

## The Life Cycles of Tick Fever Parasites

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### INTRODUCTION

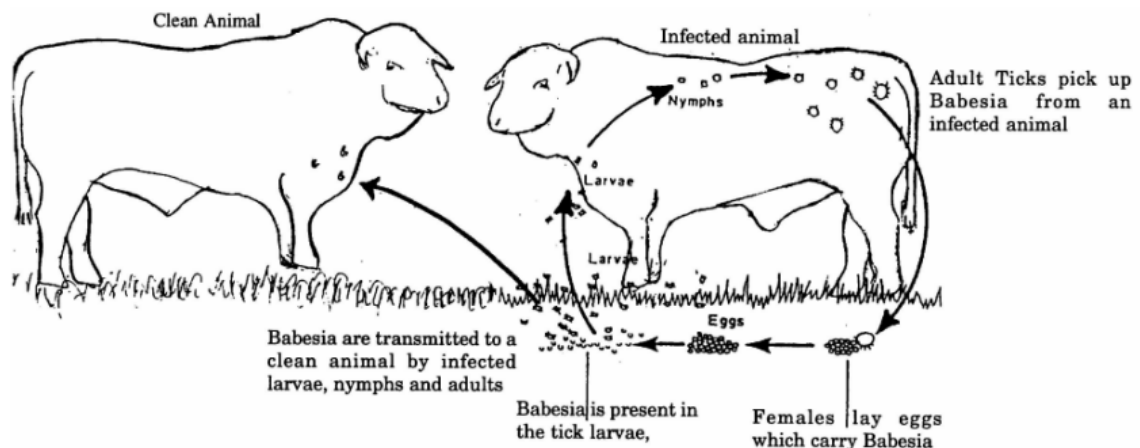
Cattle ticks (*Rhipicephalus microplus*) have been a major problem for the cattle industry in northern Australia for almost 100 years.

The ticks transmitted tick fever, a serious disease, which killed many thousands of cattle as the vector spread through susceptible cattle populations during the late 1890s. Today, the ticks and tick fever are confined to an 'enzootic' area of northern and eastern Australia through the controlled movement of cattle and by climatic conditions which limit their spread.

A knowledge of the nature and habits of the ticks and the disease agents they transmit helps in their control. This Agnote outlines the life cycle of the tick fever organisms and describes how and when the disease is transmitted.

### THE DISEASE COMPLEX

Tick fever refers to a disease complex. The three pathogenic parasites transmitted by cattle ticks are *Babesia bovis* (previously called *Babesia argentina*) and *Babesia bigemina*, both of which cause babesiosis, and *Anaplasma marginale*, which causes anaplasmosis. *B. bovis* is the most common cause of tick fever. *B. bigemina* is very widespread in the enzootic tick area but outbreaks of disease caused by it are not common. *A. marginale* ranks between the two as a cause of disease.



### LIFE CYCLES AND TRANSMISSION

#### Babesiosis (*B. bovis* and *B. bigemina*)

The life cycles of *B. bovis* and *B. bigemina* are similar in both cattle and ticks. The following is a composite description for the two parasites.

### *The development cycle in cattle*

Infective forms called small merozoites are produced in large numbers in the salivary glands of feeding ticks. The infective forms of *B. bovis* are injected into cattle by larval ticks; those of *B. bigemina* are injected into cattle by nymphal and adult ticks.

In infected cattle, the parasites invade red blood cells, where they undergo development and division and destroy red cells. More parasites are thus released into the blood stream and invade other red blood cells. The destruction of blood cells releases the red pigment, haemoglobin. In severe infections, sufficient haemoglobin is excreted by the kidneys to discolour the urine - hence the common name - 'red-water'.

The blood cell cycle is repeated until the animal dies or until its immune system controls the infection. Parasites may remain in the blood stream in very small numbers, perhaps for years, without causing sickness (disease carrier).

### *The development cycle in the tick*

The developmental cycle in the tick is more complex, with the parasites undergoing many changes. The parasites invade and multiply in various tissues of the developing embryo and of the new generation of larvae.

When a female tick feeds on an infected animal, babesial parasites present in the red blood cells enter the gut lumen of the tick. In the gut lumen, the parasites escape from the red cells and invade gut epithelial cells where they undergo massive multiplication. The end result is the production of large parasites called large merozoites, which are released into the haemolymph, which is the tick's 'blood'.

The merozoites are motile and are able to swim. Some enter the oviduct and invade the developing eggs. Here, the parasites multiply again and then remain dormant until the eggs hatch and the larval progeny infest a suitable host.

After attachment of infected seed ticks (larvae), the babesia is activated and development recommences. The main stimulus for this seems to be heat, provided by proximity of the larvae to the warm-blooded animal.

### *Transmission*

Not all larvae carry the infection. The proportion of larvae infected, referred to as the 'infection rate' varies considerably. The infection rate in larval ticks depends mainly on the concentration of parasites in the blood of the animal on which the 'mother' tick fed. The infection rate in larvae from ticks, which have fed on 'carrier' cattle, is likely to be extremely low and may be zero.

However, if female ticks engorge on an animal sick from babesiosis, the larval progeny will have a high infection rate and the chance of a subsequent outbreak of the disease in other cattle within the herd is increased. It is obviously a good practice to reduce tick numbers on cattle suspected of having tick fever.

Other factors which influence the infection rate in larval ticks are temperature and time after hatching. Studies suggest that larvae, which have spent two to four weeks on the ground before infesting cattle, are more likely to spread babesiosis than newly-hatched larvae. It seems that babesia needs a dormant period within non-parasitic larvae to develop fully. Cool weather (about 14°C) appears to enhance this development.

On average, about one in 10 000 ticks is infected with *B. bovis* and one in 3000 is infected with *B. bigemina*.

*B. bovis* is transmitted to cattle only by larval ticks and infection is not retained by the tick following its first moult.

*B. bigemina* continues its development in both nymphal and adult stages. The nymph is undoubtedly the principal infecting stage for *B. bigemina*, but adult stages are also capable of transmission. Because the adult male has a relatively long life span and is readily transferred between cattle in close contact, this stage may also have a role in the spread of *B. bigemina* infection.

## **Anaplasmosis (*A. marginale*)**

### *Life cycle*

*A. marginale* is a different type of parasite to babesia, but is similar in that it is spread by cattle ticks and also invades and destroys red blood cells of cattle.

### *Development cycle in cattle*

In specially stained blood from infected cattle, *A. marginale* organisms viewed under an ordinary microscope are seen as black, irregular-shaped dots, usually at the edge of infected red blood cells.

As the infection progresses, more and more red cells contain parasites and are destroyed. The disease is usually more protracted than babesiosis, and anaemia, jaundice and ill-thrift occur. Red water is not seen, but the urine may become brown in colour. As with babesiosis, animals which survive the acute disease become carriers of the infection.

### *Development cycle in the tick*

Little is known about the development cycle of *A. marginale* in ticks. The infection does not appear to be passed through the eggs from the infected parent tick to its larval progeny. However, ticks do become infected when they ingest infected red cells and they can retain the infection for at least several weeks.

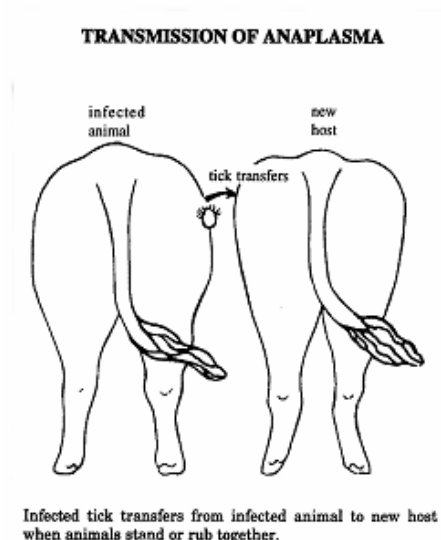
### *Transmission*

Larvae, nymphs and adult ticks can all transmit *A. marginale*. The infection is probably spread when the ticks feed on an infected animal and then transfer to another susceptible animal. This is most likely to occur when tick-infested cattle are in close contact with others, such as when calves suckle, or during yarding of stock for routine management procedures. Mixing of tick-infested and clean cattle should thus be avoided.

Anaplasmosis can also be readily spread in small amounts of infected blood. Procedures such as dehorning, castration, vaccination and collection of blood samples may spread the disease within a herd if precautions are not taken against the transfer of blood on surgical instruments and needles from infected to non-infected cattle. Biting flies can spread anaplasmosis.

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