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MARCH 2007 PRIMEFACT 446 (REPLACES AGFACT A0.9.57)

Liver fluke disease in sheep and cattle

Dr Joseph C. Boray

Former Principal Research Scientist (Parasitology)

Revised by Dr GW Hutchinson and Stephen Love (March 2007)

Nationally, up to 40 million sheep and 6 million cattle graze pastures where liver fluke is endemic. Graziers spend approximately $10 million a year on fluke drenches alone; lost production costs a further $50–80 million a year (1999 estimate).

Deaths account for only a part of this loss. Other significant losses in sheep include:

- reduced production and quality of wool
- reduced lambing percentages
- poor growth rate of lambs
- increased costs for replacement stock

In cattle, losses include:

- reduced production and quality of milk
- lower growth rates and lower feed conversion rates in fattening cattle.

The liver fluke can develop to sexual maturity in sheep, cattle, horses, pigs, goats, alpacas and deer. Other hosts include kangaroos, wombats and rabbits, which may maintain the contamination of pastures as reservoirs. People can be infected by eating watercress from naturally contaminated creeks.

Fasciola hepatica infection is widespread across eastern New South Wales where the annual mean rainfall is about 600 mm or more. Infected areas include the Tablelands and nearby slopes.

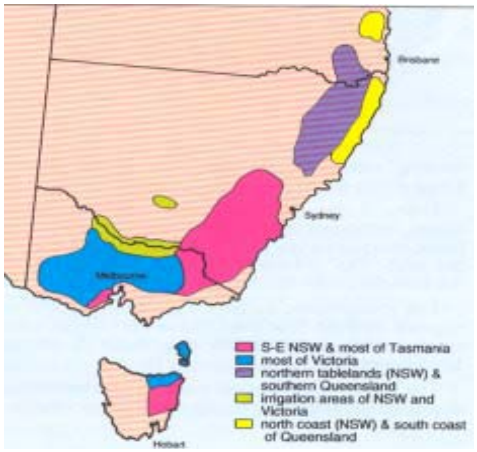
Infection is also found in irrigation areas, where the annual rainfall of around 400 mm is supplemented by regular irrigation.

Infection is endemic on the south-eastern coastal areas, often in combination with stomach flukes (paramphistomes).

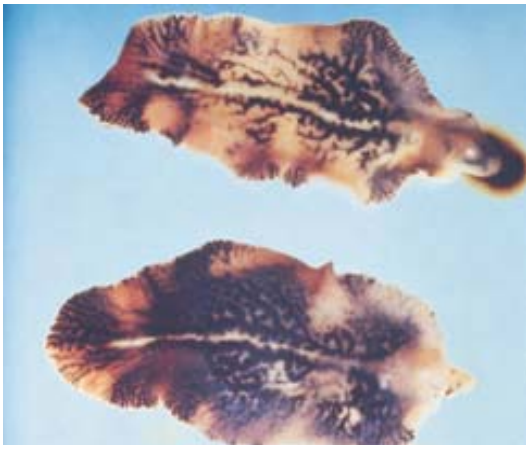
The adult flukes in the bile ducts produce eggs which are passed in the faeces (see Figure 1).

The eggs hatch when separated from faecal material in wet areas, under optimal conditions. The first larvae or miracidia released (b) invade the lymnaeid snails in which they develop and multiply as sporocyst, rediae and cercariae (c).

The tadpole-like cercariae leave the snails (d) and swim until they encyst on vegetation, forming metacercariae (e), which are the infective stage of the fluke. The entire cycle of the liver flukes in the

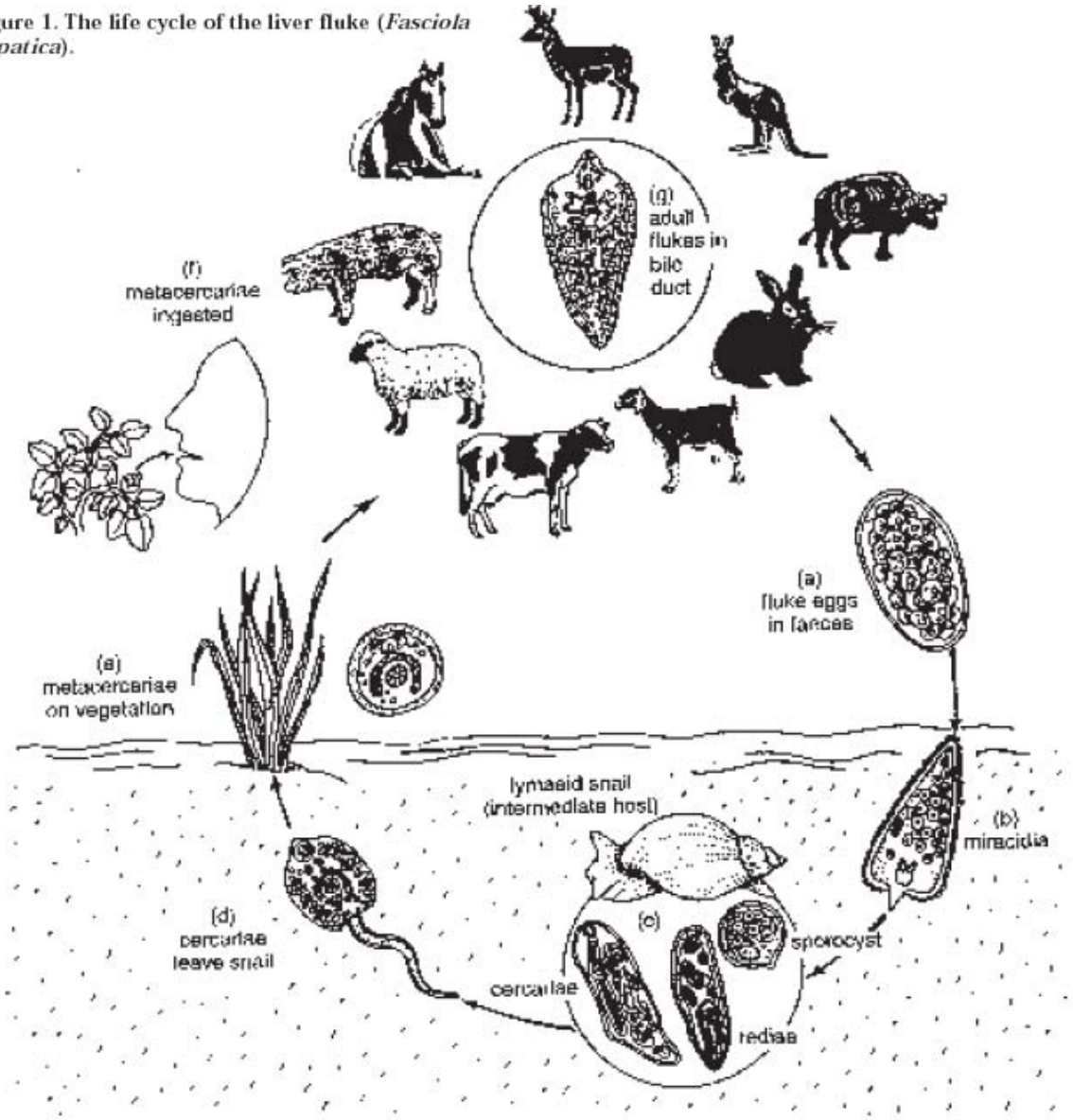


Distribution of liver fluke disease in different climatic regions.



Liver fluke (Fasciola hepatica) from sheep.

Figure 1. The life cycle of the liver fluke (*Fasciola hepatica*).



snails takes two to three months under favourable conditions in the field.

If the metacercariae are ingested by sheep, cattle or other hosts, including people (f), the metacercariae excyst in the small intestine and the released immature flukes penetrate the intestinal wall into the abdominal cavity.

The young flukes penetrate the liver capsule and migrate through the liver tissue for six to seven weeks before entering the bile ducts to become adult flukes (g).

The flukes reach sexual maturity and commence egg production at eight to ten weeks after infection.

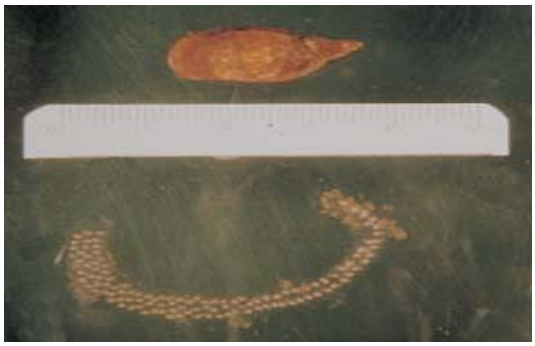
Epidemiology

The two primary requirements for the establishment of liver fluke are a suitable snail (the intermediate host) and an environment that suits the fluke eggs, the snails and the larval fluke – such as springs, slow-moving streams with marshy banks, irrigation channels and seepages.

In Australia, the most important intermediate host is the indigenous freshwater snail, *Lymnaea tomentosa*. An introduced North American snail (*L. columella*) and an introduced snail from the Pacific area (*L.viridis*), found in defined locations of the NSW coast, have also been identified as additional intermediate hosts.

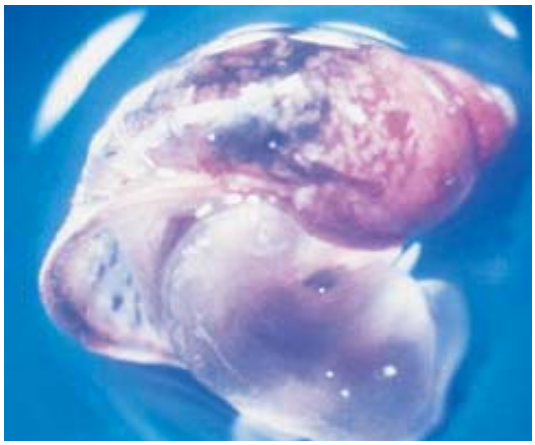
The fluke eggs are passed in the faeces into wet areas. Here they hatch, when mean temperatures increase to above 10°C (mostly from mid-September to May). In summer, the eggs take approximately 21 days to develop into miracidia; in the spring and autumn, hatching can take up to 90 days.

The larva (miracidium) invades the snail, where it develops and multiplies. One single miracidium hatching from a fluke egg can produce up to 4000 infective cysts (metacercariae). Actively swimming cercariae released from the snail attach to substrates, especially vegetation. The tail is shed



The introduced Lymnaea columella and its egg mass with embryos (shell 16 mm long).

L.tomentosa, the common intermediate host in Australia and New Zealand (shell 12 mm long).



The body cavity of L. tomentosa showing cercariae just before emission.

The cercariae leave an infected snail, Lymnaea tomentosa.

and the cercaria forms a resistant cyst stage (metacercaria). In the presence of sufficient moisture the metacercariae will remain alive for many weeks, depending on the temperature. They survive longer at below 20°C; higher temperatures and desiccation will destroy the metacercariae in a short time.

The snails, acting as intermediate hosts, produce eggs throughout the year. These eggs hatch when the temperature is right. There is a marked increase in reproduction from spring to late autumn. Snails may produce 3000 eggs a month and one generation of snails from egg to egg takes only about one month under optimum conditions. *Lymnaea tomentosa* survives in dry mud for at least one year, and tolerates low temperatures. The snail can move with and against the water current for long distances.

Metacercariae encysted on grass blades.

The larval stages of fluke (sporocysts, rediae) also survive in those snails for long periods, and resume development when climatic conditions improve.

The egg production of adult flukes is responsible for the degree of pasture contamination. Fluke survive for many years in the liver of infected sheep; the adult fluke lays between 20,000 and 50,000 eggs a day, and over a long period. In cattle, the egg production declines as the animal develops a natural resistance to chronic infections.

The epidemiology of the disease is influenced by the grazing habits of animals. Cattle often graze in the wet marshy areas favoured by the fluke snail, so the eggs are deposited in a suitable environment. If food is available elsewhere, sheep and goats prefer to graze away from marshy pastures. Long wet seasons are usually associated with a higher infection rate but sheep are more likely to ingest large numbers of cysts during dry periods after a wet season, when the animals are forced to graze in swampy areas, resulting in heavy infection.

Tablelands cattle grazing in a typical snail habitat – a slowly running stream fed by springs.

Liver fluke disease

Acute fasciolosis

There may be an outbreak of the disease following a massive but relatively short–term intake of metacercariae. The high intake is the result of certain seasonal and climatic conditions combined with a lack of fluke control measures; typically, stock forced to graze in heavily contaminated wet areas as a result of overstocking and/or drought.

Animals suffering from acute fasciolosis may not show any obvious symptoms. Some animals may show abdominal pain and may become jaundiced.

Death is usually due to blood loss resulting from haemorrhage in the liver. The liver haemorrhage is the result of the immature fluke burrowing through the liver.

Subacute fasciolosis

Subacute fasciolosis is characterised by jaundice, some ill thrift and anaemia. The burrowing fluke causes extensive tissue damage, leading to haemorrhaging and liver damage. The outcome is severe anaemia, liver failure and death in 8–10 weeks.

Chronic fasciolosis

Chronic fasciolosis is the most common form of liver fluke infection in sheep, goats and cattle – and particularly in more resistant hosts, such as horses and pigs. It occurs when the parasites reach the bile ducts in the liver. The fluke ingests blood, which produces severe anaemia and chronic inflammation and enlargement of the bile ducts. The clinical signs develop slowly. The animals become increasingly anaemic, appetite is lowered, the mucous membranes of the mouth and eyes

Sheep with pale conjunctiva, due to anaemia.

Sheep with bottle jaw (oedema) due to chronic fasciolosis.

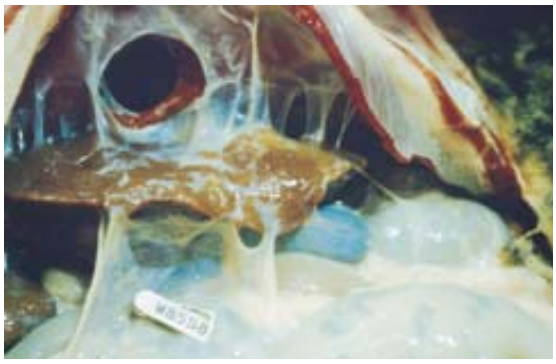
Calf with bottle jaw.

become pale and some animals develop oedema under the jaw (‘bottle jaw’). Affected animals are reluctant to travel.

Black disease

Black disease is an acute and fatal liver disease which can affect sheep and cattle. It is usually associated with the liver damage caused by the migrating young fluke; the damage provides a suitable environment for the germination of spores of *Clostridium novyi* type B bacteria in the liver.

Sheep liver with advanced immature fluke causing haemorrhages (subacute fasciolosis).



Adhesions due to fibrous perihepatitis.

Sheep liver with migration tracks due to early immature fluke (acute fasciolosis).

Parasite–host relationship

In sheep, there is no evidence of any acquired resistance to *Fasciola hepatica*. Acute and chronic fasciolosis can occur at any age.

Cattle have a natural resistance and under normal conditions the clinical disease is only likely in young cattle.

Chronically infected cattle can spontaneously recover, and previously infected animals can partially resist reinfection. However, this resistance is only possible because of chronic fibrotic changes in the liver, so with even a small number of fluke present, there may be production losses.

Diagnosis

Fasciolosis should be considered when there are deaths, anaemia or ill thrift in sheep or cattle grazing on fluke-prone country.

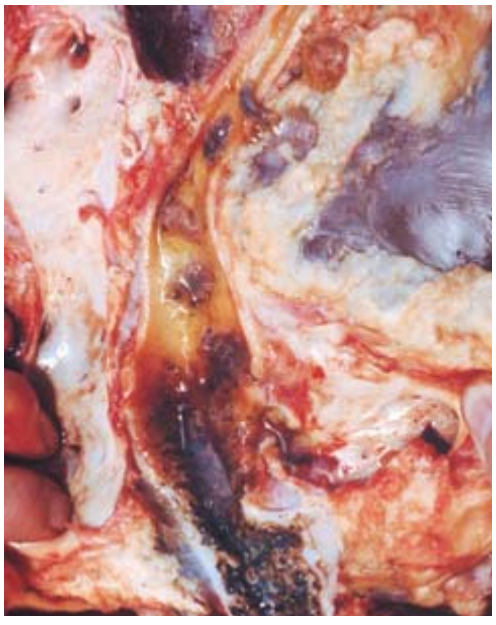
In live animals, chronic fasciolosis is indicated by fluke eggs in faecal samples. The sampling technique is generally reliable in sheep but much less so in cattle.

Diagnosis in dead animals relies on seeing mature or immature fluke in the liver. Necropsy will also identify other conditions that may be contributing to the problem. A serological test (ELISA) is also available for fasciolosis. It detects infection with both immature and adult fluke in a flock or herd, but it is not sensitive enough for diagnosis in individual animals.

Treatment

The treatment recommended will depend on the nature of the disease. Some of the available anthelmintics are not effective against immature fluke and so are not recommended in acute fluke outbreaks. Also, they are less efficient for the strategic control of fasciolosis. The best prevention and control can be achieved with drugs such as triclabendazole, which are effective against early immature and adult fluke.

Table 1 (below) summarises the efficacy of drugs registered for treatment of fasciolosis in sheep and cattle.



Calcified bile duct, adult flukes (cattle).

Strategic control

Due to the great biotic potential of *Fasciola hepatica* and their intermediate host snails, only a continuous and coordinated strategic application of

all available measures can provide economic control of the disease.

Control should be on a preventive rather than a curative basis. For effective control:

- use strategic anthelmintic treatment, to reduce the number of fluke in the host and the number of fluke eggs in pasture;
- reduce the number of intermediate host snails;
- manage fluke-prone areas, to reduce exposure to infection.

These three strategies are detailed as follows.

Using anthelmintics

The first of these strategies is the use of anthelmintics, based on the epidemiology of the disease. This makes it possible to determine the time of the year when the maximum effect can be achieved with the fewest possible treatments.

The correct time for anthelmintic treatment depends mainly on climatic conditions and weather data. Timing is basically similar across districts, with only small adjustments required in south–eastern Australia.

Figures 2–4 suggest timing of strategic treatments for the Central Tablelands, the Northern Tablelands and the North Coast. Fewer treatments than indicated may be required. The weather pattern of the Central Tablelands (Figure 2) is similar to that of the Southern Tablelands. The North Coast pattern (Figure 4), apart from higher rainfall, is similar to conditions on the south coast.

In the irrigation areas a similar program is recommended where the epidemiology of fasciolosis depends mainly on temperature. Treatments are essential when clinical disease is apparent, even though it may be too late to prevent economic losses. Treat according to the charts in order to prevent the disease and reduce the problem of liver fluke disease to a manageable level.

Drugs play an important role in the control of fasciolosis. An efficient strategic control program relying on a minimum number of treatments per year and aimed at long–term elimination of pasture contamination requires drugs that are effective against both mature and early immature flukes. More frequent treatments are necessary if you use drugs that are only effective against advanced mature fluke aged 12–16 weeks or older.

Drug resistance has been reported against triclabendazole and closantel but is not yet widespread. When found it is usually first seen as

Table 1. Comparative anthelmintic efficiency and safety of drenches suitable for the treatment of fasciolosis in sheep and cattle.

Active Ingredient	Safety index* at recommended dose	Over 90% efficiency at recommended dose						
		Age of fluke (weeks)						
		2	4	6	8	10	12	14
Triclabendazole (oral; pour-on formulations are also available)	20	+	+	+	+	+	+	+
Closantel[t]	5.3	-	-	-	+	+	+	+
Closantel[t] plus oxfendazole	5.3	-	-	+	+	+	+	+
Closantel[t] plus albendazole	5.3	-	-	-	+	+	+	+
Nitroxynil[§]	4.0	-	-	-	-	+	+	+
Albendazole	6.0	-	-	-	-	-	±	+
Oxyclozanide** plus levamisole	4.0	-	-	-	-	-	±	+
Clorsulon[§] plus ivermectin	20	-	-	-	-	-	+	+

* Safety Index = Maximum tolerated dose divided by the recommended dose rate.

§ Registered as a subcutaneous injection for cattle

± At 12 weeks is less effective in cattle than in sheep

[t] Not registered for cattle

** Registered for lactating cows

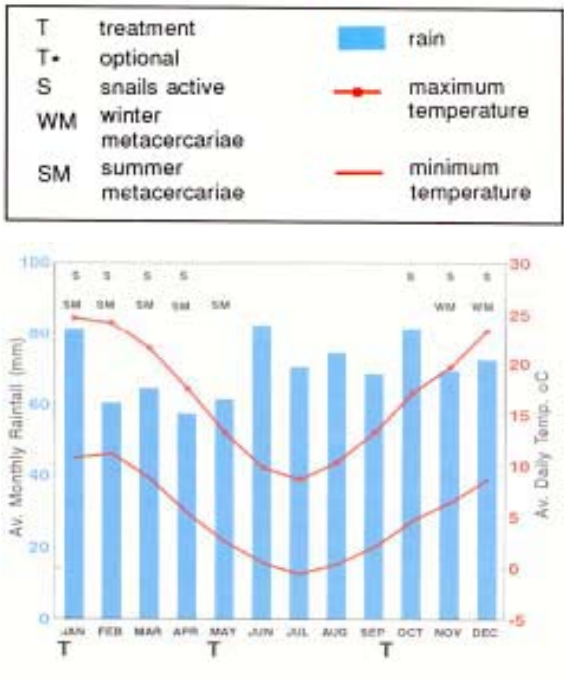


Figure 2. Oberon (Central Tablelands): program for liver fluke control.

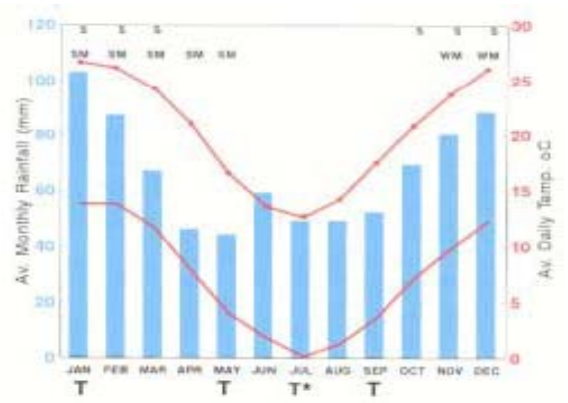


Figure 3. Armidale (Northern Tablelands): program for liver fluke control.

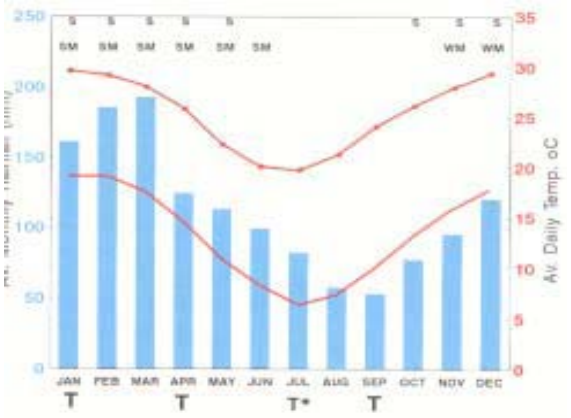


Figure 4. Lismore (North Coast): program for liver fluke control.

reduced effectiveness against immature flukes. Recently a number of combination drugs against fluke and roundworms have been registered for use. Care should be taken not to use them for frequent treatments for roundworms as this may encourage the development of resistance in *F. hepatica.*

Sheep (using closantel-based flukicides)

Some of the anthelmintic treatments for sheep can be readily integrated into the WormKill and DrenchPlan programs.

Closantel is effective against *Haemonchus* as well as liver fluke. It was a cornerstone of the original WormKill program (1984) before widespread resistance of *Haemonchus* appeared in northern NSW (1990s). The drug is effective against young mature fluke aged about six to eight weeks, but has reduced effect on early immature fluke populations. This lower efficacy against early immature fluke is more pronounced where closantel resistance in immature *F. hepatica* has emerged. The closantel plus oxfendazole combination has good synergistic efficacy against susceptible fluke aged four weeks and can be successfully used against triclabendazole-resistant fluke.

Closantel, or the above combination (both registered for use in sheep), is suitable for the late winter/early spring treatment. The recommended treatments are:

Late winter/early spring

Preventive treatment of all sheep (and cattle) at this time reduces pasture contamination before the snails and fluke become active. Otherwise, the contamination of pastures with fluke eggs will result in high fluke burdens in late spring and summer.

Summer

The larvae that infected snails in the previous autumn resume their development as temperatures increase (over-wintering infection). A fluke drench in January is necessary to eliminate the fluke picked up in the late spring and early summer.

This treatment can be delayed until February to coincide with a broad-spectrum drench that may be given in WormKill or DrenchPlan. Use a drench that is effective against early immature fluke – triclabendazole – because of the additional build-up of fluke during the summer months.

Autumn

The peak output of infective cysts is during late summer/early autumn (summer infection). Use a drench that is effective against early immature fluke – triclabendazole. This controls clinical disease and reduces pasture contamination.

Dam sites that are typical snail habitats: snails may be in the edge of the dam (above) or in the overflow during rainy periods (below).

Typical snail habitat (North Coast hills)

The best time for this treatment is April/May, which may coincide with a broad-spectrum treatment in DrenchPlan or WormKill.

Summer rainfall areas in the northern Tablelands and North Coast may need another treatment in July after a wet summer.

April/May

To eliminate fluke picked up during summer and early autumn.

Winter

If you have used chemicals that are not effective against immature fluke, another fluke drench is necessary in June/July. This removes the fluke that survived the April drench when they were still at the immature stage. (As noted earlier, drug resistance can sometimes reduce the efficacy against flukes.)

Sheep (using triclabendazole-based flukicides)

Triclabendazole is very effective against both early immature and adult fluke. If this drug is used then good control may be achieved with only three treatments a year.

These treatments are given as follows:

August/September

To remove fluke carrying over from late autumn and winter, and to prevent pasture contamination.

January/February

To eliminate fluke picked up during late spring and early summer.

April/May

To eliminate fluke picked up during summer and early autumn.

Using triclabendazole more frequently (such as every three months from September) reduces fluke disease to a negligible level. However it has to be a continual program if new stock are introduced or if there is likely to be reinfection from streams coming from neighbouring paddocks. Also, more frequent drenching may lead to development of drug resistance.

Drug resistance in liver fluke to triclabendazole has been reported on a few farms. The development of resistance may be delayed by alternating use of triclabendazole with a closantel plus oxfendazole combination. A closantel plus oxfendazole combination is good as an alternative drench due to its synergistic effect against liver fluke.

Beef cattle

Cattle are more resistant to fluke infection than sheep. Adult cattle require fewer treatments to control fasciolosis. The recommended treatments are as follows.

August/September

To eliminate fluke before spring, when the conditions become favourable for fluke eggs and host snails. This is an essential treatment for all cattle. It is advisable to treat cattle and sheep at the same time.

February
An additional treatment for all young cattle.

April/May
Another important treatment for all cattle, to eliminate any fluke picked up during summer.

Dairy cattle

Treat young heifers and dry cows with a drug effective against immature fluke – triclabendazole – and follow the above plan for beef cattle.

The two drugs registered for use in lactating cows (oxyclozanide plus levamisole, and clorsulon plus ivermectin) are only effective against adult fluke aged 12-14 weeks or older. If your property is heavily contaminated, you may have to treat lactating cows monthly during summer and autumn, using this product, which also controls gastrointestinal nematode and lungworm infections.

You will improve fasciolosis control with a triclabendazole treatment a month before calving, and immediately after drying off.

Mixed grazing

Be careful if sheep and cattle are grazing on the same pasture, whether together or alternately: you may need to treat your cattle every time you treat your sheep, to reduce or eliminate contamination of pastures and thus infection. For best results use a drug highly effective against early immature fluke, i.e. triclabendazole, or against advanced immature fluke, i.e. nitroxynil.

Snail habitat on the South Coast (Jamberoo).

Irrigation channel and shallow drainage area.

Snail habitat in an irrigation area near Griffith (ineffective drainage).

Intermediate host snail control

This is the second available strategy for control of *Fasciola hepatica.*

Chemical control

It is unlikely that chemical control or biological means will eradicate the snail population, because it reproduces so readily. Rapid repopulation from adjoining areas can occur.

There is no product registered for snail control in Australia.

Improved drainage

Irrigation projects can provide the snails with ideal habitats. Regular clearing of vegetation from drainage channels may reduce silting and blockages that normally support snail–contaminated herbage.

Seepages from irrigation channels often harbour large snail colonies. In low-lying areas, adequate drainage would prevent accumulation of water. Snails multiply for extended periods in wet, low-lying areas.

Draining marshy pastures and building dams may reduce snail habitats and increase grazing areas.

Disease control by farm management

This is the third available strategy for control of *Fasciola hepatica*.

Fencing

On many properties, the snail-infested pastures occupy only a small part of the animals' grazing area. Fencing off these contaminated areas is a most economic and efficient method of controlling fasciolosis. Spending a few hundred dollars on fencing may prevent a serious outbreak of liver fluke disease.

Grazing management

The number of animals needing fluke drench could be reduced by more attention to grazing management. Identify the snail-infested pastures on the property; only those animals grazing these areas need treatment.

A rotational grazing program was once recommended in Australia to eliminate infection, but unfortunately the system was never widely adopted.

The theory was to first use an effective drench before moving stock to potentially contaminated areas. The second step was to alternate the grazing between the potentially fluke-infected areas and the fluke-free areas.

Grazing in infected areas would be for less time than it takes the fluke to reach maturity and produce eggs (six weeks).

Grazing would be for longer periods in fluke-free areas. Here, any fluke picked up on the fluke-infested paddocks would reach the adult stage but would be removed by drenching about two weeks before stock moved back to contaminated pastures.

The major objection was the difficulty in organising pasture rotation and the problems of moving fences or erecting new fences.

However, the system could be easily applied to many properties where only a small number of paddocks have suitable snail habitats. In mixed grazing properties the more resistant cattle could be grazed on the known fluke-prone areas. These animals are less likely to be affected and would require less treatment.

Further reading

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ISSN 1832-6668

Replaces Agfact A0.9.57

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