TIMERITE®

information package

TIMERITE

For the control of redlegged earth mites

James Ridsdill-Smith and Celia Pavri

CSIRO Entomology

CSIRO

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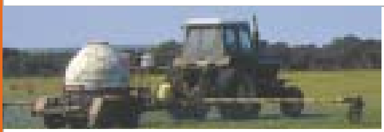


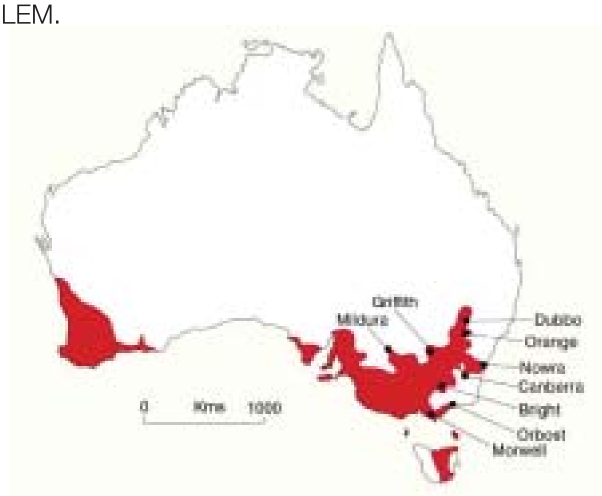
CONTENTS

Introduction to TIMERITE®

The TIMERITE® package provides a reliable and effective option for control of redlegged earth mite (RLEM) in Australian pastures.

The RLEM is a major pest of pasture legumes in the winter rainfall regions of southern Australia.

RLEM are found throughout areas of southern Western Australia, South Australia, Victoria, New South Wales and Tasmania with winter dominant rainfall and a dry summer. The TIMERITE® package covers all areas affected by RLEM.



RLEM distribution in Australia.

TIMERITE® provides farmers with the date for a single spring spray that controls RLEM through to the following autumn.

This date is unique to each farm and will remain constant from year to year.

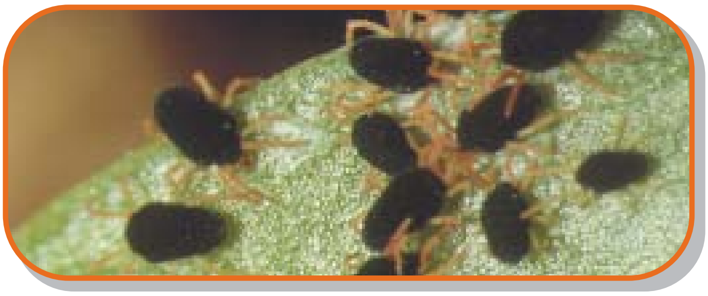
For a short time in spring, after RLEM have finished laying normal winter eggs on the pasture, but before they produce their over-summering eggs, there are no eggs present.

This is the ideal time to spray because eggs are impervious to sprays. Controlling mites in this period means that the whole population can be affected, leaving no mites the following autumn.

Over a period of seven years, TIMERITE® has been demonstrated on 60 farms across southern Australia. On average, a single spray at the critical time in spring resulted in a 93 per cent RLEM control in autumn eight months later. The benefits measured were:

- 43 per cent increase in subterranean clover seed yield in summer; and
- 55 per cent increase in numbers of subterranean clover seedlings the following autumn.

This package was developed by CSIRO Entomology and supported by woolgrowers through Australian Wool Innovation Limited.



RLEM and feeding damage.

How to use TIMERITE®

Decision on spraying

This package is for spraying for RLEM in spring. You do not need to have very high mite numbers to consider spraying. But if you cannot see any mites in your pasture it is probably not worth spraying. TIMERITE® is available in all areas of southern Australia within the known range of RLEM distribution.

The specific spray date for your property

You can obtain the spray date for your property from the Australian Wool Innovation Limited Helpline on 1800 070 099.

You will need to provide either a named place on or very close (less than 10km) to where your property is that can be looked up on a map, or the exact latitude and longitude of the paddock you are to spray (to the nearest second).

Alternatively, you can type the latitude and longitude of your property into the TIMERITE® website at www.timerite.com.au to obtain your optimum spray date.

Once you have the date it should not change, and you do not need to get it again (write your date in the space below so you do not lose it).

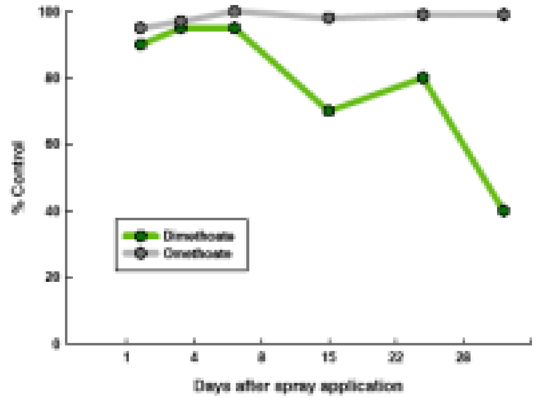
Timing of spraying

Spray as close to the date as possible. If it is not possible to spray within a couple of days of your date, use a systemic, residual chemical applied within a two week period leading up to and including the optimum TIMERITE® spray date.

Spraying after the optimum date does not achieve good control the following autumn and this should be avoided. You will need to decide on the chemical you use and the method of spraying. It would be best to refer to your local agronomist for the chemical most suited to your soils and conditions.

Note that chemicals will not kill mite eggs. Winter eggs that have been laid on the pasture can take up to ten days to hatch and if any of these are still present at the time of spraying a contact chemical will not be effective.

Residual chemicals will kill more mites as they will still be active for a period of time after spray application. The length of time varies between different compounds so again check with your local agronomist.



Effectiveness of omethoate (residual) and dimethoate (less residual) on RLEM in pastures (data from John Seidel, Bayer Australia Ltd).

Autumn

It is still necessary to check for mites in the following autumn, because the spray may not always reduce RLEM to levels where they cause no damage. When planting a high value crop, like canola, with a low damage threshold, it may be worth using a seed dressing at the time of sowing as insurance to mop up any surviving mites.

Write your spray date here

This date is unique to each farm and will remain constant from year to year

Identifying the redlegged earth mite

Although RLEM are one of the most common pasture pests in southern Australia, other species are also present. Correct identification of RLEM before spraying in spring is important.

RLEM are small mites (1 mm long) with black bodies and red legs. They spend most of their time on the soil surface, moving up onto plants to feed.

The blue oat mite is also present in pastures during the growing season and is often mistaken for RLEM as they look quite similar to the naked eye. The adult blue oat mite is about 1 mm long with a blue-black coloured body, red legs and a red mark on their back. RLEM have a completely black body and do not have the red 'dot' on their back.

Blue oat mites are generally seen feeding singularly or in small groups, whereas RLEM generally feed in larger groups. Damage caused by blue oat mites appears the same as RLEM, however blue oat mites feed more on grasses and cereals and RLEM feed more on the legume and capeweed content of pastures.

RLEM (bottom right) and blue oat mite (top left).

Mite numbers in pastures

During winter, RLEM are usually the most abundant pasture pests in southern Australia, on average representing about 87 per cent of earth mites in eastern Australia and 95 per cent in Western Australia.

Average RLEM populations at 40 sites in southern Australia between 1998 and 1999 were 21,000 mites/m^2. At the same sites, blue oat mite populations were 740 mites/m^2.

Scanning electron micrograph (SEM) image of a RLEM feeding on a clover leaf.

Blue oat mite populations can increase to higher levels at times during the season and populations vary between seasons. In some areas, such as northern New South Wales, blue oat mite is present and RLEM is not found.

TIMERITE® is not effective at controlling blue oat mites.

Other mites that may be confused with RLEM

Bryobia mite

Adult mites are 0.75 mm long, the body is oval shaped, flattened dorsally and rusty brown, pale orange or olive in colour. The eight legs are pale red/orange. The front pair of legs is very long and held out in front of the body.

Balaustium mite

The balaustium mite has a greyish, brown to red body and bright red legs. The body is covered with short bristly looking hairs. The adult mite grows to almost twice the size of RLEM.

Bryobia mite.

Balaustium mite.

Redlegged earth mites and pasture damage

When feeding, RLEM make holes in the cells on the upper surface of leaves and suck out the sap.

RLEM have very short mouthparts and feed in the surface layers of the leaf, causing a silvering which can look like frost. This is very characteristic of RLEM feeding damage.

Mite feeding damage to young subclover seedlings.

RLEM have a very wide range of hosts including pastures, crops and vegetables. They feed on all growth stages from seedlings to leaves and flowers.

Mite feeding can result in production losses throughout all stages of annual legume growth in pastures and crops.

Seedlings are particularly vulnerable and mites can kill them. In annual systems these plants will not be replaced. Feeding on older plants can also substantially reduce dry matter production and seed yield. Damaged leaves have reduced palatability and digestibility for grazing stock.

Pastures based on subterranean clover are self-regenerating and a reduction in seed yield leads to reduced plant density the following year and contributes to 'pasture decline'.

The economics of pasture damage

Mites are often abundant in pastures and it has been calculated that 12,000 mites/m^2 use as much energy as one dry sheep equivalent per hectare (one DSE/ha). Mite densities well in excess of 12,000/m^2 are frequently recorded in pastures and can lead to a high level of competition with sheep for the pasture resource.

Likewise infestations in crops can be costly, particularly in high value crops such as canola.

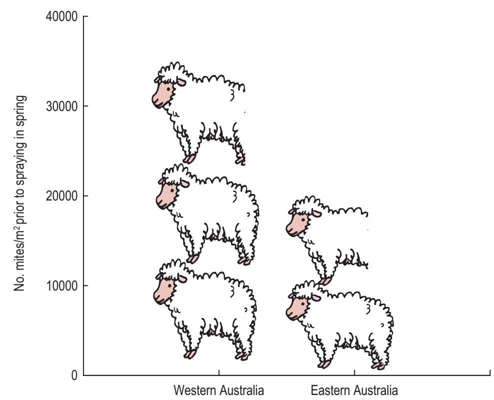
Crops (such as lupins) following pastures can also benefit from controlling mites in the pasture phase.

Research consistently shows control of mites in pastures and crops leads to increased financial returns.

Eliminating RLEM from pastures will result in increased pasture growth in spring when 40 per cent of the growth occurs.

Farmers need to change their management to make use of this extra feed in order to achieve the full economic benefits from controlling RLEM. Otherwise the benefit becomes more of an insurance against years with poor pasture emergence and production.

Over eight years of trials (see page 10), the spring mite populations prior to spraying were 34,000/m^2 in Western Australia and 20,000/m^2 in eastern Australia.



Average spring mite populations prior to spraying equivalent to number of DSE/ha.

Spraying

Spray timing – the window of opportunity

Increasing spray flexibility

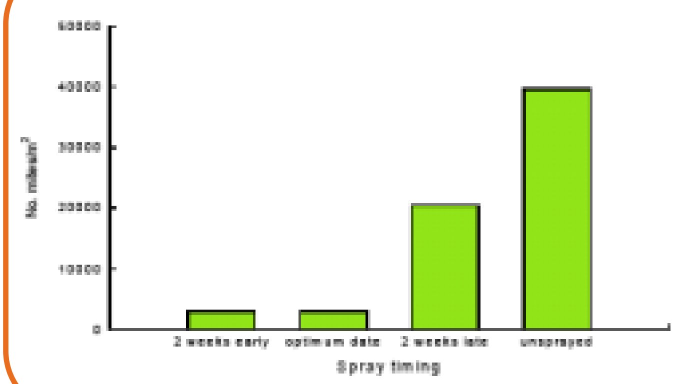
TIMERITE® provides farmers with a single spray date for optimum control of RLEM with a suggested period of three days either side of this date to achieve good control the following autumn.

However, if spraying within three days either side of the optimum spray date is not possible, it is still possible to achieve reasonable control of RLEM by spraying within a two week period leading up to and including the optimum TIMERITE® spray date.

Results of trials of spray flexibility

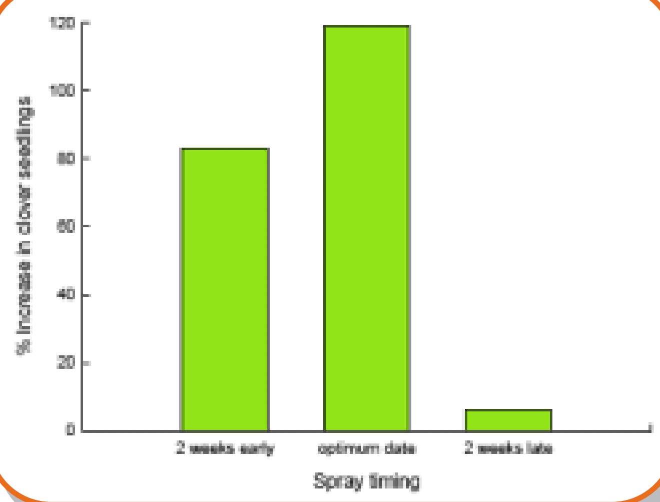
On four grazed subclover sites in Western Australia, the effects of controlling RLEM on the optimum TIMERITE® date were compared with spraying on dates either side, using two common insecticides: omethoate and dimethoate. While both are systemic insecticides, omethoate is more persistent than dimethoate.

The results showed that RLEM control the following autumn after spraying was high at sites sprayed two weeks early and on the optimum date, but poor when sprayed two weeks late.



Mite numbers the following autumn.

The seedling data showed similar trends. With the average percentage increase in seedling numbers across all sites being high in areas sprayed two weeks early and on the optimum date but low when sprayed two weeks late.



Percentage increase in subclover seedlings the following autumn.

Dimethoate was not as effective as the more residual omethoate. At the sites using dimethoate, average control during autumn for plots treated two weeks early and on the optimum date was lower (58 per cent) than for the other two sites where omethoate was used (98 per cent).

These trials showed that for farmers to achieve the benefits of good RLEM control and increased subclover density, their best option would be to use a systemic, residual chemical applied within a two week period leading up to and including their optimum spray date from the TIMERITE® database.

Spraying after the optimum date with either chemical does not result in sufficient mite control the following autumn.

- **Use a systemic, residual chemical applied within a two week period leading up to and including the optimum TIMERITE® spray date.**
- **Spraying after the optimum date does not achieve good control the following autumn.**

Spraying – application methods

Successful chemical control requires correct application. When spraying consider the following:

- Application method
- Water rates
- Water quality
- Chemical rate.

Application method – Boom sprays vs misters

Boom sprays are considered the most reliable method of insecticide application. However it is often not practical to use them due to the amount of area that needs to be covered in a limited period of time, inaccessibility to paddocks due to rough terrain, treed areas, boggy ground or risk of flattening crops.

In these situations misters or aeroplanes are the only alternative and with these methods wind and weather conditions need to be ideal to achieve reasonable control. The use of these methods also often results in patchy control, as ground coverage may not be as good as a boom spray. Therefore the use of a marking system such as GPS guidance or foam markers is recommended.

Boom sprays are considered the most reliable way of controlling insects in pastures.

Water rates

Most boom spray applications use between 50 and 100 litres of water per hectare and it is important that rates are not reduced below this.

When using equipment other than a boom spray, water rates are often cut to 5-10 litres per hectare. This poses problems because the small droplets from misters and aeroplanes are not absorbed by the plants - therefore there is no systemic activity of the insecticide.

Low water volumes also result in most of the water evaporating from droplets on leaves so the plant does not absorb the chemical. Low water volumes also significantly reduce the penetration of the chemical through the pasture canopy to the soil surface where the mites spend most of their time.

For these alternative methods 30-50 litres of water per hectare should be the minimum requirement in combination with 1-2 per cent anti-evaporative oil.

Water quality

Quicker degradation of some insecticides occurs due to alkaline hydrolysis with high pH and/or iron content in the water used as the carrier. The original strength of the insecticide is reduced by 50 per cent in 48 minutes at a pH of 9, in 12 hours at a pH of 6 and 21 hours at a pH of 2.

Water supplied through concrete-lined pipes is liable to increase in pH the further from the source it travels. If this water is pumped through concrete-lined pipes during winter, pH levels of 9 can be reached. The same situation probably applies to concrete water tanks, especially new ones.

Problems can also be associated with dam water sourced from limestone or high pH mallee country.

Operators should always test the pH of their water near the time of using it because a pH reading taken from their water supply in early spring might be different than that taken during periods of higher water use in the late spring.

If high pH is a problem, an acid based buffer should be added to the spray tank first, before the addition of the insecticide. Do not tank mix the insecticide and then store for an extended period of time and avoid storing chemicals at high temperatures.

Chemical rate

Recommended label rates of the most commonly used insecticides are considered to be associated with autumn application, a time of year when feed on offer (FOO) is very low (1,000-2,000 kg DM/ha). When spraying in spring, FOO is much higher (up to 8,000 kg DM/ha).

Many farmers and agronomists consider that chemical rates should be increased as FOO increases.

However, there was no evidence from the CSIRO's Badgingarra trial (see page 9) that this was necessary to achieve control, unless exceedingly high mite populations were present at the time of spraying.

Insecticide options

The effectiveness of chemicals has not been compared in developing this package. Please check with your distributor for the most effective chemical to use.

CSIRO's observation is that RLEM live on the soil surface but move up onto foliage to feed. It seems that as long as chemicals cover the foliage the mites will be exposed to them. CSIRO has not observed any requirement to increase dosage in tall pastures (see page 9).

The insecticides listed below are the most commonly used for controlling RLEM. Each chemical has different application rates, modes of action, as well as different rain fast times and withholding periods. The period of residual activity also varies considerably between the different chemicals.

Not all of the insecticides are suitable for certain methods of application. Check labels for suitability with boom spray, mister or aerial application.

Pesticides for RLEM control

Chemical	Rate ml/ha	Note
Dimethoate	55-85	Contact effect + some residual
Omethoate	100	Contact effect + residual
Chlorpyryrifos	140	Contact effect + some residual
Bifenthrin	50-100	Residual effect
Cypermethrin	75	Contact
Alpha-Cypermethrin	50-100	Contact + some residual effect
Endosulphan	500	Longest control on bare earth

An integrated approach to control

Integrated pest management is the integration of different chemical and non-chemical methods of control to minimise use and risk of chemicals while increasing use of management and biological methods.

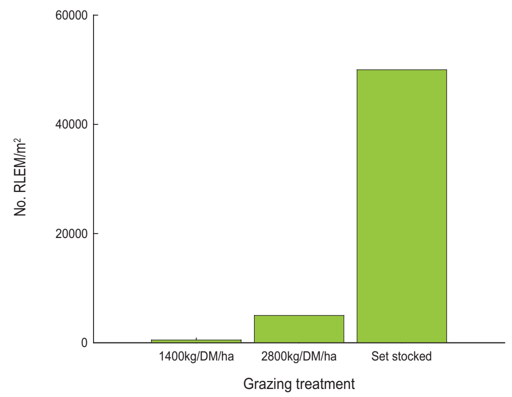
Natural enemies

A number of generalist predators are present in pastures in southern Australia that feed on RLEM. These include several predatory mites but they have a wide range of prey and are not specialised to feed on RLEM.

Up until now, none of these predators have been able to prevent the build up of RLEM populations in pastures in a sufficiently reliable way to avoid the need for other control methods. However, chemical use should aim to avoid killing these beneficial invertebrates.

Grazing management

Scientists at the WA Department of Agriculture have demonstrated that heavy grazing of pastures in spring can reduce RLEM populations by up to 99 per cent.



Effect of grazing management on RLEM populations in spring (Source: Grimm et al, 1995 Pl Prot Quart).

Weeds

RLEM are associated with weeds in pastures. However, a CSIRO study has shown that the mites use capeweed as a favourable habitat, while feeding mainly on subclover plants. Tall patches in pastures provide a good home for the mites, whichever plant species is involved.

Resistant varieties

Good progress was made in the Legume CRC to identify accessions of subclovers from the national collections with resistance to RLEM. Recently, a move to implement phase pastures has changed the emphasis to look at the RLEM resistant status of new species. Gland clover (Prima) shows strong resistance to RLEM, as does Biserrula (Casbah). The role of these species in managing mites has not yet been determined.

Effect on non-target invertebrates

TIMERITE® targets only RLEM. Spraying on the TIMERITE® predicted date during spring provides significant control of RLEM but has little effect on non-target invertebrates, both pest and beneficial, during the following autumn.

There is no evidence of other pests increasing in numbers to fill the gap left by controlling RLEM and so becoming major pests.

Researchers have assessed the effect of TIMERITE® on non-target invertebrates at 35 demonstration sites in Western Australia, South Australia, Victoria and southern New South Wales. At these sites during autumn, RLEM made up 87 per cent of the invertebrates sampled, followed by lucerne flea and blue oat mite at about five per cent each.

The average control of RLEM across the trial sites that received a spring spray was 97 per cent during 1999 and 96 per cent during 2000. Results showed that other pest species were not effectively controlled nor were predatory mites affected.

Control of non-target invertebrates

Species	Percentage control June 1999	Percentage control June 2000	Control during following autumn
Redlegged earth mite	97	96	Highly effective
Blue oat mite	42	59	Partial
Lucerne flea	74	37	Partial
Aphids	-25	-15	Not effective
Bryobia mite	-6	67	Not effective
Tyrophagous mite	59	41	Not effective
Pasture snout mite	39	0.5	Not effective

- **TIMERITE® does not effectively control other pasture pests the following autumn.**
- **No evidence that populations of other pests increased to fill the gap left when RLEM were controlled.**
- **Predatory mite numbers the following autumn were not affected by a spring spray.**

TIMERITE® in tall pastures

Trials were carried out in both short pastures (where FOO was less than 3,000 kgDM/ha) and tall pastures (where FOO was more than 6,000 kg/DM/ha) on Jo Felber's property at Badgingarra, Western Australia. Before spraying, mite populations were much higher in the tall pasture (96,000 mites/m^2) than the short pasture (24,000 mites/m^2).

The label rate of Le-mat® (100 ml/ha) was applied in one area of each paddock, while 200ml/ha (registered rate for aphids) was applied in a second area.

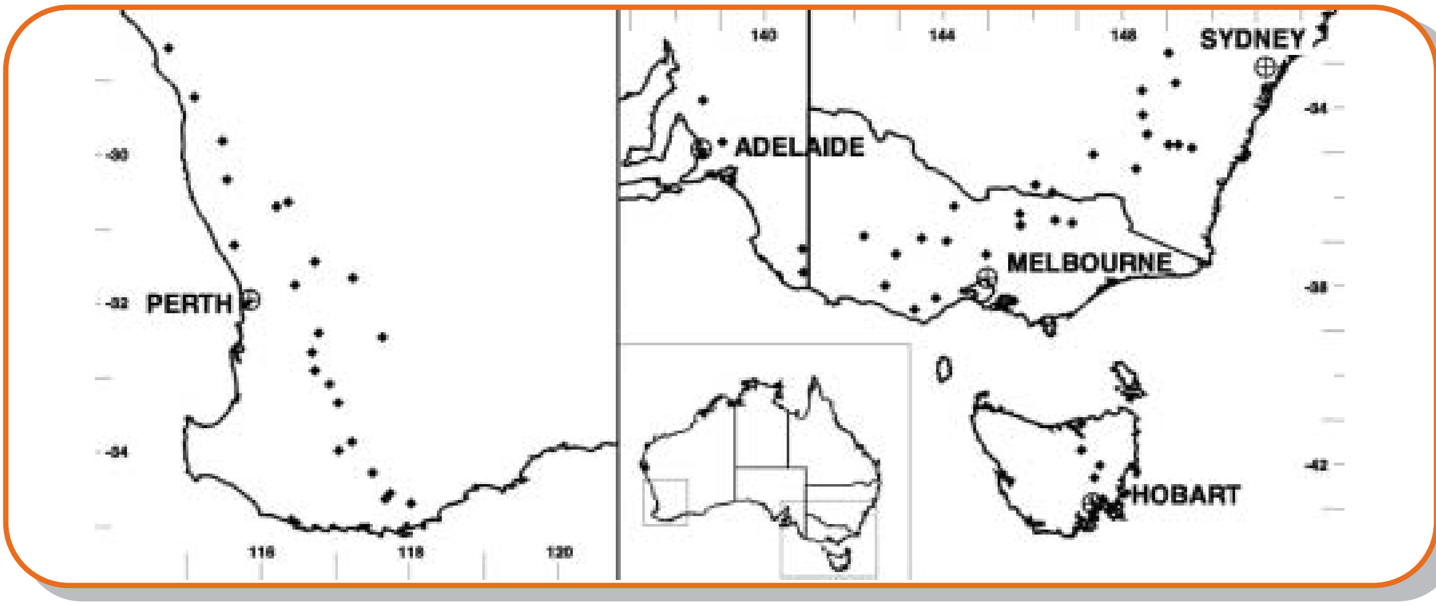
RLEM control two weeks after spraying averaged 99 per cent across the short and tall pastures. Although control was high, RLEM populations surviving the spray were higher in the tall pasture (804 mites/m^2) than short pasture (351 mites/m^2), probably because RLEM numbers before spraying were so much higher in the tall pasture.

There was little difference in the effectiveness of the chemical applied at the low and high rate with 99.1 per cent control in pasture sprayed with 100 ml/ha and 98.8 per cent in pasture sprayed with 200 ml/ha. But at the lower rate, numbers surviving were higher in tall (1025 mites/m^2) than short pastures (144 mites/m^2).

Jo Felber spraying a tall pasture paddock.

- **Using TIMERITE®, RLEM control is virtually as effective in tall pastures as short pastures.**

Demonstrated benefits of using TIMERITE®



60 sites were set up on farms across southern Australia to demonstrate the benefits of Timerite®.

Between 1997 and 2003, a total of 60 trial sites were set up on farms in Western Australia, South Australia, Victoria, New South Wales and Tasmania to quantify the benefits of spraying mites on the optimum date predicted from the TIMERITE® model. An area of pasture of at least four hectares was selected at each of the trial sites.

Mites were sprayed on the predicted date at each farm by the farmers, using their own equipment and the insecticide of their choice.

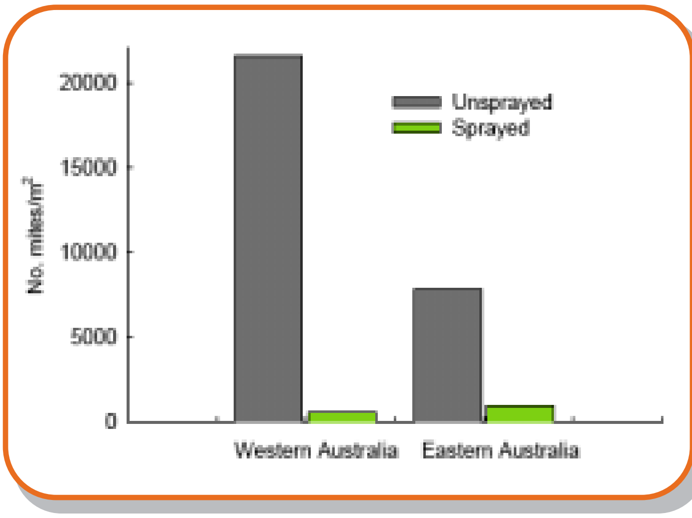
Bayer Australia Ltd provided Le-mat® for all the sites, and many farmers used this compound. An adjacent area of pasture was left unsprayed.

RLEM control in the following autumn

These farmer demonstrations sites were used to determine how well the TIMERITE® package provided RLEM control and to quantify some benefits. Over the eight years of trials, the average number of mites in spring just prior to spraying was over 34,000/m^2 in Western Australia and 20,000/m^2 in eastern Australia. Populations averaged less than 1,000/m^2 the following autumn as a result of using TIMERITE®

In Western Australia, the following autumn there were 21,569 mites/m^2 in the unsprayed plots and the single spray in the previous spring gave 550 mites/m^2 in the sprayed plots (average 97 per cent control on 20 farms).

In eastern Australia, the following autumn there were just under 8,000 mites/m^2 in the unsprayed plots and the single spray in the previous spring gave 919 mites/m^2 in the sprayed plots (average 88 per cent control on 38 farms).



Reduction in mite numbers the following autumn.

Reduction in mite populations

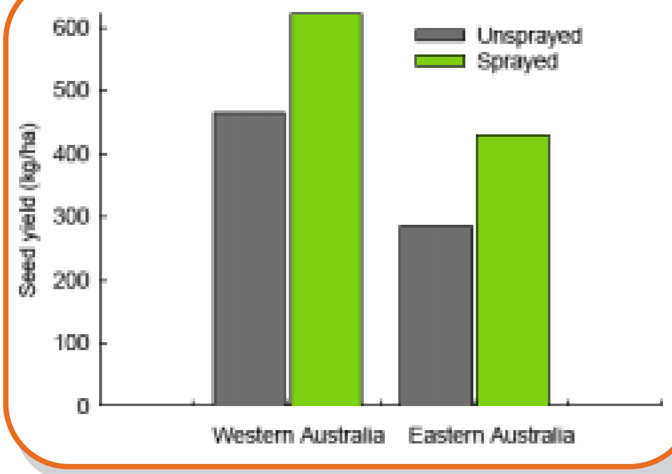
- Western Australia 97% reduction
- Eastern Australia 88% reduction

Increase in subterranean clover seed yield

Total pasture production is difficult to measure in the presence of sheep. One good predictor of the carrying capacity of pastures is the density of clover in the pasture. To quantify the benefits of controlling RLEM it was decided to use density of clover seedlings as the measure.

Subterranean clover seed yield at sites in Western Australia was 464 kg/ha in the unsprayed plots and the benefit from spraying was an additional 157 kg/ha (34 per cent increase).

In eastern Australia, the seed yield was 285 kg/ha and the benefit from spraying was an additional 145 kg/ha (51 per cent increase).



Increase in subterranean clover seed.

Clover seed yield increase

- Western Australia +157kg/ha (34 per cent increase)
- Eastern Australia +145kg/ha (51 per cent increase)

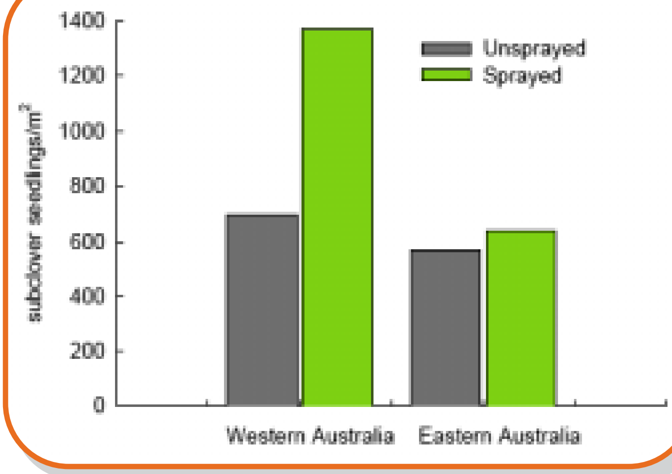
The size of the benefits varies considerably between sites, reflecting the fact that many factors other than mites feeding in the spring are important in determining seed yield. At half the sites the benefit was more than 100kg seed/ha.

Increase in subterranean clover seedlings the following autumn

Increases in subterranean clover density in autumn after a single spray on the TIMERITE® date in the previous spring gave good average benefits, but not all farmers got the same level of benefit.

In Western Australia, the following autumn there were 697 clover seedlings/m² in the unsprayed plots and 1,371 seedlings/m² in the sprayed plots (a 97 per cent increase at the 20 trial sites).

In the east, the benefits were lower. There were 566 subclover seedlings/m² in the unsprayed plots and the single spray in the previous spring gave a 13 per cent increase with an average of 640 seedlings/m² counted in the sprayed plots at the 38 trial sites.



Increase in subterranean clover seedlings the following autumn.

Clover seedling increase

- Western Australia +674/m² (97 per cent increase)
- Eastern Australia +74/m² (13 per cent increase)

What have farmers already using TIMERITE® said?

Charles deFegely, Ararat, Victoria

Victorian woolgrower Charles deFegely believes the TIMERITE® model for spraying RLEM has controlled populations in his Ararat pastures.

RLEM have caused problems for Victorian woolgrowers during spring where subclover pastures have been damaged, particularly through seed set at the end of spring leaving paddocks with low clover stands. The worst effects of the mites have been experienced during autumn.

As a woolgrowers advisory group member, Charles was instrumental in setting up 10 sites in western and north-eastern Victoria for the CSIRO spraying trials. With subclover being the 'engine room of wool growing', participants were enthusiastic about a program that would effectively control mites in one application.

Before spraying was carried out, the Victorian sites averaged more than 24,000 mites/m^2. After spraying on the predicted date during spring, farmers saw an average 90 per cent reduction rate.

Emerging subclover seedlings also increased by 55 per cent the following autumn. Seed yield increased 32 per cent from 181 kg/ha in the unsprayed paddocks to 214 kg/ha in the spring sprayed paddocks. The result would be that sheep would have a better pasture to eat.

Charles and Liz deFegely discuss the use of TIMERITE® on their Ararat property with James Ridsdill-Smith from CSIRO and John Seidel from Bayer Australia.

Tony Piggin, Corowa, New South Wales

An integrated pest management strategy is the key to including vulnerable crops such as lupins and canola in rotations, according to Tony Piggin of Corowa.

Managing destructive insect pests is vital for Tony who produces certified pasture seed, mixed crops and prime lambs on his 430 ha property. Tony said RLEM had been a major problem on his property and the TIMERITE® trial could be crucial to managing both the pest and the threat of insecticide resistance.

Mite numbers measured during autumn 1999 were 3,901/m^2 on the unsprayed plot compared with 341/m^2 on the sprayed area. A 61 per cent increase in seedling numbers was measured on the sprayed plot after spring control.

Tony currently uses a pre-planting autumn spray of Le-mat® (100mL/ha) or dimethoate in the cropping phase plus perimeter sprays of endosulfan, particularly in RLEM susceptible crops such as canola or lupins. In the pasture phase he will use an autumn application if required or apply insecticide in spring when spray topping.

Tony believes if he can control RLEM with one pass at the right time during spring instead of two or three applications of chemical such as dimethoate at a rate of 70–80 ml/ha in autumn-winter the benefits would be significant.

The prime lamb enterprise also relies on effective RLEM control as pasture seedlings can be destroyed by mites, particularly if there is a late break in the season and mites are active earlier than germination. Tony has seen a marked difference in pastures on his own property where pest control is paramount compared with other properties where RLEM are uncontrolled.

Roger and Caroline Telfer, Darkan, Western Australia

Western Australian farmers Caroline and Roger Telfer from Darkan have boosted their wool and sheep meat income by $51/ha from an outlay of $10/ha in RLEM control including chemical and contracting costs.

Encouraged by TIMERITE® trial results, the Telfers have sprayed their entire farm for RLEM using the recommended spring spray date. They are confident extra pasture will boost carrying capacity on their 1,000 ha property by 1–2 DSE per winter grazed hectare.

The Telfers expect excellent returns from spraying once fleece weights and weaning percentages have been assessed. Roger suggested maximising RLEM control allowed for better pasture seed set and establishment because fewer mites hatched at the break of the autumn growing season after a single spring spray.

Total annual income

Total income ($)	Sprayed paddock	Control paddock
Net wool income	1,639	1,366
Net lamb income	2,962	2,381
RLEM spray @ $10/ha	-140	0
Total income (less spraying expenses)	4,461	3,747
Income ($/ha)	319	268

Source: Woolprose

Tony Guinness, Corrigin, Western Australia

Positive results from on-farm TIMERITE® trials have prompted Tony Guinness of Corrigin to adopt the RLEM control strategy across his property. Tony farms 1,900 ha in a mixed farming-wool growing operation that includes 800 ha of wheat and RLEM-susceptible canola.

During 1999 half of his pasture land, about 500 ha, was sprayed within four days of the TIMERITE® date with Le-mat or dimethoate at 100–120 mL/ha. Tony used a gooseneck boom spray towed by a four-wheel-drive vehicle.

He said at a cost of 70–80 cents/ha, dimethoate was a cost-effective option for controlling RLEM. Tony said the trial showed an amazing comparison in mite numbers, subclover seed banks and seedling density between the sprayed and unsprayed sites. He could visibly see the difference in clover density and seedling survival on the sprayed plot and was not surprised to find the figures showed a 39 per cent difference in seed yield between the two sites during 1998–1999.

During autumn 1999, following spring spraying, RLEM numbers were just 1.5 per cent of the unsprayed plot or 1,281 mites/m^2 compared with 83,957 mites/m^2.

Tony said this was a phenomenal response and was also impressed with the June 1999 subclover seedling count which measured 564 plants/m^2 on the sprayed plot compared with just 106 plants/m^2 on the unsprayed plot.

He said he could see he would cut more wool due to better clover stands and hopefully boost wheat and canola yields through better RLEM control.

Tony's insecticide bill has been higher under the TIMERITE® spring spray system but he said he was better off overall by preventing an autumn outbreak of RLEM.

Life history of the redlegged earth mite

RLEM is active in the cool wet months from May to November. During the winter, the mites pass through three generations on average, each lasting about eight weeks. When conditions are favourable the populations can increase rapidly, with peaks in autumn and/or spring.

In Western Australia over two years at Keysbrook in the coastal area, average RLEM density was 11,300 mites/m^2, whereas at Narrogin, with a lower rainfall average, density was half that at 6,400 mites/m^2.

The first two winter generations of mites lay eggs singly, usually on the under surface of the leaf of the plants.

Abundance of these can be high and at the two sites mentioned above, average egg populations were 8,500 eggs/m^2 at Keysbrook and 2,900 eggs/m^2 at Narrogin.

Chemical sprays do not kill mite eggs, and it is easy to see, with numbers this high, that sprays which kill active mites may not control the population if high numbers of eggs hatch out after spraying.

For the six summer months of the year RLEM avoid the hot dry conditions by developing a resting stage which is impervious to heat and drought. They do this by producing diapausing eggs over summer.

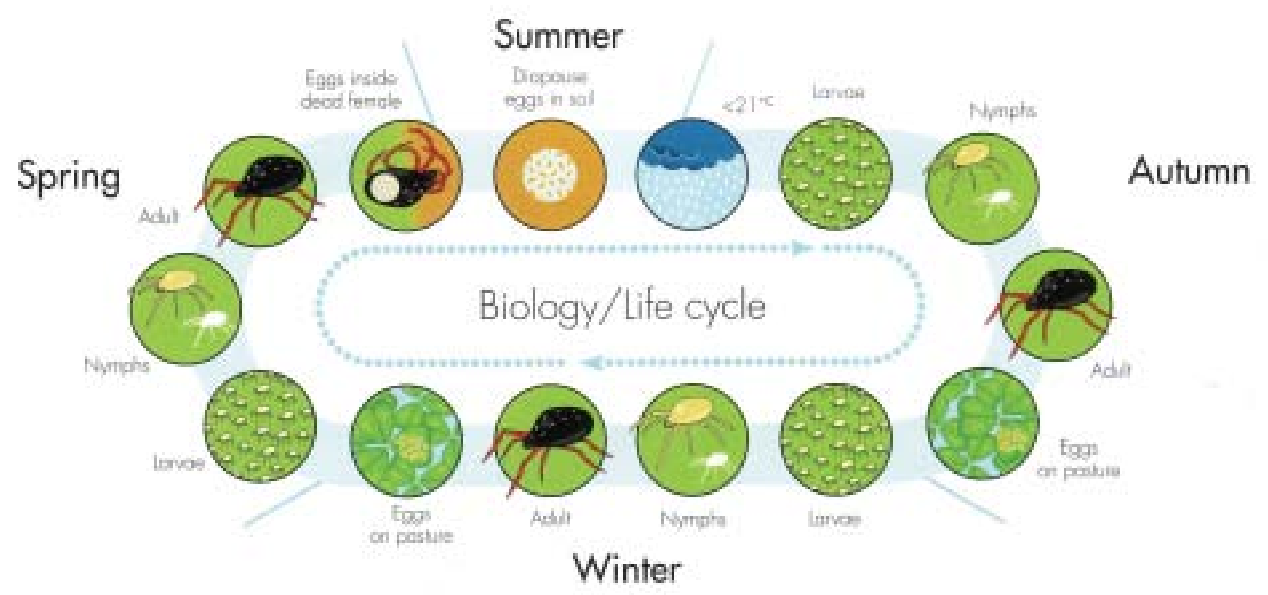
Very high numbers of over-summering eggs are found on the soil surface. Over 100,000 eggs/m^2 may be waiting to emerge in the following autumn, providing a threat to the germinating pasture or crops.

Survival of these eggs over the summer is variable, meaning that it is not easy to predict the risk long before the mites emerge. They hatch into larvae, and the mites develop through three nymphal stages into adults.

A summer vacation

In the spring the mites stop laying eggs on plants and start to produce diapause or over-summering eggs which are retained in the body. The mites die and the eggs spend the summer in the cadavers (corpses) of adult female mites on the soil surface, where they look like grains of sand.

These eggs are different from the winter eggs and are impervious to heat and to dehydration. They normally do not hatch for six months. The resting stage can only be broken after a period of very hot weather, and then at a later date the mites emerge after exposure to a combination of cooler weather and moisture.



Diapause eggs are retained in the adult female cadavers and sit in the soil over summer.

Eggs will hatch in the autumn when the mean daily maximum temperature is below 20.5°c for a week to 10 days combined with a significant rainfall event.

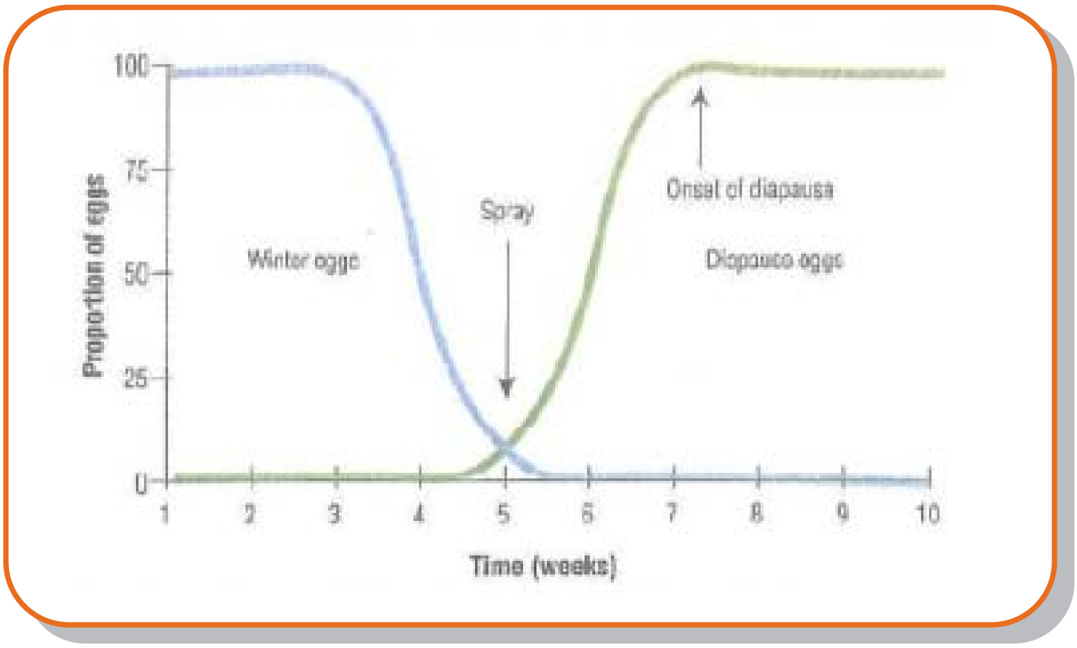
In the field 88 per cent of the variation in date of emergence in autumn was explained by weekly temperature.

The factors causing the onset of diapause in spring were not well understood before this research program was undertaken. One reason for this is that mites can remain active for several weeks in spring after they have started to produce diapause eggs. The presence of mites is therefore no guide to the presence of diapause eggs inside them.

To determine the mechanisms involved, mites were collected weekly in the spring from a number of sites in south western Australia over several years. From each site, each week, the proportion of eggs that were diapause eggs in 100 females was determined by dissecting the mites, and this was plotted against time. The date at which 90 per cent of all eggs at a site were diapause eggs was estimated. These dates were very similar at each site across years, but varied between sites, and appeared to be associated with the rising temperatures.

Mite eggs are not killed by insecticides

- **The optimum time to control RLEM is after winter eggs have been laid on the pasture but prior to the development of diapause eggs.**
- **This prevents the production of the over-summering generation of eggs, meaning no mites hatching out the following autumn to feed on susceptible germinating seedlings.**
- **If spraying is carried out too early, winter eggs will still be present and these will not be killed by the sprays (unless using a residual chemical).**
- **If spraying is carried out too late, the females will have developed some diapause eggs and, even though the female is killed by the spray, the eggs inside her will survive and hatch out the following autumn.**



RLEM production of winter and diapause eggs.

Frequently asked questions

Chemical control

Is there any evidence of mite resistance to chemicals?

No, however blue oat mite and RLEM have the potential to develop tolerance to chemicals. The best general strategy is to spray less frequently and to use different compounds instead of the same one each time.

Boom spray versus misters - which is best?

This probably depends on weather conditions at the time of spraying and operator skill. Boom sprays are preferred but misters can still achieve good control. Misters may sometimes be more practical if large areas need to be sprayed in short periods of time or if there are rocky areas or trees within the paddock.

RLEM control with spray topping?

Generally spray topping is a few weeks too late and the females will already have produced diapause eggs. The active mites will be killed but the diapause eggs within the female will survive, sit in the soil over summer and hatch out the following autumn.

Is border spraying effective?

Research shows mite damage is generally more severe around the edges of crops as mites invade from neighbouring pastures, fence lines or road verges. A border spray of 5-10 metres should be adequate to exclude mites from susceptible crops.

If I miss my spray date, should I still spray?

If it is less than two weeks after the optimum spray date, some benefits will still be achieved. Benefits will decrease with every extra day after the optimum date. By controlling mites after the optimum date some increase in clover seed set will result as the mites will not be feeding on the clover flowers.

By spraying after the optimum date, carry over control of mites the following autumn will also be reduced (see page 6). For example, if spraying is carried out one week late, approximately 50 per cent of the eggs inside the female mites will be diapause eggs and at two weeks late the percentage will be around 90 per cent. These eggs will not be killed and will hatch out the following autumn.

Spraying a short pasture paddock.

Management

Apart from chemicals, what other means of control can be implemented?

Evidence shows that grazing management affects mite abundance. Research by Mike Grimm at Agriculture Western Australia shows heavily grazed pastures normally carry lower mite populations.

Do mites compete with stock for food?

Yes. On an energy basis it is estimated 12,000 mites/m^2 is equivalent to one dry sheep equivalent per hectare (one DSE/ha).

Does burning stubble or pasture kill diapause eggs?

Late summer burning of an infested pasture or stubble can reduce numbers of mites hatching out the following autumn. But a very hot burn is essential to obtain a uniform kill and it is unlikely that the benefit derived from the burning will offset the loss of dry feed.

Biology

Do RLEM have any predators?

A number of general predators are found in pastures. One species of predatory mite, the French anystis mite was deliberately introduced in the early 1990s to reduce RLEM populations. It is established, but RLEM are still causing damage. There has recently been another attempt to find biological control agents from South Africa, without success.

How do they reproduce?

Male RLEM produce a fine webbing, usually on the soil surface, on which they deposit sperm packages. Female mites then pick up these packages and fertilise their eggs.

What conditions are most favourable for RLEM?

Mites are active typically from May until October. Peak numbers of mites are usually recorded in autumn and/or spring. Very cold weather and heavy rainfall in midwinter tend to be associated with low mite numbers.

How long do mites live?

Mites complete three generations a year, each generation lasting 8-10 weeks. Eggs hatch about 10 days after being laid, then pass through a larval stage and three nymphal stages before becoming adults. (See life cycle on page 14).

Are RLEM native to Australia?

No, they were accidentally introduced to Australia in 1917 in Western Australia. They probably arrived from the Cape region of South Africa in the ballast of ships. There are five species of RLEM in Australia; only one of these is a major pest.

How far can mites move?

Mites can move by walking up to 50 metres into neighbouring crops or pastures over a season. Diapause bodies containing eggs can also be blown with top soil over much greater distances in the summer period.

What triggers mites to hatch in autumn?

RLEM emerge from over-summering eggs when the mean daily maximum temperature falls below 20.5°c for one week combined with significant rainfall.

How many eggs does a mite produce?

Mites lay eggs over a period of time. Their fecundity is probably between 10 and 50 eggs per female. Diapausing female mites produce and retain on average 40 eggs but up to 100 eggs per female mite have been recorded.

Where do mites lay their eggs?

Winter eggs are usually laid singly on the under surface of leaves but eggs can also be found on stems, leaf litter or on the soil. Eggs are less than 0.2mm in length and bright orange in colour.

How do the mites feed?

When feeding, the RLEM braces its legs firmly on the upper surface of a leaf using the claws on its feet, and then it pierces the surface cells and sucks up the sap. The cell collapses and damage can be seen by the characteristic silvering of the leaf.

Photos of sprayed and unsprayed demonstration farm site

Photos comparing a site sprayed with Le-mat® supplied by Bayer Australia Limited with an adjacent unsprayed site on a property at Cranbrook, Western Australia.

Acknowledgement

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For more information

Call the AWI Helpline on 1800 070 099
or visit www.timerite.com.au

Australian Wool Innovation Limited
ABN 12 095 165 558
Level 5, 16-20 Barrack Street
Sydney NSW 2000
GPO Box 4177 Sydney 2001
www.wool.com.au

CSIRO

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