TIMERITE®
Information package

FOR THE CONTROL OF REDLEGGED EARTH MITES

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CSIRO

awi Australian Wool Innovation Limited

Contents

Introduction to TIMERITE®

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

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 minimal eggs present.

This is the ideal time to spray because eggs are impervious to sprays, and so the whole population is vulnerable. However control is not 100% effective and very low populations survive to 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 98 per cent RLEM control in autumn eight months later at farms in the west of Australia and 93 per cent at farms in the east. The benefits measured included an increase in subterranean clover seed yield in summer which was 60 per cent in the west; but no increase in the east. There was an increase in the numbers of subterranean clover seedlings the following autumn, which was 113 per cent in the west and 40 per cent in the east.

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

RLEM on clover trifoliate stem

How to use TIMERITE®

Decision on spraying

This package is for spraying RLEM in spring. You do not need to have very high mite numbers to consider spraying. But if you cannot see evidence of mites or mite damage to clover in your pasture it is probably not worth spraying. TIMERITE® is available for all areas of southern Australia where RLEM is found.

The specific spray date for your property

You can obtain the spray date for your property from the Australian Wool Innovation Limited website (www.timerite.com.au) or the AWI Helpline 1800 070 099

You will need a named place on or very close (less than 10km) to the paddock you wish to spray that can be looked up on a map. An alternative is to use a Differential Global Positioning System (DGPS) to find out the exact latitude and longitude of the paddock you are to spray (to the nearest minute).

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; or on the fridge).

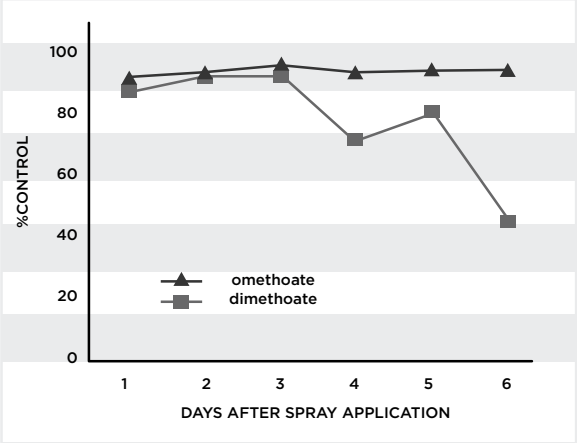
Timing of spraying

Spray as close to the date as possible. If it is not possible to spray on the TIMERITE® 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. Eggs laid prior to the TIMERITE® spray being applied may take up to 10 days to hatch. Contact insecticides will not be effective in controlling these hatchings.

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.

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 mite populations are very high in spring, the per cent control is high but more mites survive to the following autumn. When planting a high value crop, like canola, with a low damage threshold, also use a seed dressing to suppress damage from surviving RLEM.

Write your spray date here

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

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Identifying the redlegged mite

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

RLEM are small mites: the adults are about 1mm long with black bodies and red legs. They spend most of their time on the soil surface, moving up on to 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 also about 1mm 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.

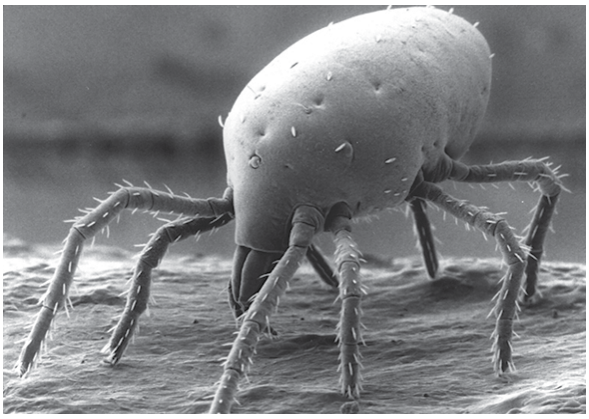
Blue oat mites are generally seen feeding singly or in small groups, whereas RLEM generally feed in larger groups. Damage caused by blue oat mites appears the same as RLEM, however blue oat mites feed more on grasses and cereals and RLEM feed more on the legume and broadleaved plants in pastures.

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 79 per cent of earth mites in eastern Australia and 94 per cent in Western Australia.

Between 1998 and 2003 average RLEM populations on farms in western Australia were 22,000 mites/m^2 and in eastern Australia were 14,000 mites/m^2. At the same farms there were 580 blue oat mites/m^2 in both regions.



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

Relative abundance of the different species can vary during the season and between seasons. In northern New South Wales, blue oat mite is the dominant species 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.

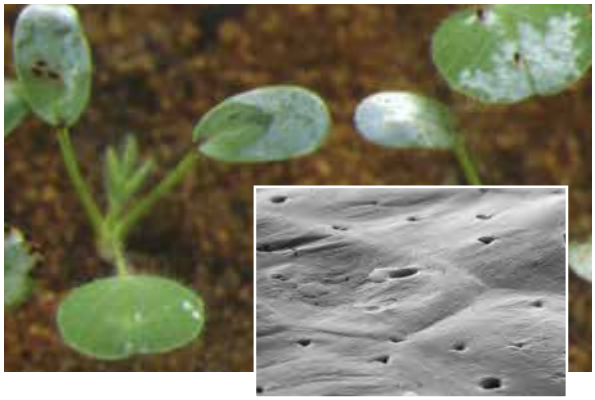
Bryobla mite

Balaustium mite

Redlegged earth mites and pasture damage

When feeding, RLEM pierce the cells on the upper surface of the leaf before sucking out the sap causing the cell to collapse.

RLEM have very short mouthparts and feeding is restricted to 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 and inset showing SEM of damage to the leaf surface.

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

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.

However, 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 even after senescence.

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

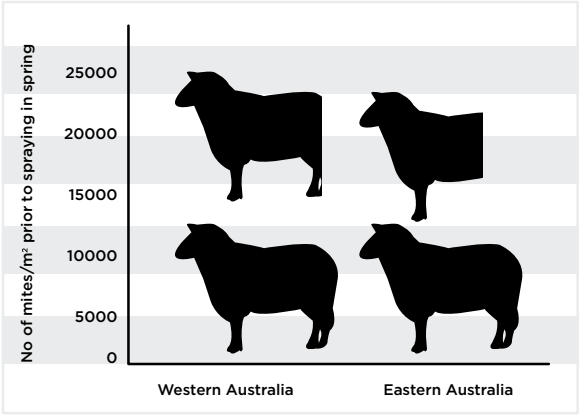
The economics of pasture damage

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).

We measured mite densities in pasture in spring in excess of 20,000/m^2 which will lead to competition with sheep for the pasture resource.

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

Throughout the trials mite populations prior to spraying in spring were equivalent to nearly two DSE/ha.



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

Research consistently shows control of mites in pastures and crops leads to increased financial returns. The largest impact is from loss of pasture seedlings, but controlling RLEM in pastures can also result in increased pasture growth in spring when 40 per cent of the annual production occurs.

Likewise, infestations in crops can be costly, particularly in high value, susceptible plantings such as canola and legume/pulse crops.

When RLEM are controlled, farmers need to change their management to make use of any extra feed produced 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.

Spraying

Spray timing – the window of opportunity

Increasing spray flexibility

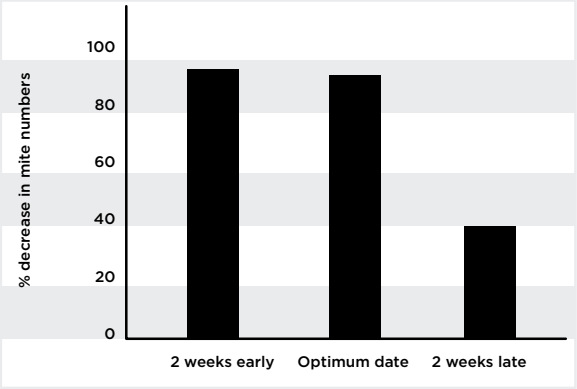
TIMERITE® provides farmers with a single spray date for optimum control of RLEM the following autumn.

However, it is not always possible to spray on this date and so we investigated the effects of spraying two weeks early or two weeks late on RLEM control the following autumn. If spraying on the optimum 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

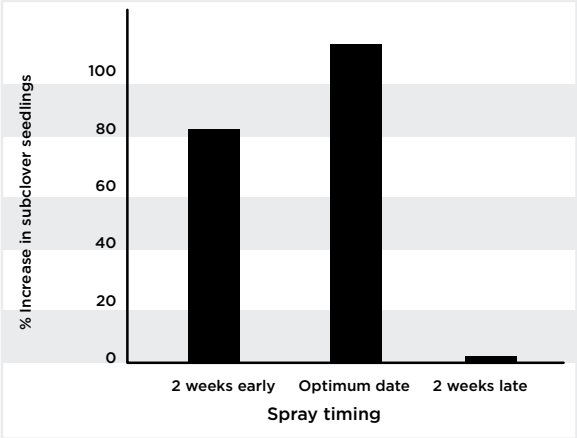
On three farms in Western Australia, with subclover pastures grazed by sheep the effects of controlling RLEM on the optimum TIMERITE® date were compared with spraying on dates two weeks before or two weeks after this date.

The results showed that RLEM control the following autumn after spraying was high at sites sprayed two weeks early (96 per cent) and on the optimum date (93 per cent), but poor when sprayed two weeks late (40 per cent).



Percentage decrease in mite numbers the following autumn

The autumn seedling data were variable but showed the same pattern. The average percentage increase in seedling numbers across all sites was high in treatments sprayed two weeks early (83 per cent) and on the optimum date (119 per cent) but low when sprayed two weeks late (6 per cent).



Percentage increase in subclover seedlings the following autumn.

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 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 results in poor RLEM 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 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

Alkaline hydrolysis can cause quicker degradation of some insecticides when the water used as the carrier has a high pH and/or iron content. 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 from 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 dry matter per hectare (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 resistance

The use of chemicals to target RLEM in grain crops and pastures continues to grow in Australia, placing strong selection pressure for the development of resistance. There are widespread and very high-levels of resistance to synthetic pyrethroids (SPs) across the Western Australian grain belt. Localised (moderate levels) of resistance to organophosphates (OPs) have recently been discovered in multiple WA properties, including to omethoate and chlorpyrifos. At present, there is no confirmed resistance to any insecticide outside of WA. Growers need to understand how to minimise further development of resistance.

Dr Paul Umina (University of Melbourne), Svetlana Micic (DAFWA) and Dr Owain Edwards (CSIRO) are heading up a group to understand resistance in RLEM and find ways to manage it. They recommend avoiding the repeated use of insecticides from the same chemical groups when targeting RLEM or other pests, as this will decrease selection pressure for resistance development. Growers are also urged to adopt integrated pest management strategies to minimise the risk of the resistance developing and spreading more widely. This includes the strategic use of seed dressings in new sowings of pastures and crops, controlling broad leaved weeds, targeted grazing of pastures and the selection of subclover varieties expressing seedling resistance to RLEM.

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

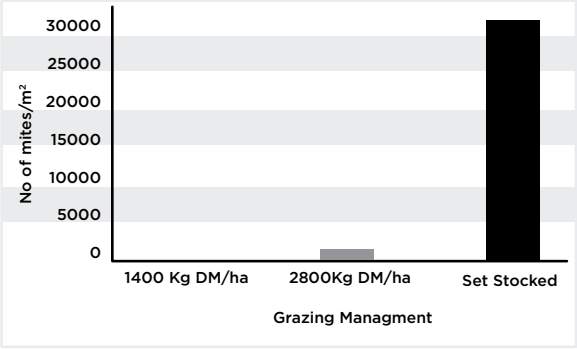
A number of generalist predators are present in pastures in southern Australia that feed on RLEM. These include several predatory mites but they have a wide range of prey and are not specialised to feed on RLEM.

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 DAFWA 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 in spring



(Grimm et al 1994)

Weeds

RLEM are associated with broad leaved weeds in pastures. However, a CSIRO study has shown that mites shelter under capeweed, while they feed mainly on subclover plants. Tall patches in pastures provide a good habitat for the mites.

Resistant varieties

Over 1000 accessions of subclovers were screened for cotyledon resistance to RLEM and resistance was detected in 18 of these. The mechanisms were identified but they were deficient in one or more agronomic attributes. A breeding program was undertaken by plant breeders in DAFWA to incorporate seedling resistance into adapted varieties. Varieties now released with RLEM resistance are Bindoon, Narrikup, and Rosabrook. Of the alternative pasture legumes released 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.

Prima Gland Clover

Casbah biserrula

Effect on non-target invertebrates

At sites on farms in the west RLEM made up 94 per cent of the invertebrates sampled, while lucerne flea and blue oat mite were 3 per cent. In the east RLEM made up 79 per cent of the invertebrates sampled blue oat mite 12 per cent and lucerne flea 9 per cent.

TIMERITE® does not effectively control other pests the following autumn.

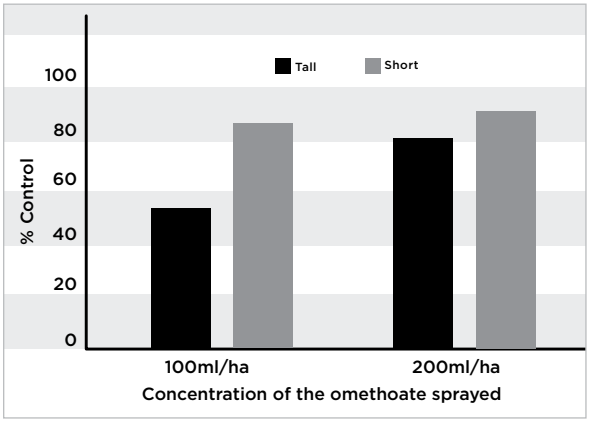
TIMERITE® in tall pastures

To determine if TIMERITE® works as well in tall pastures we carried out trials at Badgingarra, WA with Jo Felber in pastures that were short (where FOO was less than 3,000 kg DM/ha) and tall (where FOO was more than 6,000 kg DM/ha) At the time of spraying RLEM populations were much higher in the tall pasture (72,000 mites/m^2) than the short pasture (24,000 mites/m^2).

The label rate of omethoate (100 mL/ha) was applied in one area of each paddock, while 200mL/ha (registered rate for aphids) was applied in a second area. Two weeks after spraying mite control averaged 97 per cent across the short and tall pastures, with 100mL or 200mL application omethoate. The diapause date did not change with tall pastures, but on the spray date there were 12,966 winter eggs/m^2 in the tall pasture – which was five times more than the 2,593 mite winter eggs/m^2 in the short pasture.

The following autumn RLEM control in short pasture was slightly greater with 200ml (92 per cent) than 100mL (86 per cent) omethoate applied, whereas in the tall pasture RLEM control was considerably lower with 100ml (55 per cent) than 200mL (81 per cent). To improve control in tall pasture in spring it seems better to increase the chemical dose or possibly to spray two weeks before the optimum date as well as on the optimum date to further reduce the high mite numbers.

- **Using TIMERITE®, the proportion of RLEM populations controlled is virtually the same in tall and short pastures.**
- **The higher mite populations in tall pasture result in more mite survivors the following autumn.**
- **These are better controlled in tall pastures by spraying omethoate in spring at 200mL rather than 100mL.**



% Control of mites the following autumn in tall and short pasture with 100mL/ha and 200mL/ha omethoate.

Jo Felber spraying a short pasture paddock FOO < 3,000kg DM/ha.

Jo Felber spraying a tall pasture paddock FOO > 6,000kg DM/ha.

Demonstrated benefits of using TIMERITE®

RLEM control in the following autumn

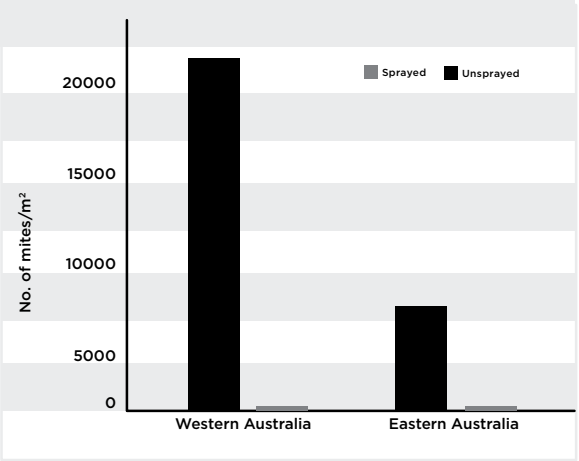
The model to predict the onset of summer diapause was developed on data from 60 sites on farms across southern Australia

Between 1997 and 2003, a total of 18 demonstration sites were set up on farms in the west (Western Australia) and 19 sites in the east (South Australia, Victoria and New South Wales) 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, most farmers used this compound, and the remainder used dimethoate. An adjacent area of pasture was left unsprayed.

Farmers with researchers at demonstration sites in Victoria

These farmer demonstration sites were used to determine how well the TIMERITE® package provided RLEM control in autumn and to measure their impact on pasture production. The average RLEM population in spring in the unsprayed treatment in the west was 23,439 mites/m^2 and in the east was 21,775 mites/m^2. The following autumn, the average RLEM population in the unsprayed treatment in the west was 22,889 mites/m^2 and in the east 6,775 mites/m^2. Mite numbers fell three fold over summer at farms in the east probably due to poor survival of the eggs in the soil with summer rainfall. However with the spring spray treatment the number of RLEM present in the sprayed treatment in autumn was 552 in the west and 502 in the east.



Reduction in mite numbers the following autumn.

Reduction in mite populations in autumn

- **Western Australia 97% reduction**
- **Eastern Australia 93% reduction**

Increase in subterranean clover seed yield

From the first trials of TIMERITE® in the west we observed big differences in numbers of seedlings where mites were controlled (see p19). Methods were developed to measure changes in subclover seedling density in pastures grazed by sheep. Subclover seedlings were counted in autumn 3-4 weeks after germination. In addition subclover seed yield was measured in summer by sieving seed from soil cores.

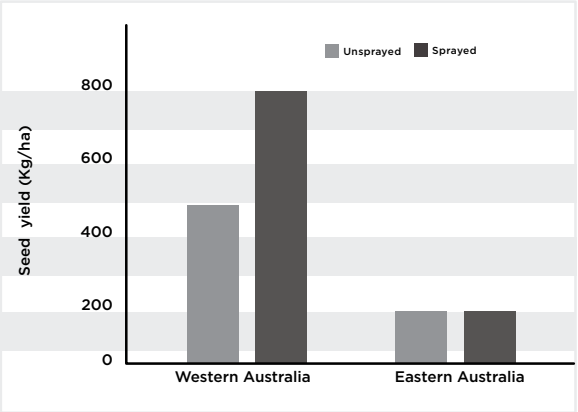
Subclover seed yield was greater at sites in the west than the east. With a spring spray seed yield at sites in the west increased from 504 kg/ha to 805 kg/ha (60 per cent) but in the east there was no consistent increase in seed yield with a spring spray treatment and mean yield was 214 kg/ha.

Increase in subterranean clover seedlings the following autumn

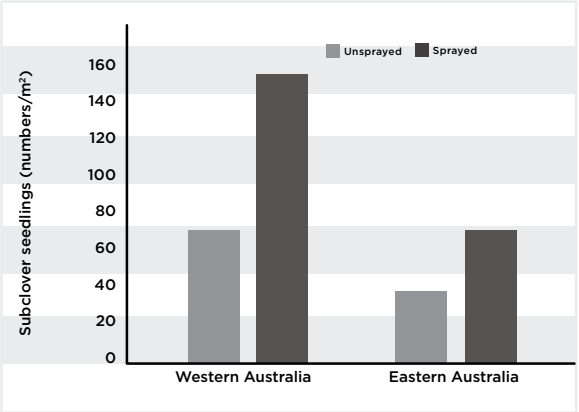
Subclover seedling density increased in autumn after a single spray on the TIMERITE® date in the previous spring.

At sites in the west, subclover seedling density was 150/m^2 in the sprayed treatment and 70 seedlings/m^2 in the unsprayed treatment (113 per cent increase). At sites in the east seedling density was 50/m^2 in the unsprayed treatment and 70 seedlings/m^2 in the unsprayed treatment (40 per cent increase).

The method used to count seedlings was developed in the west where a clear break of season made it easier to determine the time of germination. In the east there was frequently a less defined break of season and germination. This may partly explain the clearer differences in density seen in the west. Further work is needed to develop better ways to measure the impact of controlling RLEM in the east.



Increase in subclover seed yield following a spring spray.



Increase in subclover seedlings in autumn following a spring spray.

Subclover seed yield increase

- **In the west 301kg more seed/ha (113 per cent increase)**
- **In the east no significant difference**

Subclover seedling increase

- **In the west 80 more seedlings/m^2 (113 per cent increase)**
- **In the east 20 more seedlings/m^2 (40 per cent increase)**

What have farmers already using TIMERITE® said?

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.

Prior to participating in the TIMERITE ® trial, Tony used 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 used an autumn application if required or applied insecticide in spring when spray topping.

Tony now believes 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 and the benefits are significant.

However, Tony does not spray every paddock, every year. He prefers to use a targeted approach, selecting which paddocks to spray based on several factors. If a pasture will be going into a susceptible crop the next year, if sowing new pasture or if mite numbers are high, Tony is vigilant with his use of TIMERITE®. However, he says if we don't have a problem we just don't spray.

Tony Piggin.

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.

Brad Wooldridge
Arthur River and Kalgan, WA

"Warialda" was one of the first TIMERITE® trial sites in WA, which meant the Wooldridges were at the forefront of the research. Brad believes that one of the highlights of the TIMERITE® work was having entomologists in the field who could explain the implications of pest management and the importance of a variety of control methods. This message has stood the test of time.

Brad says that the initial work came at a time when there was no real control strategy for RLEM and the TIMERITE® strategy allowed a control method that resulted in a huge increase in the clover seed set. With more clover in pastures we were then able to implement other strategies.

Brad runs 1,900 composite ewes and a small Suffolk stud on 380 ha of pasture at Arthur River and Kalgan and crops 300 ha at Arthur River. All ewes lamb in July.

Brad's use of TIMERITE® and his pest management strategies have seen many phases since he first participated in the trials in 1997. After using TIMERITE® for several years in the early days, Brad's RLEM populations were reduced to a manageable level and spraying was not carried out every year.

"We got on top of the earth mites so we switched from TIMERITE® to using a winter control program of two sprays a month apart. The winter spraying program turned out to be a nightmare – it involved twice as much spraying, it was hard to get on wet paddocks and the weather wasn't always ideal. We also had to destock paddocks at a time when we were short of feed to observe withholding periods and there was the added pressure to get crops sprayed.

"It made me realise just how good the TIMERITE® system is because it involves one spray, the weather is better, there's less pressure of paddock feed and the days are longer so you manage the work load."

In 2006, the need to rebuild a bank of clover seed depleted after a poor spring and two false autumn breaks was the deciding factor in Brad Wooldridge's plan to reuse the TIMERITE® program to control redlegged earth in spring.

Brad and Tracy Wooldridge.

"After two tough years we needed to give the clover that's remaining every chance to set seed," he says.

With the mites again at a manageable level, Brad has implemented an integrated pest management (IPM) system, utilising strategic spraying as required and grazing management. We trialled a new subclover variety, Losa, with RLEM tolerance in a CSIRO/Dept pasture trial with an additional pasture component by Heritage seeds. This trial was impacted by insecticide resistant mites and the value of a clover that withstood the impact of RLEM was very revealing. Losa stood up to the attack very well and went on to produce double the biomass of the industry benchmark variety even when sowed at half the rate. (The measurements were part of an MLA / UNE PRS project calibrating handheld NDVI readers to biomass).

"The dairy style rotational grazing has had a number of impacts, it has taken capeweed out of the pastures which is a major host plant for redlegs. The pastures are grazed hard then spelled. So a lot of redlegs are eaten and the rest find their habitat destroyed and struggle to survive. This grazing promotes a more prostrate clover, with more growth points, flower production and better seed set. Spring FOO is around 1t/ha post grazing, but grazings must be short and intense, otherwise stock productivity will be compromised."

With instances of RLEM resistance to synthetic pyrethroids and organophosphates occurring, Brad is now wary of spraying. “We find that the main control point for redlegs is now early in the season when we are deferring pastures prior to grazing. If there is a dry spell, then redlegs can really set a pasture back. Spraying at this time takes only a portion of the population and more are hatching, so the pressure on resistance to chemical control is greatly reduced.

“Surprisingly, the redleg chemical resistance in pastures has come from the cropping, where bifenthrin was used pre-emergence on canola and after a number of rotations, at least one population is now resistant to this group of chemicals. Brad has been working with Svetlana Micic at DAFWA to identify instances of resistance on his property.

Even though Brad is no longer using TIMERITE® as a whole farm approach to RLEM control at Arthur River, he says that it is an invaluable tool and will use it at the new property at Kalgan to increase the clover content from the existing stand prior to introducing new varieties.

Max Watts - Gnaring Park Wandering, WA

In my opinion, this is another example of scientists working closely with producers to develop and roll out a very successful program which has huge financial rewards for farmers. With the assistance of Celia Pavri of the CSIRO, we conducted a trial at our property, “Gnaring Park”, between spring 2008 and autumn 2010 using the TIMERITE® principles.

Our pastures were tightly grazed in the spring which does have an impact on the populations of mites affecting the pasture.

To my surprise the trial site had an increase in seed set, post TIMERITE® of 150% and another participant in a similar trial at Brookton had an increase in seed set of 250%.

We farm 4500ha in 5 separate blocks up to 45 kms apart, cropping 60% and run a self replacing merino flock which includes 5500 ewes for meat and wool production.

The TIMERITE® date is very specific for each property and always falls on the same date each year. Our rule-of-thumb for mite control is to monitor newly sown clover a month after the break, but generally after a long cropping phase numbers are low.

We re-seed 200-300 ha per year which is made up of Dalkeith clover (15 kg/ha) + Alosca Inoculant (10 kg/ha) after a long cropping phase. This is a big expense but we need to get back to full production as soon as possible.

Max Watts

In the spring we TIMERITE® these pastures to maximize the return on this investment. It is the cheapest clover I buy each year.

We make a practise of not spraying the total area at once, rather having a chequered pattern of spraying, similar to a cropping program. We are very concerned not to get resistance to any of the chemicals.

Ten days leading up to the TIMERITE® due date, we use Omethoate which is dearer and the last 3 days we use Dimethoate. The day after the due date we cease spraying and put the boom spray away.

We aim to treat newly sown clover in the 1st year to protect the germinating seedlings and we also spray pasture going into crop for the first time to reduce the mite numbers for the next year’s crop.

Life history of the redlegged earth mite

RLEM is active in the cool wet months from May to October. The mites pass through three generations a year, the winter generations each lasting about eight weeks. When conditions are warmer 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, on the under surface of leaves, on organic matter or on the soil surface.

Abundance of winter eggs can be high and at the two sites mentioned above, average 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 because up to half the population in winter is in the egg stage.

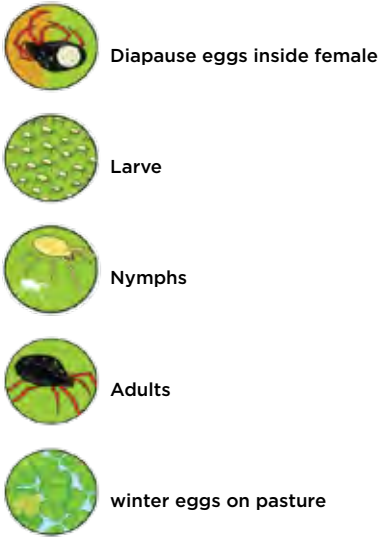
For the six summer months RLEM avoid the hot dry conditions in a resting egg stage which is impervious to heat and drought. They do this by producing diapausing eggs over summer.

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

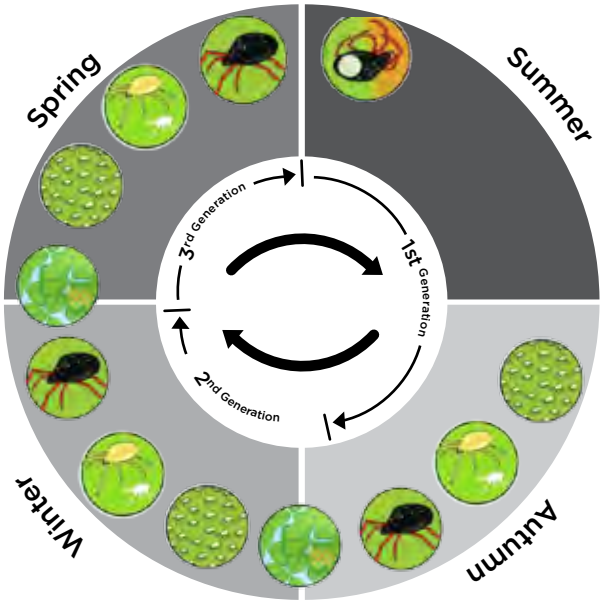
Survival of these eggs over the summer is variable so that it is not easy to predict the risk of a damaging population before the mites emerge. They hatch into larvae at the break of season in autumn, which develop through three nymphal stages into adults.

A summer vacation

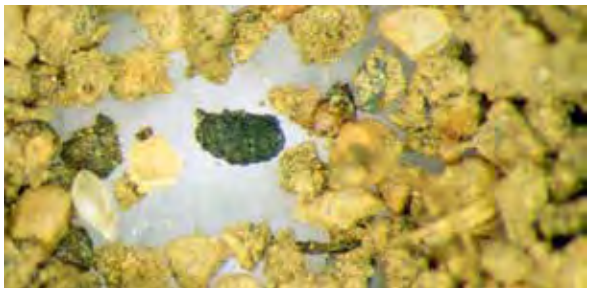
In the spring the mites stop laying eggs on plants and start to produce diapause or over-summering eggs which are retained in the body. The mites die and the eggs spend the summer in the cadavers (corpses) of adult female mites on the soil surface, where they look like grains of sand.



RLEM LIFE CYCLE



To determine when these diapause eggs are produced in spring, mites were collected weekly in the spring from nearly 60 sites across southern Australia. From each site, mites were dissected each week, and the proportion of eggs that were diapause eggs inside 100 females was determined and plotted against time. The date on 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. A model was developed to predict the onset of diapause across Australia; in spring 80% per cent of the time onset of diapause was predicted by daylength.



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

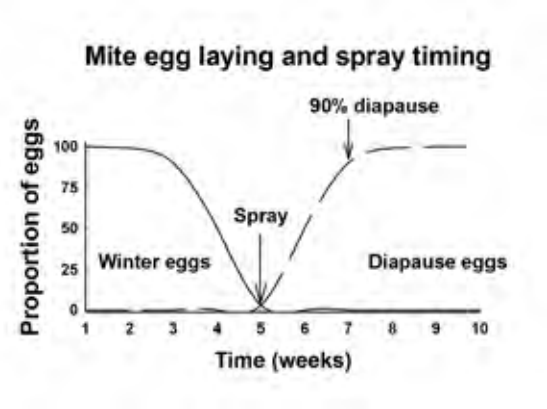
These eggs are different from the winter eggs and are impervious to heat and to dehydration. They normally do not hatch for six months. The resting stage can only be broken after a period of very hot weather, and then at a later date mite emergence occurs following exposure to a combination of cooler weather and higher moisture. Eggs will hatch in the autumn when the mean daily maximum temperature is below 20.5°C for 7-10 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 not a good guide to the presence of diapause eggs inside them.

Mite eggs are not killed by insecticides

The optimum time to control RLEM in spring is after the production of winter eggs but prior to the production of diapause eggs.



RLEM production of winter and diapause eggs.

Frequently asked questions

Chemical control

Is there any evidence of mite resistance to chemicals?

Yes there is now evidence of resistance developing in the field for RLEM against synthetic pyrethroids and organophosphates. So it is important to spray less frequently and to use different groups of 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 the timing of spray topping is a few weeks too late for RLEM 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 prevent mites moving into susceptible crops.

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

It is better to spray early than late. 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 5). 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. These eggs will not be killed and will hatch out the following autumn.

Does TIMERITE® control other non-target invertebrates?

TIMERITE® targets only RLEM. Spraying on the TIMERITE® predicted date during spring provides significant control of RLEM, partial control of blue oat mite but no control on other species.

The average control of RLEM across the trial sites that received a spring spray was 97 per cent in the west and 93 per cent in the east. Results showed that other pest species were not effectively controlled and predatory mites were not affected.

Management

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

Planting subclover varieties with resistance to RLEM will reduce damage. Grazing management affects mite abundance especially in spring. Research by Mike Grimm at DAFWA shows heavily grazed pastures 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 kill mites on the soil surface reducing 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 for biological control of RLEM. It is established, but is not sufficiently abundant to prevent RLEM population increase. There has recently been another attempt to find biological control agents from South Africa, without success.

Anystis wallacei, a predatory mite imported from France to control RLEM.

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 most active with mild temperatures and high relative humidity in autumn and/or in spring. Very cold weather and heavy rainfall in midwinter are associated with low mite numbers. They seem to be more abundant on sandy soils.

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 15).

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 soil 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. Date of emergence varies from year to year.

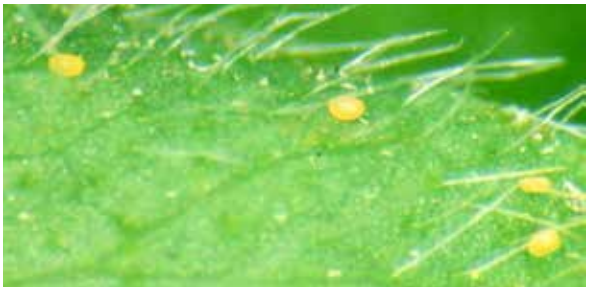
How many eggs does a mite produce?

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 and 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.

Acknowledgements

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