

Caterpillar

CAUSED ABORTION

WHITE CEDAR TREES AND MARE
REPRODUCTIVE LOSS SYNDROME (MRLS)



Research has shown that the common caterpillar is responsible for some equine abortions and that prevention is possible with the removal of the caterpillar's favoured food source.

Dr Jennifer Stewart BVSc BSc PhD

While the sight of a line of hairy caterpillars wending their way across the paddock may not immediately ring warning bells to owners of in-foal mares, according to new research these little insects are far more sinister than they may at first appear. Recent studies by veterinarians, universities and research organisations* have shown a link between caterpillars and pregnancy loss in mares in Australia.

The research indicates this syndrome is similar to that caused by the eastern tent caterpillar (ETC) in the United States, called Mare Reproductive Loss Syndrome (MRLS). In 2001-2002 this caterpillar was identified as the cause of unusually high abortion rates in mares in Ohio and Kentucky, where an estimated 30 percent of the 2002 Thoroughbred foal crop – around 3500 foals – was lost.

The effects from these caterpillars has not been limited to reproduction losses. In addition, a number of cases of inflammation within the sac surrounding the heart (pericarditis) and severe inflammation of one eye (unilateral uveitis) in the mare have been associated with MRLS.

When these caterpillars get into the mouth, bacteria start to appear in other parts of the body.

Apart from the emotional aspect for breeders of losing a perfectly healthy foal, the syndrome caused huge monetary losses – the combined economic costs of foal loss in all breeds of horses in the USA approached US\$336 million!

In the winter of 2004 a syndrome of inflammation of the foetal membranes and abortion was reported in Australia. This form of abortion had not been previously recognised in Australia and was labelled 'equine amnionitis and foetal loss syndrome' (EAFL). It was the biggest cause of abortion in the Hunter Valley, NSW. On a number of studs, mares from four to eleven months pregnant aborted their foals, with similar abortions occurring in Toowoomba, Qld and Richmond, NSW.

EAFL occurs as abortion during the last three months (113 days) of pregnancy and is usually associated with a swollen and engorged placenta (premature placental separation or 'red bag' syndrome) where foals born alive are often weak and require intensive veterinary care.

Studies revealed that all horses can inadvertently eat the caterpillars but it is in

the pregnant mare that they have by far the most dramatic effects. When caterpillars get into the mouth, bacteria from the mouth suddenly start to appear in other parts of the body. Once in the mouth, the caterpillar hairs (or setae) embed in and penetrate the lining of the gut, where they irritate the mucous membranes. Once the gut's protective barrier is breached, normal gut bacteria may gain access to, via the blood vessels, sites with reduced immunity, such as the placenta and foetus where they lodge and proliferate, finally causing abortion. Foetal death from these gut bacteria is the hallmark of the abortion syndromes.

So the bottom line is, if the caterpillars can be kept out of the mouth/intestinal tract of the horse, it will go a long way toward preventing the syndrome.

SIGNS OF EAFL

Mares experiencing early abortions typically show no outward signs, but around five percent may exhibit mild colic signs, abdominal straining or low grade fevers one to three days before foetal loss. While early losses of the foetus are staggering and certainly tragic, there can be catastrophic outcomes for both the mare and the foal in late term abortions. Typically these mares show restlessness, discomfort and sweating followed by an intense and explosive birth. The majority of mares show no signs of an impending foaling and are not identified

The caterpillar nest, which is fashioned around tree branches to give it support, can be over 30 centimetres long.



as high-risk pregnancies, but an increased number foal while standing. Premature placental separation with the appearance of engorged membranes ('red bag' syndrome) and abnormal foal positioning, result in difficult births, and some mares fail to reach full mammary development prior to delivery. Veterinary intervention is often necessary to avoid losses for both the mare and foal. If delivered alive, these foals are often compromised - weak, dehydrated and requiring oxygen supplementation - and the placentas may be abnormal.

MRLS and EAFL syndrome have similar clinical and pathological characteristics and caterpillars have been implicated as a causal factor. Investigations of environment, soil and pasture have not identified any abnormalities. Similarities between the features of EAFL and MRLS led to consideration of caterpillars as a possible risk factor in Australia. Although the USA's eastern tent caterpillar do not occur in Australia, a number of other caterpillar species occur in the areas

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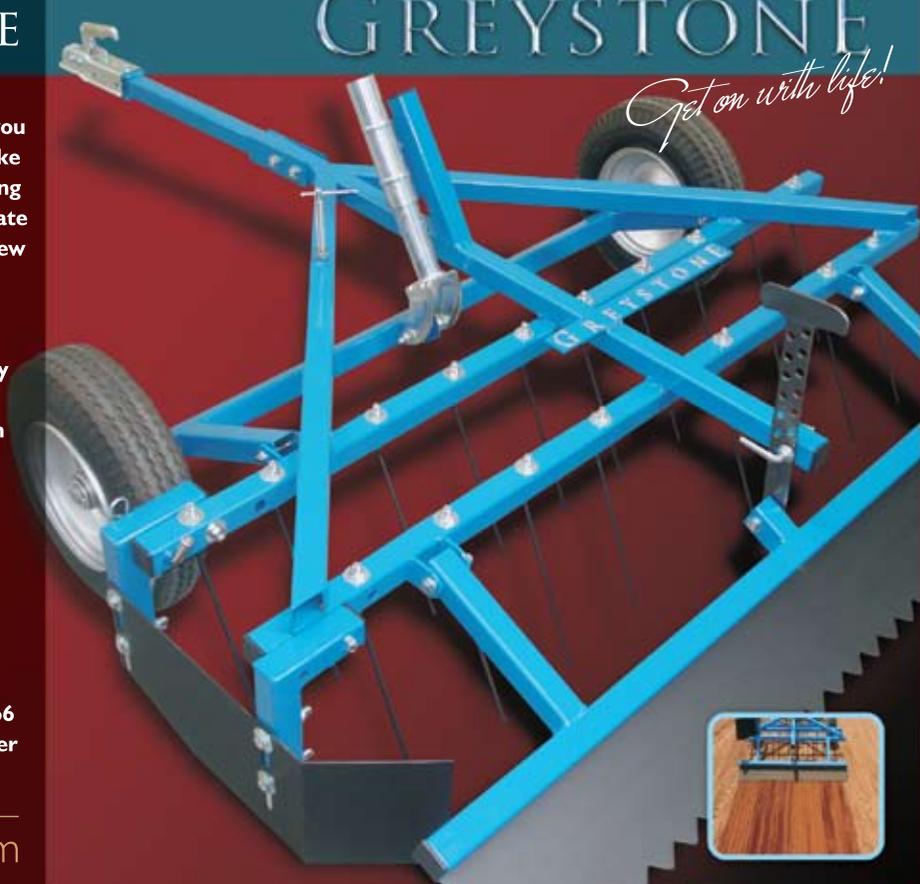
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The moth produces a single egg mass containing up to 300 eggs in her chosen tree, which then hatch out of the nest in early spring and begin their lives as processionary or white cedar caterpillars.

caterpillars complete their larval growth in as few as seven to eight weeks - in the laboratory at room temperature, the larvae reach their full size in only three weeks, increasing in mass during this period by a factor exceeding 5000!

When fully grown, the caterpillars drop to the base of the tree where they were born (natal tree), often traveling long distances over the ground in search of sheltered sites - when population densities peak, the caterpillars commonly defoliate their natal trees and must strike off over the ground in search of new trees. The caterpillar will also infest other trees, including acacia, ornamental pear, crabapples and sometimes oak. Here they spin cocoons and metamorphose, spending two to three weeks in the pupal stage before emerging as moths.

CATERPILLAR STAMINA

To assess the ability of the caterpillars to disperse, researchers in the United States tested caterpillar stamina on a treadmill. Preliminary experiments showed that caterpillars were easily able to travel at a rate of 2.7 metres per minute. Caterpillars released in the morning travelled at a fairly slow and steady rate of 0.025 metres per minute, while caterpillars released in the evening travelled at a relatively rapid rate of 0.17 metres per minute. They readily moved on the treadmill for 15, 30 and 120 minute intervals, travelling distances of up to 324 metres. The single caterpillar that lasted 240 minutes required some light prodding and eventually stopped from exhaustion after travelling a distance of approximately 624 metres!

ENVIRONMENT AND PASTURE FACTORS

As well as inventing caterpillar treadmills, researchers examined every possible factor in the environment that could have contributed to the MRLS abortions, leaving no stone unturned.

Weather patterns were meticulously studied, with three weather variables showing a degree of correlation with MRLS - massive heat accumulation in the form of temperature change over a 7-day period during spring; multiple frosts with further explosive heat accumulation after each frost; and rainfall patterns - either very dry or very wet.

Levels of ergot alkaloids (known to cause reproductive problems in mares) in tall fescue and perennial ryegrass were measured. Ergot alkaloids are toxins produced in tall fescue in late spring, due to the presence of an internal fungus called 'endophyte'. Perennial ryegrass can also be endophyte-infected and can produce

affected by 'equine aminionitis and foetal loss syndrome' - including processionary caterpillars (*Ochragaster lunifer*), white cedar moth caterpillars (*Leptocneria reducta*), and the mistletoe brown tail moth caterpillar (*Euproctis edwardsi*).

The Australian native Pennyroyal (*Mentha satuireioides*) was also reported in large amounts on one affected property and this plant has been described as a possible cause of abortion in domestic livestock. The processionary and white cedar caterpillars were the most common species reported on properties that suffered abortions, but all these caterpillars have the hairs (also known as 'setae') thought to cause these abortion syndromes.

Equine veterinarian and researcher, Judy Caldwell-Smith at the School of Animal Studies, University of Queensland in Gatton, experienced first-hand the impact of these losses. She has since dedicated her research funding and effort into helping mares and their owners avoid the tragic disappointment and economic loss of perfectly developing foals aborting before term. Judy designed a series of elegant experiments to uncover the cause of the heartbreak and misfortune. The results of her commitment to owners, breeders and equine health, showed that white cedar moth caterpillars shed their 'skin' a bit like a snake sheds its 'skin' - in caterpillars this is called 'exoskeleton' - and it is this 'exoskeleton' that can cause early pregnancy loss and MRLS in mares.

LIFE CYCLE

The number of white cedar caterpillars varies widely from year to year. Wherever they occur, the caterpillars have boom-and-bust population dynamics - outbreaks alternate with periods of scarcity. Because of its short life cycle and the capacity of



The distinctive berries help to identify the White Cedar tree (*Media azedarach*) also called a Cape Lilac.

a single female to produce a large number of eggs, the reproductive potential of the caterpillars is enormous. In theory, a single pair of moths can produce a population of nearly 100 million caterpillars in only four seasons. Although local populations never achieve their full potential for growth, they typically reach high densities for several years in succession, then collapse and all but disappear - outbreak populations may last for as little as one year to as many as nine.

The moth produces a single egg mass that contains up to 300 eggs that hatch in the early spring, just as the buds break and leaves begin to unfold. Young caterpillars launch forays up into the branches of the white cedar tree in the late afternoon at dusk, returning in the early morning before dawn. In the last stage of larval growth these caterpillars typically feed only at night, returning to the base of the tree at dawn.

Highly social, the caterpillars conduct all their activities in tight synchrony, moving to food, feeding and returning to the base of the tree. Being ravenous feeders, the

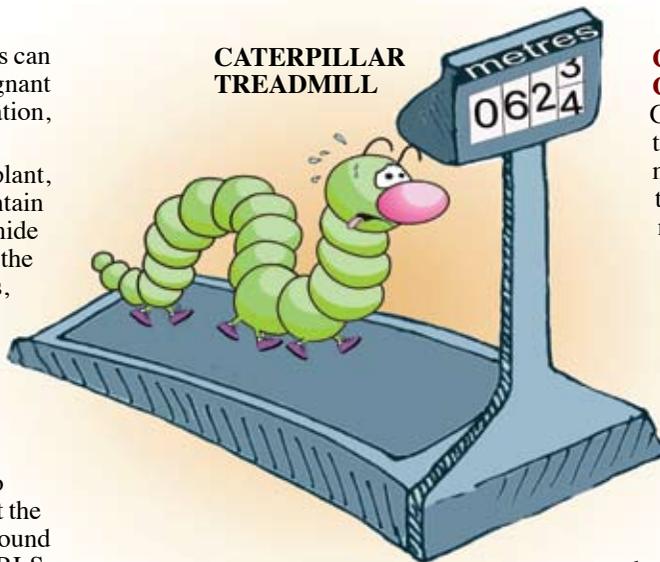
ergot alkaloids as well. These alkaloids can cause reproductive problems in pregnant mares - primarily prolonged gestation, foaling difficulty and lack of milk.

Another common pasture plant, White clover, can potentially contain phytoestrogens and cyanide. Cyanide potential in white clover is based on the amount of cyanide-containing sugars, which are genetically determined and moderated by factors such as weather or stress - frosts will raise the level of these compounds and if severe, could result in the release of free cyanide. However, cyano-sugars were not correlated to the incidence of MRLS and research at the University of Kentucky specifically found that cyanide would not induce MRLS. Fungal mycotoxins were also eliminated after intensive study.

Checking Mineral Imbalances

Mineral imbalances in pasture were also examined and eliminated as a cause. It was theorised that high levels of fertilisation led to abnormally high ratios of potassium to calcium in pastures. In addition, it was theorised that the late frosts of 2001 led to temporary spikes in potassium content of pasture plants, leading to gastric disturbances and allowing bacteria from the gut to enter the blood stream and attack the foetus. However, pasture monitoring found no correlation to MRLS, and in addition, MRLS was found on pastures that had received no commercial fertiliser for the previous 15 years. Feeding hay on pasture was also eliminated as a cause and related only to low levels of MRLS. It may be that providing hay made mares less likely to come into contact with caterpillars in the pasture, however, feeding hay on pasture is not considered to lower the risk of MRLS.

CATERPILLAR TREADMILL



CONTROLLING THE CATERPILLARS

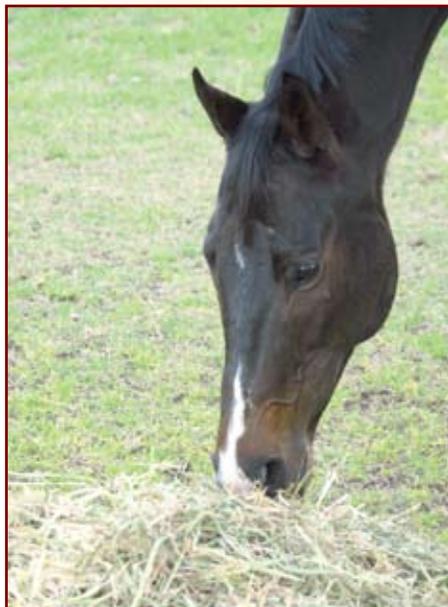
Current management recommendations include minimising or eliminating exposure of pregnant mares to the caterpillars, keeping pregnant mares out of proximity to white cedar or other host trees, and minimising exposure of mares to endophyte-infected pasture.

Caterpillar control can be done by removing the white cedar trees or spraying, and there are a range of sprays available. When the caterpillars are young, spraying the leaves of the white cedar can be done with a product based on *Bacillus thuringiensis* (Bt).

It must be eaten by small caterpillars to be effective as there is no contact effect and consequently, applications should be made to as much of the canopy as is feasible, especially the foliage around active nests. Direct application to nests will not provide any control. Bt residues on foliage can be broken down by sunlight in three to four days, so it is important to assess control and re-treat if necessary. The effectiveness of Bt decreases as caterpillar size increases.

Other foliar sprays containing either bifenthrin or carbaryl have both stomach and contact activity, so they can be effective when sprayed on either foliage or the caterpillar nests. The residual life of carbaryl is about a week and that of bifenthrin is at least two to three weeks. Another option is to inject trees with a systemic such as bidrin. Regardless of the treatment used, it is important to revisit the sites in about five days to assess caterpillar activity. Although the white cedar is the

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Research indicated feeding hay made it less likely the mare would come in contact with caterpillars.

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Caterpillar Caused Abortion cont..

preferred host for caterpillars, they can travel long distances, so look outside of field boundaries for other host trees.

The development of Abacide was based on data from a 2004 University of Kentucky College of Agriculture study on managing caterpillars to prevent MRLS. Abacide showed 100 percent control of caterpillars in trials, quickly killing large tent caterpillars crawling over or through treated pasture grass. It is an effective insecticide and the active ingredient has low toxicity to people and livestock. It is in the same insecticide class of anti-parasite medication already in use on horses, pets and livestock. The application rate is 50 ml per five litres of water, sprayed as a band about ten metres wide. Property owners needing to stop caterpillars from crawling into pastures from adjacent untreated areas may want to consider this tactic. Alternatively, the spray can be applied to lower tree trunks or to the ground around the base of trees. Applications should be made outside of the perimeter so that the caterpillars will be killed before entering the pasture. Rainfall the night before application of abacide reduces the effectiveness.

Controlling caterpillars is a vital procedure to control abortions so, whilst treating these pests, it is important to remember that neighbouring properties and farms may not have caterpillar control practices. Caterpillars show no respect for property lines and can cause problems to the farms or properties that are working hard to eliminate the risks associated with white cedar trees and processionary caterpillars, however if all concerned understand the horrific nature of pregnancy loss in mares there is no reason why the risks cannot be reduced by working together to eradicate these caterpillars.

MRLS and EAFL offer an opportunity for international researchers to work together to achieve an outcome that will benefit both equine breeding industries. And, although financial constraints often prevent horse owners from fully investigating all equine abortions on their property, doing so will benefit owners and the industry – as well as future in-foal mares and their unborn foals.

Controlling caterpillars or removing in-foal mares from infected paddocks will improve the chances of producing a healthy, live foal. Sophie Roberson's foal brag photograph is by the imported Oldenburger stallion Royal Oak II



*Organisations involved in the research: AusVet Animal Health Services, South Brisbane, Qld, Australia; ²College of Veterinary Medicine, University of Georgia, Athens GA, USA; ³Tails and Scales Veterinary Services, The Junction, NSW, Australia; ⁴Gundy Veterinary Services, Scone, NSW, Australia; ⁵MayneHealth Vetnostics, Kotara, NSW, Australia; ⁶Faculty of Veterinary Science, University of Melbourne, Vic, Australia; ⁷Satur Veterinary Clinic, Scone, NSW, Australia; ⁸Scone Veterinary Hospital, Scone, NSW, Australia; ⁹EquiVet Australia, Southbrook, Qld, Australia; ¹⁰School of Animal Studies, University of Queensland, Gatton, Qld, Australia the Rural Industries Research and Development Corporation (RIRDC) and the Hunter Valley Equine Research Centre

About The Author

Dr Jennifer Stewart worked at the USA Universities of North Carolina, Ocal and Florida with a period in Newmarket and Cambridge, England before establishing an exclusively Equine practice on the Central Coast of NSW and working as a Consultant Equine Nutritionist for Australian Feed Company. She is the Official Veterinarian with NSW Thoroughbred Racing and Sydney Turf Club and speaks at racing, breeding and endurance racing seminars in Australia, and overseas.

