease, caution must be exercised in the use of vaccine. A vaccination program may interfere with an eradication program and this disadvantage should be considered when vaccination is contemplated. The vaccine should not be administered to animals under 6 weeks of age. It is advisable to consult a qualified veterinarian for information and assistance in handling a flock that is infected or exposed to infection.

## SCRAPIE

Scrapie is a fatal, chronic, wasting disease of sheep, characterized by a long incubation period, intense itchiness, progressive weakness and impaired gait. It was diagnosed in Canada for the first time in 1938. "La tremblante" or "prurigo lombaire" are terms used in the French literature to designate the disease.

It is believed that all breeds of sheep, either purebred or crosses, are susceptible, though some breeds appear to be more so than others. Sex is not a factor. Because of the long incubation period, infected sheep do not show symptoms before 18 months of age, but there seems to be no upper age limit.

Many theories have been advanced as to the cause of scrapie. Most workers attribute it to a filterable virus. A ram may become infected through either parent and develop symptoms when about 2 years old or older. A ram may also become infected from mating with infected females. Even rams that have been castrated and have not been used for breeding purposes can contract the disease.

A ram can convey infection to a healthy flock so that the disease appears in its progeny or in previously healthy females; the ram itself may not show any symptoms. Ewe lambs can bring the disease into a clean flock and not show symptoms until lambing time. Also, a proportion of their progeny may act in the same way and others never show symptoms of the disease. Some authorities believe infection can be transmitted through the medium of the pasture.

The long period of incubation is one of the peculiarities of this disease. It is seldom less than 18 months and can be as long as 2 or 3 years. Generally, ewes show clinical symptoms shortly before or after lambing, whereas most rams appear to be affected soon after mating.

One of the first symptoms is a loss of bloom on the outer surface of the fleece, which becomes a peculiarly dull brownish blue. Later, intense itchiness causes an infected animal to rub against objects. This thins or entirely removes the wool, first from the crown of the head and around the rump. If the itchiness extends to all parts of the body, very large denuded areas may develop. Scratches and abrasions of the skin are caused by the animal scratching. Frequently these become infected and abscesses may occur. In acute scrapie, animals die early and little wool is lost.

If the skin of an infected sheep is rubbed or scratched, especially over an area devoid of wool, the animal will extend its neck, elevate its head and have tremors in its lips. The term "scratch reflex" is applied to this particular symptom.

At the onset of the disease an animal may appear very nervous, and frequently get up and lie down or change position. When approached, it has a startled look and the pupils appear dilated. Excessive movement of the jaw is often observed. Close observation, either in a field or pen, reveals the presence of muscular tremors and nervous twitching of the ears and eyelids. The voice may be altered to a nervous, trembling bleat. There is grinding of the teeth. Some sheep, when caught, develop such severe convulsions that they are unable to stand.

Infected sheep have a tendency to move in an aimless and stupid fashion. Their gait resembles that of a donkey; stiff forelegs make it difficult for them to get over low obstacles. Later their hind feet drag slightly on the ground and there may be knuckling at the pasterns and fetlocks.

Frightening or chasing scrapie sheep can promote convulsions, with subsequent loss of consciousness and sometimes frothing at the mouth. These fits last only a few minutes but may recur after a short interval. If an animal does not die after a convulsion, it eventually becomes partially or completely paralyzed, and dies in a matter of hours or days. Some animals die without ever exhibiting symptoms of any kind.

Early in the disease, appetite and rumination remain normal, although thirst is increased. Later, infected animals do not eat, rapidly lose weight and become emaciated. There is no temperature increase. The disease has an average duration of 2 to 6 months, but some animals die within 2 weeks. Occasionally, an animal has been known to survive for as long as a year. The disease is always fatal and the number affected in a flock may range from 4 to 30 percent.

Autopsy of a scrapie sheep does not reveal specific lesions, but some brain lesions are considered to be indicative of scrapie. The carcass is usually thin and emaciated, with little or no natural fat present. Scab formations and abscesses of the skin caused by secondary infections are sometimes present.

Diagnosis is based on clinical manifestations supported by the results of microscopic examination of certain parts of the brain.

Two other diseases, scabies (mange) and listeriosis, are sometimes confused with scrapie. Scabies, a parasitic disease of the skin, is caused by a mite and can be controlled by appropriate treatment. With scabies many animals are usually affected at the same time, but with scrapie only a few. Sheep infected with listeriosis, a disease of bacterial origin, have a tendency to throw their heads to one side and circle in one direction, rather than moving about aimlessly like sheep with scrapie. Also, the course of listeriosis is more rapid than that of scrapie.

There is no known treatment for scrapie. If the disease is suspected, it should be reported immediately to a local veterinarian or to the nearest officer of the Health of Animals Branch, Canada Department of Agriculture.

## BLUETONGUE

Bluetongue is an infectious disease of ruminants caused by a virus. It occurs mainly in sheep and is characterized chiefly by an ulcerative inflammation of the lining tissues of the mouth and nose and sometimes of the gastrointestinal tract.

The disease is present on the continent of Africa, in countries bordering the northern shores of the Mediterranean Sea, and in the United States, but it has never been diagnosed in Canada.

The causative agent is present in the blood and major organs of affected animals and may persist in the blood of recovered animals for a long period. It is very resistant to drying and to disinfectants normally able to destroy viruses. The disease is not transmitted by direct contact but, as far as we know, only by biting insects, including gnats, sand flies and possibly sheep keds.

The disease occurs in both mild and acute forms. In the mild form an animal may have a temperature of 104°F (40°C) or higher for a few days. Sometimes this is the only sign of infection. In the acute form, there is depression, nasal discharge and salivation. Swelling of the upper lip may extend to the ears and the whole face. The lining of the mouth may become red and later turn to a bluish tinge. Several days after this there may be complete sloughing off of the epithelium of the lips, cheeks, and lining of the mouth, and still later ulceration and involvement of the nasal lining. In some cases blood-stained diarrhea is noticed; in others lameness followed by a rapid loss of weight and general weakness may be evident. The course of the disease runs from 6 to 14 days, and in fatal cases death occurs within that period. In non-fatal cases the chronic condition may persist for several weeks.

Sickness rarely involves over 30 percent of a flock; however, mortality among sick animals can vary from 2 to as much as 90 percent.

Diagnosis is based on the clinical picture, lesions, and season of the year; this may be confirmed by inoculating susceptible and immunized sheep with blood taken from sheep in the early stages of the disease. There is also a blood test that can be carried out on samples taken from animals that have recovered. As mentioned previously, the bluetongue virus is not transmitted by contact but only through vectors. As these vectors are not active during cold weather this would account for the seasonal occurrence of the disease in the summer and early autumn.

The Health of Animals Branch of Canada Department of Agriculture exercises control measures on the importation of ruminants, certain animal products and veterinary biological products in an effort to prevent the introduction of bluetongue virus into Canada. Suspicious cases should be reported immediately to a veterinarian or officer of the Health of Animals Branch.

## ENZOOTIC ABORTION OF EWES

Enzootic abortion of ewes (E.A.E.) was first discovered in Scotland and later on the European continent. It is caused by organisms of the Chlamydia group (psittacosis-lymphogranuloma group) but its transmission under natural conditions is not understood.

The incidence of abortions usually does not exceed 5 percent; however, when the disease strikes a flock for the first time 20 percent of the sheep may abort. Abortion occurs late in the gestation period and the fetus is usually expelled in a fresh state. Retained placenta is common. Mortality in breeding flocks is usually low but can reach 10 percent. Animals that abort are subsequently immune.

Diagnosis may be made by laboratory examination of fresh fetal membranes and by studying paired blood samples, one taken at the time of abortion and a second 10 days to 2 weeks later.

A vaccine has been developed for use in countries where the disease is prevalent.

## DISEASES CAUSED BY MORE THAN ONE TYPE OF AGENT

### PINKEYE

Pinkeye (infectious keratoconjunctivitis, contagious ophthalmia) is an acute contagious disease of sheep in which there is acute inflammation of the tissues surrounding the eyeball, sometimes accompanied by swelling and a profuse discharge. Infected animals are irritated by bright light, which makes them blink and seek shade or a dark corner. The cornea (eyeball) becomes opaque or cloudy, and in extreme cases it may ulcerate or rupture.

The condition is spread from sheep to sheep by transfer of infected eye discharges either by direct contact or, perhaps, by insects. It occurs in lambs and feeders and rarely in adults, which are considered immune after an initial attack. Carriers are apparently responsible for spreading pinkeye.

Many bacteria have been incriminated as well as viruslike agents called *Rickettsia*. Most animals recover without treatment. Treatment of affected eyes with suitable antibiotic preparations may be advisable in severe cases. Vaccines have not been successful in controlling the disease.



Figure 11. A lamb with pinkeye.

## DISEASES CAUSED BY METABOLIC DISTURBANCES

### PREGNANCY TOXEMIA

Pregnancy toxemia (ketosis) is caused by impaired metabolism of carbohydrates and fatty acids, and is frequently associated with faulty diet. Overly fat ewes and ewes carrying twins or triplets are more susceptible than ewes in poor condition. Developing lambs cause an excessive drain on available maternal nutrients. Lack of exercise, sudden changes in diet, transport, storms and excessive heat may be predisposing factors. Liver damage can be expected in severe or prolonged cases because of an excessive shift of body fat. The most significant predisposing cause of the condition is a decreasing plane of nutrition during the last 6 to 8 weeks of pregnancy.

Ewes in advanced pregnancy exhibit nervous signs such as twitching of the ears, muscle spasms, blindness and convulsions. They are listless and show loss of appetite. Eventually they go into coma and die. Death may occur 2 to 5 days after signs are first noticed.

Treatment is most often ineffectual. Assistance in managing an outbreak of pregnancy disease should be obtained from a veterinarian. Some workers have reported good results from the administration of propylene glycol or glycerine, 4 ounces daily by mouth. Removal of lambs by Caesarean section of affected ewes often effects a rapid recovery. Immediate steps should be taken to improve the nutrition of the flock but the change must be gradual. Grains and high quality legume hay are good sources of energy for ewes in late pregnancy.

Adequate exercise and well-balanced rations are the two most important preventive measures. Feeding should be planned to ensure that the plane of nutrition rises during the last 2 months of pregnancy. If it is necessary to use poor quality feed, it should only be fed early in pregnancy.

## DEFICIENCY DISEASES

### WHITE MUSCLE DISEASE

White muscle disease (stiff lamb disease, muscular dystrophy) in sheep occurs in various areas of Canada and is characterized by degeneration of the muscles. This disease syndrome can be prevented by the proper administration of selenium, vitamin E or a combination of the two and is referred to as being selenium—vitamin E responsive. However, the exact nature of the interaction of vitamin E and selenium, and the manner in which they prevent the development of muscular dystrophy, is not clearly understood.

Both selenium and vitamin E are essential to normal health. There is considerable variation in the selenium contents of soils from various areas of Canada resulting in variable selenium content of feeds grown on them. In addition, the selenium content of feeds is influenced by the other chemical constituents of the soil on which they are grown and the ability of particular plants to take up selenium from the soil. Normal sheep diets usually contain adequate amounts of vitamin E. However, certain conditions can destroy or make unavailable the vitamin E present in the feed.

Muscular dystrophy is manifested by a variety of disease signs. Lambs may be born dead or die within 3 or 4 days of birth. In older lambs, the leg or back muscles may be affected so that walking becomes difficult or even impossible. Affected lambs may be unable to rise. The tongue muscle can be affected resulting in difficulty in nursing or an inability to suckle although the desire to feed may not be affected. Difficulty in breathing occurs when the respiratory muscles are affected. Affliction of the muscles of locomotion has been reported in lambs up to 8 months

of age. Unthriftiness is sometimes the only sign of the condition observed in lambs.

Heart muscle is frequently damaged and lambs may exhibit signs of heart weakness. Deaths from heart failures are not infrequent.

Infertility in ewes, often the result of early fetal death, has been associated with this disease.

On occasion, this disease has been confused with the infections that cause arthritis, joint ill or tetanus. However, the absence of general symptoms of sickness helps differentiate between this and other diseases causing stiffness and paralysis.

Affected animals frequently recover following treatment with selenium—vitamin E administered by mouth or injection. Also, the disease can be prevented by administering selenium—vitamin E to the pregnant ewes and to lambs.

Although small amounts of selenium are essential to good health, an excess is toxic and may prove fatal. Treatment and preventive measures should be conducted under the guidance of a veterinarian.



Figure 12. A lamb suffering from white muscle disease.



## TRACE MINERAL DEFICIENCIES

Sheep require several minerals in very small amounts. Iodine, cobalt and copper are some of these so-called trace minerals. Fortunately, most of these minerals are found in common feeds in sufficient quantities to meet the requirements of sheep. However, in some districts the soil may be lacking or deficient in certain trace minerals, or the condition of the soil may not allow plants to take up enough of them to meet an animal's requirements. In these districts, supplementation is sometimes necessary.

*Iodine deficiency* is widespread in Canada and a lack of it causes goiter in lambs. This condition is not apparent in adult animals but affects lambs of deficient ewes. The lambs may be weak or dead at birth or may die soon afterwards. Their wool has the appearance of hair and the thyroid gland at the throat is enlarged. Lambs can receive iodine through the milk from iodine-supplemented dams. Feeds vary greatly in iodine content depending on the iodine content of the soil on which they were grown. To ensure an adequate supply of iodine, it is best to feed iodized salt and/or a mineral mixture containing iodine to all ewes.



Figure 13. Left, a normal lamb. Right, a young lamb with goiter. Note large, swollen neck due to enlarged thyroid, and absence of wool on ear.

Certain areas have a *deficiency of cobalt*. Grass may be ample in quantity and appear satisfactory and yet be deficient in cobalt. In extreme cases of cobalt deficiency, sheep become weak, emaciated, progressively anemic and finally die. In less-extreme cases, the symptoms are often a transient state of unthriftiness that can only be diagnosed with certainty by a rapid response following cobalt supplementation. Legumes tend to have a higher cobalt content than grass. Supplementation with cobalt by feeding cobaltized salt is a good practice. Mineral mixtures generally contain supplemental cobalt.

A *copper deficiency* affects lambs more than it does mature sheep. Lambs under 1 month old that suffer from this deficiency may have very fragile bones. Lambs 1 to 4 months of age may be affected by 'sway-back,' have a staggering gait and show some degree of paralysis of the hindquarters. Merino and half-breeds sometimes have straight, steely wool in which the wool fibers lose their crimp. In black-wooled sheep, the lack of pigment in the wool is a sensitive indicator of copper deficiency.

An analysis of copper in forage does not always give an accurate indication of the copper status of sheep because of the interrelationships of copper, molybdenum and sulfates.

Since sheep need considerably larger quantities of the minerals *salt*, *calcium* and *phosphorus* than of iodine, cobalt and copper, generally the trace minerals are mixed with these elements. A simple procedure is to give sheep a choice of a mixture of cobalt-iodized salt and a calcium-phosphorus supplement such as bone meal, rock phosphate and various commercial preparations. The calcium to phosphorus ratio should be 2:1 and contain at least 13 percent phosphorus. The amount of salt in the mixture should not exceed 50 percent. In areas where sheep normally consume little salt, a mineral mixture should be used that contains no salt. In these cases, cobalt-iodized salt should be available free choice in addition to free choice salt-free mineral.

## PLANTS POISONOUS TO SHEEP

Every aboriginal people has had a sound practical knowledge of the poisonous plants indigenous to its tribal area. In modern civilization this primitive knowledge has become lost to most individuals. Instead, the livestock owner of today receives considerable protection from poisoning of animals by plants and plant products through legislation relating to feedstuffs, and through being usually within consulting distance of a qualified veterinarian or other advisory service. Consequently, no attempt is made here to present a detailed account of plant poisoning in sheep. Certain broad principles are outlined and a few of the most dangerous plant poisonings and those of special interest will be briefly discussed.

Plant poisoning is not likely to occur on carefully cultivated grounds or well-managed range or pasture. It happens more often when animals are put to graze on wild land, on western ranges, in wild meadows, along streams, and in sloughs and woods. Most poisonous plants are unpalatable and livestock rarely eat them when wholesome forage is abundant.

They are most dangerous to livestock in the spring when sheep and other herbivores, after being on winter rations, have an increased appetite for green, growing plants. Often poisonous species put up tempting green shoots before grass becomes green, and animals may eat these and be poisoned. Overgrazing constitutes another special hazard: it encourages the increase of weeds and poisonous plants, which hungry animals are compelled to eat because grass is scarce. The effects of drought are similar to those of overgrazing.

Good judgment should be used when turning animals to pasture in the spring; in areas where plant poisoning is likely to occur it is probably best to wait until there is ample green grass. Overgrazing should be avoided at all times. As a safeguard against drought, a supply of feed for a year ahead can usually be kept.

## WATER HEMLOCK

The water hemlocks (*Cicuta* spp.) are the most poisonous plants in Canada, but fortunately they seldom cause losses in sheep flocks. One or more species grow in every province. As all are equally poisonous and similar in growth habit, they can be considered as a group. The plants grow in water or close to water in sedgy sloughs, lakes and ponds, wet meadows and other swampy places. The water hemlocks belong to the parsnip family, and the inexperienced person is likely to confuse them with certain other wild plants belonging to this family, especially the water parsnip.

The plants grow 2 to 5 feet (0.6 to 1.5 meters) tall and have compound heads (umbels) of tiny white flowers. Perhaps the easiest way for a non-botanist to identify the plants is by examining their characteristic roots. If a rootstock (the part just below the stem) is cut lengthwise, it will be found to be divided into narrow transverse chambers, separated by thin partitions. The roots attached to the outside of the rootstock may be thick and fleshy or thin and fibrous, depending on the species of water hemlock.

The rootstock and roots are poisonous at all times. The young shoots are also poisonous. In the heat of summer the tops are somewhat less poisonous and may even be innocuous. This is because the poisonous principle, cicutoxin, is very sensitive to temperature change, being polymerized by heat.

Poisoning of livestock usually occurs in early spring when alternate freezing and thawing has heaved and loosened the roots. At this time the roots are likely to be pulled up by their spring shoots and eaten by grazing animals.

In water-hemlock poisoning, death may occur in less than an hour; poisoned animals that are found dead show signs of agonized struggling. The first symptoms are frothing at the mouth and signs of colicky pain, followed rapidly by violent intermittent convulsions ending in death.

There is no treatment for water-hemlock poisoning. Prevention consists in keeping animals away from the plants. The plants can be fenced off or they can be pulled, allowed to dry and burned. As they are seldom present in large numbers and are easily dug up, the cost of clearing a farm of water hemlock is seldom excessive.

## CAMAS

From the standpoint of plant toxicology camas (*Zygadenus* spp.) fall into two groups: the so-called white camas, and the death camas.

The white camas are only mildly poisonous and are not a problem with sheep. Two species of white camas occur in Canada; one, *Zygadenus chloranthus* Richardson, is an eastern species, the other, *Zygadenus elegans* (Pursh) Rydb., is a western species.

Death camas are very poisonous and are responsible for most of the losses caused by sheep grazing poisonous plants in Western Canada. The death camas are western species and are found from southwestern Saskatchewan to the Pacific Coast. *Zygadenus gramineus* Rydb. is the species common in southwestern Saskatchewan and southern Alberta, and *Zygadenus venenosus* S. Wats is the commoner species in British Columbia.

Death camas grow in meadows and on coulee hillsides among grass, and the plants may be thinly scattered or more numerous in patches. In the spring, before flowering, camas appear to the untrained eye to be grass, but unlike grass they grow from bulbs. The species common in Alberta and Saskatchewan blooms early, in May or June. The death camas commonest in British Columbia comes into blossom later. The greenish-yellow or greenish-white flowers are borne in elongated clusters (racemes) at the top of the flower stem and are quite showy. The flower stems reach a height of from 8 inches (0.2 meter) to over 2 feet (0.6 meter).

All parts of the plant are poisonous, the seeds being particularly toxic. For the most part, sheep losses occur among animals grazing the green leaves early in the spring. It should be remembered, however, that death camas are deadly at all times and may kill sheep throughout the summer and fall.

Affected animals nearly always froth at the mouth, are nauseated and vomit. At this stage breathing is quickened, and there are signs of muscular weakness, distress and excitement. Often these early symptoms are not observed, and the first indication of death camas poisoning is the finding of sheep dead or lying down, in a state of stupor, and unable to rise. This sudden collapse is characteristic. After collapse, breathing is slower, but periods of quiet are broken at intervals by spells of rapid breathing, panting and struggling that last for a few minutes. Fatally poisoned animals lie quietly and breathe heavily. They sometimes lie for many hours or even days without eating or drinking. Ewes in this state will continue to recognize their lambs. In the more acute cases, however, sheep die without any spasms within 2 to 6 hours. Sheep that are not fatally poisoned recover rapidly. Some that collapse will regain their feet within a short time and recover uneventfully.

There is no known treatment for death camas poisoning. Prevention consists in keeping sheep away from places where the plants grow. Sheep owners should be able to recognize the plant in its various stages of growth so that they can avoid it. If it should be necessary to drive a flock of sheep across an area where death camas are abundant, the animals should be well fed before starting, since hungry sheep are more likely to be poisoned. Even then there is some risk because the death camas is so highly toxic.

# CHEMICAL POISONING

In the everyday pursuits of modern agriculture more and more chemicals that are poisonous to animals under certain conditions are coming into common use.

These can be divided into two groups: inorganic and organic compounds. The former includes metals such as lead, mercury and arsenic; salts of metals such as copper sulphate or arsenous oxide; acids such as hydrocyanic acid; and alkalies such as bleaching powder. The organic group includes organochlorines such as D.D.T. or B.H.C., which are complex substances, as well as simpler ones such as carbon tetrachloride; and organophosphorous compounds such as malathion and coumaphos.

## INORGANIC COMPOUNDS

### Lead

Lead is a frequent cause of poisoning in farm animals. Substances containing lead are common on farms and include some types of paints, lead arsenate used as a plant insecticide and plates from discarded storage batteries.

Poisoning can result from a single dose of a lead-containing substance (acute poisoning) or from repeated small doses over a period of time (chronic poisoning). Animals acutely poisoned show a lack of appetite, constipation followed by dark, foul-smelling diarrhea, weakness and stumbly gait. There may be colicky pain, but the nervous symptoms and convulsions commonly seen in cattle poisoned with lead are usually absent.

A chronic form of lead poisoning has been reported in lambs. Affected lambs develop lameness and posterior paralysis, which can be mistaken for white muscle disease caused by selenium—vitamin E deficiency.

Most animals affected with lead poisoning die although some lambs with the chronic form of poisoning may spontaneously recover.

Treatment is of value in some cases and should be carried out under veterinary supervision.

### Arsenic

Newer chemicals have replaced many of the arsenic compounds formerly used as insecticides, wood preservatives and weed killers, which were responsible for many incidents of arsenic poisoning. Nevertheless, arsenic poisoning attributed to agricultural chemicals still occurs.

In acute poisoning, there is severe inflammation of the stomach and intestines. There are signs of abdominal pain, salivation, groaning, restlessness and depression. Poisoned animals may rapidly become prostrate and die within a few hours of the first signs of illness.

Chronic arsenical poisoning has been reported in which affected lambs showed incoordination and blindness.

Treatment of acutely poisoned animals is usually disappointing. Good nursing care is essential. Chronic poisoning cases may recover if the source of arsenic is removed from the diet.

## ORGANIC COMPOUNDS

### Organochlorines (Chlorinated hydrocarbon compounds)

Organochlorine compounds are widely used as agricultural pesticides and include D.D.T., lindane, toxaphene, chlordane, aldrin and dieldrin, as well as others.

These products can be used with safety when manufacturers' directions are followed and precautionary statements are heeded. Their misuse can result in poisoning and death of livestock or undesirable residue in animals destined for slaughter.

Signs of poisoning vary with the formulation of the compound but, in general, toxic doses act as a stimulant to the central nervous system. Signs may vary from excessive salivation (drooling of saliva) and staggery gait to belligerent attitude, twitching of the muscles and convulsions. The periods of excitability may be alternated with periods of depression. The severity of the symptoms is not necessarily an indication of the outcome of the poisoning. Some animals may die after one convulsion and others may suffer a number of convulsions and recover. Death may result in a few hours after the start of signs of poisoning or may not occur for several days.

Poisoning with organochlorines may be confused easily with a number of other disease conditions that affect the brain and nervous system, for example rabies.

There is no specific antidote for organochlorine poisoning. Treatment is directed at alleviating the signs. Controlling the convulsions by the use of drugs is considered helpful in aiding the recovery of poisoned animals.

A veterinarian should be consulted in any suspected case of organochlorine poisoning to confirm the diagnosis, supervise treatment and ascertain the reason that poisoning developed.

### Organophosphorus Compounds

These compounds include malathion, ronnel and coumaphos, which are used as pesticides on sheep. Other organophosphorus compounds, such as dioxathion, are widely used in agriculture for the control of pests

on plants and trees. The toxicity of organophosphorus compounds varies but all are potentially poisonous. They may be used with safety if the recommendations for their use are followed closely.

The signs of poisoning are similar to those seen in organochlorine poisoning and may include drooling, diarrhea, abdominal pain, difficult breathing and staggy gait.

Poisoning can develop within 5 minutes of contact with the poison or not for several days. Treatment with atropine and 2-PAM is often of benefit to animals suffering from organophosphate poisoning. Treatment should be under the supervision of a veterinarian and should be undertaken as soon as possible following the onset of signs of poisoning.

## HANDLING CASES OF SUSPECTED POISONING

Where poisoning is suspected, a veterinarian should be called immediately. If the source of the poisoning has not been definitely determined, it is imperative that this fact be ascertained as soon as possible, because in many cases specific antidotes must be administered quickly. If the immediate history clearly indicates a cause, the flock must be removed from the source of the poison or vice versa.





## METRIC EQUIVALENTS

### LENGTH

inch	= 2.54 cm	millimetre	= 0.039 in.
foot	= 0.3048 m	centimetre	= 0.394 in.
yard	= 0.914 m	decimetre	= 3.937 in.
mile	= 1.609 km	metre	= 3.28 ft
		kilometre	= 0.621 mile

### AREA

square inch	= 6.452 cm <sup>2</sup>	cm <sup>2</sup>	= 0.155 sq in.
square foot	= 0.093 m <sup>2</sup>	m <sup>2</sup>	= 1.196 sq yd
square yard	= 0.836 m <sup>2</sup>	km <sup>2</sup>	= 0.386 sq mile
square mile	= 2.59 km <sup>2</sup>	ha	= 2.471 ac
acre	= 0.405 ha		

### VOLUME (DRY)

cubic inch	= 16.387 cm <sup>3</sup>	cm <sup>3</sup>	= 0.061 cu in.
cubic foot	= 0.028 m <sup>3</sup>	m <sup>3</sup>	= 31.338 cu ft
cubic yard	= 0.765 m <sup>3</sup>	hectolitre	= 2.8 bu
bushel	= 36.368 litres	m <sup>3</sup>	= 1.308 cu yd
board foot	= 0.0024 m <sup>3</sup>		

### VOLUME (LIQUID)

fluid ounce (Imp)	= 28.412 ml	litre	= 35.2 fluid oz
pint	= 0.568 litre	hectolitre	= 22 gal
gallon	= 4.546 litres		

### WEIGHT

ounce	= 28.349 g	gram	= 0.035 oz avdp
pound	= 453.592 g	kilogram	= 2.205 lb avdp
hundredweight (Imp)	= 45.359 kg	tonne	= 1.102 short ton
ton	= 0.907 tonne		

### PROPORTION

1 gal/acre	= 11.232 litres/ha	1 litre/ha	= 14.24 fluid oz/acre
1 lb/acre	= 1.120 kg/ha	1 kg/ha	= 14.5 oz avdp/acre
1 lb/sq in.	= 0.0702 kg/cm <sup>2</sup>	1 kg/cm <sup>2</sup>	= 14.227 lb/sq in.
1 bu/acre	= 0.898 hl/ha	1 hl/ha	= 1.112 bu/acre



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