



# FACT SHEET

FEBRUARY 2007

## ABORTION IN EWES

Abortions in ewes are the result of many factors that stress the pregnant animal. Intrauterine infections are the most common cause.

The commonly reported abortion rate in the New Zealand sheep flock is between one and two per cent, although in 'abortion storms' a single flock can abort 25-40%. This represents a significant loss or wastage. If the abortion occurs late in the pregnancy, dead lambs can be found out in the paddock. If it occurs in early pregnancy the conceptus may be reabsorbed. This may go unnoticed until the farmer realises there is a high number of dry ewes in the flock.

## CAMPYLOBACTER

Campylobacter is a bacterium which causes disease in farm animals. *Campylobacter fetus* (formerly *Vibrio fetus*) subspecies *fetus* is one of the most common causes of abortion diagnosed in sheep. On rare occasions *C. fetus fetus* can cause disease in humans, especially immuno-compromised patients.

### TRANSMISSION OF DISEASE

Infection is picked up orally from pasture, which may be contaminated from variable sources, especially from infected ewes and their foetuses or placenta. Other sources of infection include the mechanical transfer of *C. fetus fetus* by birds and contaminated water supplies. The causative organism may survive for up to 20 days in winter, in soil or hay.

### CLINICAL FEATURES

A feature of the organism is its adaptation to the intestine, where it may persist for some time. After initial infection bacteria are found in the blood for 10-14 days, allowing infection of the placenta.

Bacteraemia (the presence of bacteria in the blood) arises in susceptible ewes. The bacteria invade the placenta, where they cause placentitis. In the foetus, micro-abscesses develop in a range of organs.

Abortion occurs about seven to 25 days after foetal death. The interval between infection and abortion may range from 13 to 113 days. *C. fetus fetus* may persist in uterine discharges for up to six weeks. Some ewes become carriers and remain infectious for up to 18 months. Recently purchased, healthy carrier animals are the most likely mechanism for introducing *C. fetus fetus* into clean flocks.

A common sequence of events in affected flocks is for one or two ewes to abort in the third or fourth month, followed in two to three weeks by a sharply increased rate of abortion (or 'storm').

Ewes of any breed or age can be affected. Historically the period of susceptibility to abort is roughly the last three months of the gestation period. The disease has been reported from most areas of the world where sheep are bred. The ewe seldom has any ill effects from the disease.

### DIAGNOSIS OF CAMPYLOBACTER

When a definitive diagnosis cannot be obtained by visual inspection of the foetal membranes and aborted lamb, specimens should be taken for laboratory analysis.

Lesions in a case of *C. fetus fetus* infection:

- may be variable and non-specific
- enlarged red-grey cotyledons are observed
- sero-sanguineous subcutaneous oedema may be present
- in up to one-quarter of foetuses, pale white-yellow lesions on the liver can be seen
- excess fluid in peritoneum and chest

The diagnosis of *C. fetus fetus* is classically based on the isolation of the causative organism from an aborted lamb. Following infection of the mother, the organism crosses the placenta resulting in a generalised infection of the lamb and its subsequent death. This is evidenced by the ability to isolate large numbers of *C. fetus fetus* from the lamb's stomach contents, liver and lungs.

For examination of aborted lambs it is preferable to have the entire foetus and foetal placenta. Culture of foetal stomach contents will generally establish a diagnosis of *C. fetus fetus* infection. See sampling method instructions at the bottom of this document.

## CONTROL

### Vaccination

- vaccinate all breeding ewes
- use two doses in the first vaccination year: a sensitiser and a booster – plus a single booster in subsequent years
- sensitiser dose should be given pre-tupping and a booster dose injected four to eight weeks later – in subsequent years, use a single booster at pre-tup

### Environmental contamination

The disease is spread mainly through susceptible sheep grazing contaminated pasture. Therefore it is necessary to be quick to diagnose and remove and isolate aborting ewes and aborted foetuses.

Strict hygiene (vehicles, equipment and humans) is important to reduce the chance of spreading the disease to unaffected flocks. Check unaffected mobs first, before checking affected mobs.

## TOXOPLASMOSIS

Toxoplasmosis is the second most common cause of abortion in sheep. A summary of this information has been included at the bottom of the toxoplasmosis section to aid understanding of this complex disease

### THE TOXOPLASMA INFECTION CYCLE

*Toxoplasma gondii* has a complicated lifecycle, involving several stages. The three most important of these are the oocyst (egg), the tachyzoite (rapidly multiplying form) and the bradyzoite (slowly multiplying form).

There are two parts to the lifecycle. One, the asexual part of the cycle, takes place in a wide range of warm blooded animals and involves the fast and slow multiplying forms of the parasite (tachyzoites and bradyzoites). A susceptible animal, which might be a mouse or a sheep, eats food contaminated with

toxoplasma eggs. When this happens the toxoplasma parasite penetrates the membrane lining the digestive tract and spreads to the animal's lymph tissues, where it multiplies. The resulting large numbers of intermediate forms are then carried by the blood throughout the body. They may end up in muscles or the brain where they form tissue cysts containing hundreds or thousands of slow multiplying forms. Once this stage is over the animal remains clinically normal, although still infected, and further cycles of infection may occur from time to time.

A second part of the lifecycle, the sexual part, occurs exclusively in cats. When a cat becomes infected by eating infected meat – eg, a mouse or bird – the cysts in the meat and brain of the mouse or bird dissolve in the stomach of the cat and release the slow multiplying forms of the parasite. These invade the lining of the cat's intestine and multiply. Within 10 days, the cat will excrete toxoplasma eggs (oocysts) in its faeces.

An infected cat remains infectious only for about a week, but in this time may shed millions of oocysts every day. As the oocysts are extremely robust and very difficult to destroy, they can remain infective for up to two years.

Cats are likely to become infected at quite a young age because of the widespread occurrence of toxoplasma in New Zealand. Once past their dangerous infective phase, cats will no longer be a source of toxoplasma oocysts. However, as uncontrolled numbers of feral cats are found on many farms, and the oocysts can persist so long in the farm environment, any cat presence at all is likely to result in a continual source of infection.

### TRANSMISSION OF THE DISEASE

The sheep is an important intermediate host of toxoplasma, and problems arise when susceptible ewes become infected while pregnant. Sheep become infected from eating contaminated food (pasture, concentrate feeds, hay etc). Once ingested, the toxoplasma spread to the sheep's muscles and brain – and also to the placenta. Shielded from the ewe's defence system the parasite multiplies rapidly, killing cells as infection spreads. As groups of cells die they give rise to small spots of dead placenta – necrotic foci – which can often be seen with the naked eye.

Infection in a pregnant ewe not previously infected by toxoplasma results in loss of the foetus. However, the time of infection determines the signs evident to the farmer.

- Early pregnancy – early embryonic death; no abortion or visible signs
- Mid-pregnancy – foetal death and abortion; dead lambs may be found on the ground
- Late pregnancy – stillborn lambs or weak lambs that fail to thrive

Ewes that have contracted toxoplasmosis remain infected for life; however they develop 'immunity' within about four weeks of first infection. Ewes which



contract toxoplasmosis will be free from toxoplasma-induced abortion in the future, whether or not they are pregnant when they first contract it.

Laboratory tests on the blood of infected ewes will show very high levels of antibody. However, the detection of high levels of antibody collected from the foetus is of more value in establishing a definitive diagnosis.

## **CLINICAL FEATURES**

Field outbreaks caused by infection in mid to late pregnancy will result in affected ewes lambing a few days early. A large proportion of lambs, although outwardly quite normal, will be stillborn and sometimes accompanied by a 'mummified' foetus (a dead, chocolate brown miniature of a lamb). Twin lambs may be very uneven in size, with one twin smaller and less developed than the other.

In addition, a proportion of the lambs born alive will be weak and die within the first few days of life, despite careful nursing. Such animals invariably have brain damage, which is thought to occur as a result of inadequate supply of oxygen reaching the unborn lamb across the diseased placenta.

Toxoplasma-infected ewes will exhibit foetal membranes which are normal (pink and translucent) but the cotyledons will be diseased and covered in small white spots of dead tissue 1-2 mm in diameter (the necrotic foci mentioned above). These signs, taken together, are evidence of a probable toxoplasmosis abortion storm. Diagnosis should be confirmed with laboratory tests on the blood of the lamb and mother.

Field outbreaks may also occur caused by infection early in pregnancy. Such abortions are usually without immediate visible signs and the ewe may remain in the flock, assumed pregnant until found to be empty at lambing time – or earlier if ewes are pre-lamb sorted or scanned. These ewes are frequently culled from the flock, despite the fact that their abortion due to toxoplasma does not detract from their future fertility, and that having contracted toxoplasmosis, they are immune to future infection.

Trial results throughout New Zealand show that toxoplasmosis abortions early in pregnancy are much more common than previously thought. The effects are just as damaging to farmers, but are hidden, being evidenced only in the numbers of apparently 'barren' ewes.

## **CONTROL AND MANAGEMENT**

Potential methods to manage the damaging effects of toxoplasmosis include sheep vaccination, drug treatment, and management of cats and sheep.

### **Vaccination**

Toxovax vaccine uses the s48 strain of toxoplasma tachyzoites (the fast multiplying form) which have lost the ability to undergo the lifecycle. After vaccination the S48 tachyzoites multiply in the sheep for about

seven days. As the parasite cannot transform into the slow multiplying form, tissue cysts do not develop and instead the parasite dies out. The sheep is left immune and free from infection, so that its meat is safe for eventual consumption. This is an important point, because toxoplasma can infect humans.

Toxovax is made from a laboratory mouse adapted strain which is incapable of completing its lifecycle in the normal fashion. The vaccine strain is incapable of forming cysts or tachyzoites in sheep, thus the identification of these in tissues is evidence of a field infection.

Toxovax will not cause abortions or other ill effects. Vaccinated sheep cannot infect other sheep (the vaccine strain cannot be passed from sheep to sheep by congenital or venereal routes). Vaccinated sheep cannot infect other intermediate hosts or cats. The vaccine strain cannot, therefore, be passed through intermediate hosts in the field.

Toxovax vaccine, effective against toxoplasmosis infection, has been marketed in New Zealand since 1988. As the vaccine is live it has a very short shelf life, so orders have to be placed before you need them. However, you only need one shot of the vaccine, and it is highly effective in providing long-lasting protection.

### **Drug treatment**

Drugs capable of suppressing acute toxoplasma infections in the human population exist, but their efficacy and cost effectiveness for use in infected pregnant sheep and goats still needs to be assessed.

### **Management**

Stock management remains an important weapon, backed up with knowledge of the lifecycle of the parasite and its possible routes of transmission. Toxoplasma oocysts spread in cat faeces are very probably the main source of infection for sheep.

Cats acquire infection when they hunt for meat, and up to 64% of cats have become infected by the time they are fully mature. The most likely source of infection for cats is wild rodents such as mice and rats, as well as young rabbits. Unlike cats, these creatures pass the infection to their young before birth, but with no clinical disease. The significance of this is that an infected rodent population can harbour infection for generations and act as an infection reservoir for cats.

Although the toxoplasma-infected rodent is no direct threat to sheep, the situation is quite different when cats are present. Infected cats shed oocysts in their millions, and the area in which the cats live can become heavily contaminated.

Unlike other abortion agents (eg, campylobacter), toxoplasmosis does not spread directly between sheep, from one ewe to another. There is therefore no advantage in either isolating ewes from ewes thought to be infected in the hope of avoiding cross-

infection, or in placing non-pregnant ewe hoggets or two-tooths where toxoplasma abortions have occurred in the hope of 'inoculating' them.

## SUMMARY OF TOXOPLASMOSIS

Because toxoplasmosis is such a complex disease the following summary may prove useful as a reference.

Toxoplasmosis is an important cause of death in unborn lambs.

The disease is caused by *Toxoplasma gondii*, a single-celled organism which lives and multiplies inside the lamb's own cells.

*Toxoplasma* infects all warm-blooded animals but an essential stage of its lifecycle occurs only in cats.

Infected cats excrete toxoplasma eggs (oocysts) in their faeces. These eggs can contaminate a farm and, under favourable conditions, are a potent source of infection for up to two years.

Susceptible sheep become infected and can remain so for life.

If ewes contract toxoplasmosis while pregnant, abortions will occur. Ewes which abort due to toxoplasmosis infection do not generally abort due to toxoplasmosis in subsequent seasons.

The time that a ewe is infected makes a difference to what farmers see:

- Early pregnancy – early embryonic death; no abortion or visible signs
- Mid-pregnancy – foetal death and abortion; dead lambs may be found on the ground
- Late pregnancy – stillborn lambs or weak lambs that fail to thrive

If early pregnancy infection has occurred then the problems caused by toxoplasmosis may be hidden. Such foetal death will only show up when there are more 'barren' ewe hoggets or two-tooths than expected.

If non-pregnant ewes contract toxoplasmosis, they will develop 'immunity' within four weeks and are unlikely to abort due to toxoplasmosis in the future.

Toxovax is a 'live' vaccine which will prevent toxoplasmosis in sheep.

*Toxoplasma gondii* can infect humans and sheep abortion material should be handled carefully.

## SALMONELLA BRANDENBURG

Up until 1996 this disease caused only infrequent cases of abortion in ewes. But the number of cases has steadily increased to epidemic proportions. This is especially evident in southern and eastern parts of the South Island. The economic loss of ewe and lamb wastage can be highly significant. This disease can also

be transmitted to humans (zoonotic); putting a greater emphasis on control of disease outbreaks. It can cause severe diarrhoea and stomach cramps in people, with recovery taking up to six weeks (Clark *et al*, 2000).

## TRANSMISSION OF DISEASE

Ewes can become infected through:

- direct contact with aborted fetuses or placentae
- eating contaminated feed
- ingesting yard dust

The organism can survive in the environment for over four months. Infected sheep that have survived an initial infection can carry the organism in their intestines for approximately six months. It is therefore vital to know the health history of all the animals you buy.

Farmers and vehicles are also important vectors of this disease, therefore strict hygiene practices are essential to prevent further transmission if an outbreak occurs. Black-backed gulls who scavenge the aborted material may also spread the disease via their faeces.

Farms that have high stocking rates and use intensive grazing systems have also been shown to have higher instances of *Salmonella* Brandenburg abortions.

## CLINICAL FEATURES

Most abortions are observed in multiple bearing ewes, with two-tooth and mixed age ewes affected. Ewes that are late in their pregnancy will become dull and run a high temperature. The aborted foetus and placenta will show advanced decomposition.

Without treatment (see section below) approximately half of infected ewes will die, and may develop severe diarrhoea before death. In some cases a live lamb may be born, but will be weak and small.

It has been reported, via combine farm data, that an average of 3-4% of an infected flock will abort (range 0.2%-25%) over a period of 30 days (range 7-75 days).

## TREATMENT

Ewe death can be prevented by injecting a long-acting oxytetracycline antibiotic early on in the course of the disease, but this will not prevent abortion.

## CONTROL

### Vaccination

It is important to select a vaccine that contains inactivated *S. Brandenburg*. For protection against *S. Brandenburg* abortion, it is recommended that all ewes receive a sensitiser dose and then a booster four to six weeks later. An annual booster should be given to all ewes in subsequent years.

It is important to administer the vaccine at the correct time. Ewes should be vaccinated early in pregnancy, followed by a second booster dose (eg, at ram introduction then ram removal, or at ram removal and then scanning).

This vaccine gives increased resistance to abortion, but not complete protection. If there is a heavy challenge you should follow other control methods and be aware of (and reduce) other predisposing factors to decrease abortion.

### Other control methods

Farms which have high stocking rates and/or intensive grazing systems (such as strip grazing) tend to be more susceptible to the disease. If an outbreak occurs, sheep should be spread out to reduce stock density. This can sometimes decrease the numbers affected, but is not always the case. Minimising stressful situations like pre-lamb yarding and nutritional stress is also recommended.

Avoid purchasing stock from properties that have had a history of S. Brandenburg outbreaks. This can be a method of contamination onto your own property because the organism can be excreted for up to six months after transmission.

Steps to minimise environmental contamination:

- rapid disposal of aborted fetuses and placenta
- quarantine aborted ewes
- good hygiene of clothing, equipment and vehicles
- visit non-affected mobs before affected mobs to reduce transfer of infection
- control scavenging birds, eg black-backed gulls

S. Brandenburg is zoonotic (can be transmitted to humans). Make sure all employees are aware of the need for good hygiene when dealing with affected sheep and material.

## HAIRY SHAKER DISEASE (BORDER DISEASE)

This virus has been diagnosed as a cause of abortion mainly in the Otago and Southland regions, although it's sometimes noted in other parts of New Zealand. This virus is closely related to bovine viral diarrhoea (BVD). It can affect all ages of ewes.

### TRANSMISSION OF DISEASE

Infection is via mucous membranes. The disease may be introduced to the flock by seemingly normal looking ewes and rams. Lambs which survive the infection and ewes which have been affected in the past may be potential sources of infection. However ewes can breed satisfactorily the next season.

### CLINICAL FEATURES

Hairy shaker disease includes a wide range of symptoms:

- embryo death, which shows as a ewe returning late to cycle (oestrus)
- abortion of mummified fetuses
- if transmission occurs late in pregnancy, abortion of small, hairy fetuses

- ewes are seldom affected by the disease
- live lambs are often produced but are usually hairy and stunted. These lambs are susceptible to underfeeding, and may die as a consequence of malnutrition, although some affected lambs will survive and reach weaning weights.

### CONTROL

Control of viral abortions is accomplished by:

- avoiding exposure of susceptible ewes during pregnancy, especially at tupping and during the first three months of gestation (pregnancy)
- cull any lambs that have been severely affected
- cull any ewes that produce offspring with hairy shakers for two consecutive years
- buy in ewe replacements instead of retaining affected ewes lambs
- any new ewes that have been purchased should be mixed with the flock at least four weeks before tupping
- attempt to fatten any mildly affected lambs to slaughter weights

By following these guidelines the incidence of hairy shakers should decline. Long-term control relies on good flock management, which either prevents infection entering the flock or ensures that the infection occurs early on in life, when the breeding stock is not pregnant.

## BACILLUS AND LISTERIA

The cause of these abortions is usually from feeding out poor quality baleage or silage - usually from bales or silage stacks that have been exposed to air and have subsequently rotted. Avoid feeding to pregnant ewes.

## NON-INFECTIOUS CAUSES OF ABORTION

Some farmers have reported macrocarpa-caused abortions. Another cause is trauma to the ewe's abdomen, from crutching, shearing, or crushing in gateways. Pregnancy toxemia can also cause the ewe to lamb early; these fetuses can be born live but are usually premature and weak.

## SAMPLING ABORTION MATERIAL

Collect several of the freshest fetuses and foetal membranes. If practicable, send fetuses and membranes to the diagnostic laboratory, otherwise send:

- formalin-fixed brain, liver and cotyledon
- fresh stomach contents, lung and foetal membranes

Collect into sterile containers using good hygiene - ie, gloves.

Get to the lab within 24 hours.

## REFERENCES

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