NATIONAL

REDLEGGED EARTH MITE

Best management practice guide

Revised November 2024

GRDC

The overuse of insecticides, particularly repeated applications of chemicals from the same mode of action (MOA) group, has led to the evolution of resistance in the redlegged earth mite (*Halotydeus destructor*, RLEM).

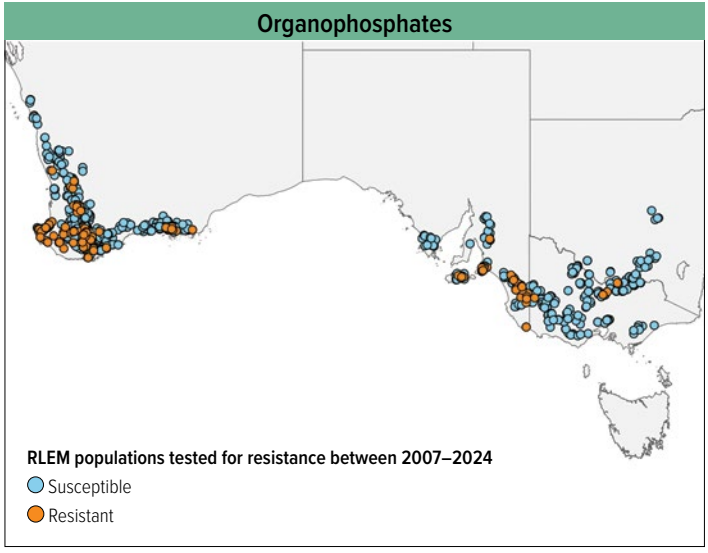
RLEM has evolved resistance to the two main chemical groups commonly used for its control in grain and pasture industries: synthetic pyrethroids (Group 3A) and organophosphates (Group 1B). Resistance to both chemicals is widespread across Western Australia and in parts of eastern Australia. It is expected that resistance will continue to increase and expand across these regions.

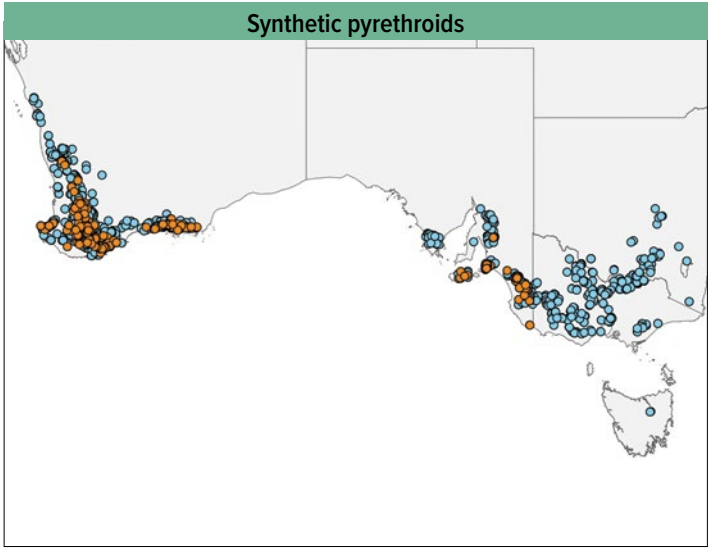
Ultimately, the use of insecticides to control RLEM in pastures and crops places strong selection pressure on the evolution of resistance. A chemical windowing strategy has been developed for RLEM (pages 14–17), which aims to reduce selection pressure and decrease the risk of further resistance issues in this pest.

HOW TO USE THIS GUIDE

1. **Become familiar with RLEM biology and identification**
2. **Determine the risk for each paddock and follow the recommendations**
3. **Consider seasonally based best management practices and actions**
4. **Follow the chemical windowing strategy**

Insecticide resistance in RLEM was first discovered in 2006 and continues to expand. Resistance to organophosphates and synthetic pyrethroids is common across large parts of the Western Australian grainbelt and in parts of South Australia (including Kangaroo Island, the Fleurieu Peninsula, and the south-east and mid-north regions). Additionally, a small number of resistant RLEM populations have recently been found in Victoria.





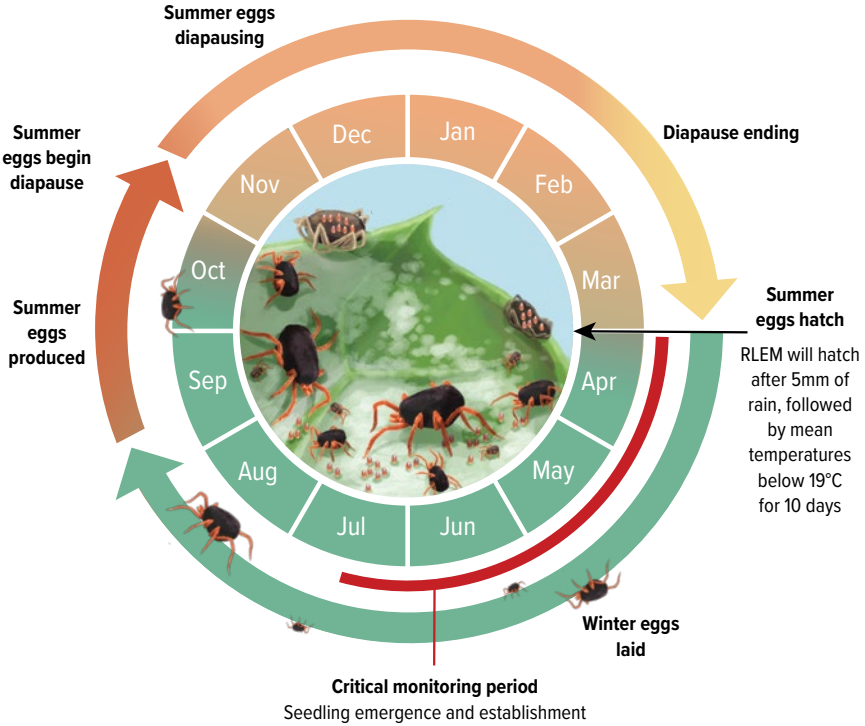
SOURCE: CESAR AUSTRALIA, JULY 2024

RLEM is widespread in the southern cropping regions of Australia and is a major pest of pastures and grain crops.

RLEM is particularly damaging during seedling establishment, resulting in the potential for considerable economic losses. The impact of RLEM varies between paddocks, but is generally most damaging to canola and emerging annual pastures. While RLEM is less of a concern in cereals and some pulses (such as chickpeas), it can cause damage to these crops.

RLEM is typically active from late April until early November, completing three to four generations per year. RLEM survives the summer as diapausing eggs, which remain dormant on the soil surface.

Autumn rainfall, accompanied by cool temperatures, breaks summer dormancy and triggers diapause eggs to hatch.



An adult RLEM is approximately one millimetre long, with a velvety black body and eight orange-red coloured legs.

Newly hatched RLEM are pinkish-orange with six legs, and are only 0.2mm long and not generally visible to the untrained eye. This stage is followed by three nymphal stages in which the mites have eight legs and resemble adults but are smaller.

Unlike other mite species that tend to feed individually, RLEM often feeds in clusters of up to 30 individuals. Typical mite damage appears as 'silvering' or 'whitening' of the attacked foliage.

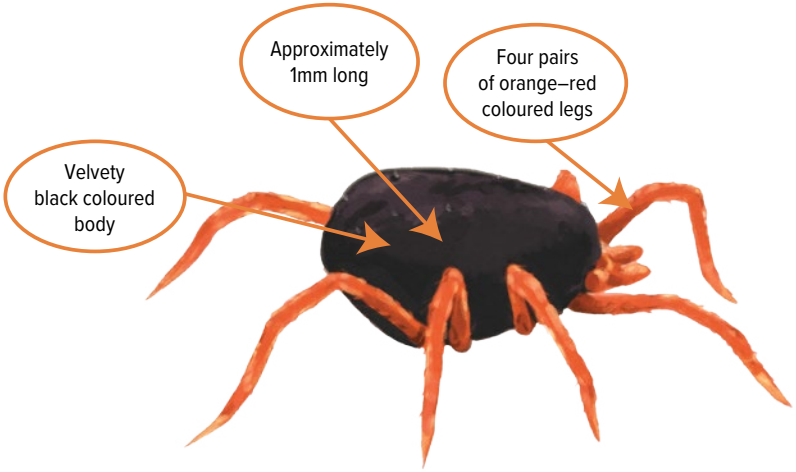


PHOTO: CESAR AUSTRALIA

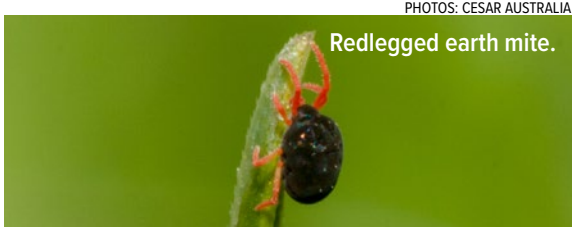
Redlegged earth mite feeding damage.

Mites are not true insects; they are arachnids and closely related to spiders.

RLEM can occur with other pest mites that have different life cycles and can be more tolerant to insecticides, such as the *Balaustium* mite (which is larger and moves slower), blue oat mites (which have a red spot on their back) and *Bryobia* mite (which has a flattened body and long front legs). These mite species require different management approaches to RLEM, and so correct identification is important.

Several predatory mites can also be found in pastures and grain crops. These are beneficial and help reduce populations of pest mites, including RLEM.

PHOTOS: CESAR AUSTRALIA


Redlegged earth mite.


Balaustium mite.


Blue oat mite.


Bryobia mite.

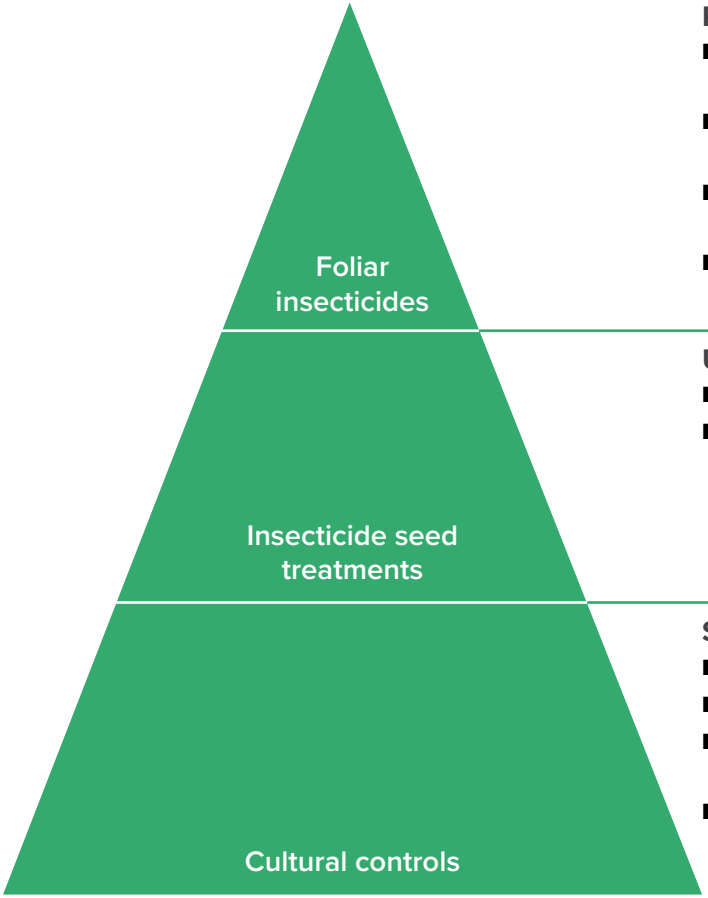
Understanding your risk is key to best management practice. The table below is a guide to assessing RLEM risk from pre-season to crop establishment.

NB: Overall risk assessment should be based on the balance of low versus elevated risk factors. The online RLEM seasonal risk tool at cesaraustralia.shinyapps.io/rlemseasonalrisk considers multiple risks and management tactics.

Risk factor	Low risk	Elevated (mod. to high) risk	Explanatory notes
Last year			
Crop type	Chickpeas or cereals grown	Canola, forage brassicas, medics or pasture grown	Some crops (e.g. chickpeas) disrupt the life cycle of RLEM and reduce population sizes the following autumn.
Weed status	No or few broadleaf weeds or pasture legumes (< 5%)	Broadleaf weeds and/or pasture legumes (> 20%)	Broadleaf weeds (e.g. capeweed) and pasture legumes provide favourable habitats for RLEM. Controlling these weeds can reduce population sizes the following year.
Pasture foliage in late winter and spring	Foliage reduced to < 2t/ha dry matter	Foliage not reduced (> 2t/ha dry matter)	Decreasing pasture foliage (e.g. grazing, cutting hay/silage) for four weeks leading up to the Timerite® date will limit RLEM food and shelter, reducing population sizes the following autumn.
Timerite®	Timerite® applied on the calculated best spray date	Timerite® not used and RLEM numbers in spring abundant	Large RLEM numbers in spring is a strong predictor of elevated risk the following autumn.
Climate	A ‘hard’ (sudden) finish to the growing season in spring	A ‘soft’ (extended) finish to the growing season in spring	Mild and moist weather conditions in spring will lead to an increase in the number of diapause eggs produced by RLEM.

Risk factor	Low risk	Elevated (mod. to high) risk	Explanatory notes
This year			
Stubble management prior to sowing	Stubble burnt	Stubble not burnt	Burning stubble can directly kill RLEM and its eggs, reducing population sizes in autumn.
Seedling emergence	Early emergence before RLEM hatch	Late emergence after RLEM have hatched	RLEM damage during establishment can be minimised if seedlings emerge early. Use the hatch timing tool to estimate RLEM hatching (see 'Further resources').
Weed status in autumn and early winter	No or few broadleaf weeds in paddock and along fencelines	Broadleaf weeds abundant in paddock and along fencelines	Broadleaf weeds (e.g. capeweed) provide favourable habitats for RLEM and facilitate population growth.
Crop sown	Chickpeas	Canola, forage brassicas, clover-dominated pasture or medics	Canola, forage brassicas, medics and clover-based pastures are susceptible to RLEM and will support large populations of mites.
Rainfall in autumn	Above average	Below average	Low rainfall in autumn can cause uneven gemination, retard plant growth and increase susceptibility of crops and pastures to RLEM feeding damage.
Autumn temperature	Mean daily temperatures (MDT*) > 19°C	Mean daily temperatures (MDT*) < 19°C	Low temperatures in autumn contribute to earlier hatching of RLEM, which may coincide with seedling emergence.

*MDT = Tmax – (Tmax – Tmin) /4



Protect the limited insecticides available

- In pastures, apply Timerite® in the previous spring if RLEM is abundant
- Avoid prophylactic pre-emergence/bare-earth sprays in autumn
- Rotate modes of action (MOA) when controlling RLEM and other pests
- Use insecticide mixtures strategically and only in the absence of resistance

Use seed treatments based on risk

- Base seed treatment decisions on RLEM risk
- Apply seed treatments when RLEM pressure is predicted to be medium or high during seedling establishment

Start with a solid foundation

- Graze pastures in spring to below 2t/ha dry matter
- Keep paddocks and fencelines weed free
- Use higher seeding rates for canola and clover-based pastures if RLEM risk is predicted to be high
- Sow mite-tolerant crops

Key actions

1. Assess RLEM risk for next season's paddock before making management decisions.
2. Determine if Timerite® should be used in pastures.

LOW RISK

- Do not use Timerite®.

MODERATE RISK

- Use stock grazing to reduce pasture dry matter.
- Use Timerite® if sowing canola, pasture or medic next year.

HIGH RISK

- Use Timerite®.
- Keep pasture foliage below 2t/ha dry matter prior to the Timerite® date.

Considerations

- If using Timerite®, follow the recommended best spray date and ensure RLEM is the dominant mite species; Timerite® is not effective against other pest mites.
- If possible, graze pastures to < 2t/ha dry matter for four weeks leading up to the Timerite® best spray date. A shorter pasture with exposed soil will limit food and shelter for RLEM, reducing population sizes the following year.

Systems with stock grazing can help manage RLEM populations.

PHOTO: BCG

Key actions

1. Assess RLEM risk using the risk assessment table on pages 7–8.
2. Use risk ratings to determine the appropriate management plan.

LOW RISK

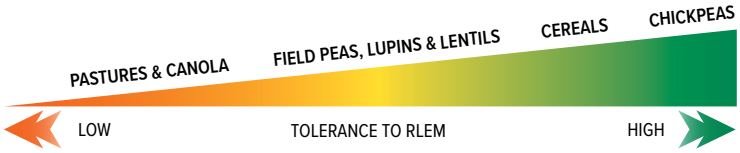
- Do not apply preventive insecticides.
- If using retained seed:
  - do not use a seed treatment for RLEM; and
  - assess risk of other pests.
- If high risk of other pests:
  - apply insecticide treatment (seed treatment or sprays) after considering the chemical windowing strategy on pages 14–17.

MODERATE RISK

- Use a seed treatment on canola and pastures, selecting a MOA group according to the chemical windowing strategy on pages 14–17.

Considerations

- Use the hatch timing tool to estimate RLEM hatching. If crop or pasture seedlings are establishing before the hatch date, preventative insecticides may be ineffective.
- RLEM risk is reduced if paddocks and fencelines are kept weed-free in autumn to early winter.
- Crop tolerance to RLEM varies.



HIGH RISK

- Sow a more tolerant crop, such as chickpeas or cereals.
- Use a seed treatment on all crop types susceptible to RLEM, selecting a MOA group according to the chemical windowing strategy on pages 14–17.
- Sow early and before mite hatching (keeping in mind the risk of other pests, such as green peach aphid).
- Use higher seeding rates for canola and clover-based pastures to compensate for possible seedling loss.

Key actions

1. Monitor and use economic thresholds to decide if insecticide sprays are warranted.
2. If insecticide use is warranted, rotate chemical MOA groups according to the chemical windowing strategy on pages 14–17.

LOW RISK

- Do not spray.

MODERATE RISK

- Use strategic spraying to target where RLEM are most abundant (e.g. fenclines) rather than blanket sprays.

HIGH RISK

- Where populations exceed economic thresholds, apply insecticides to delay the build-up of RLEM.
- Select a MOA group according to the chemical windowing strategy on pages 14–17.
- Use insecticide mixtures on RLEM only in the absence of resistance.

Considerations

- Feeding from RLEM is unlikely to result in yield loss beyond the following plant growth stages:
  - canola – six-leaf stage;
  - pulses – four-leaf stage;
  - cereals – tillering; and
  - annual pastures – five weeks post-emergence.
- It is important to monitor paddocks regularly in the first three to five weeks after sowing. Monitor at least 10 points across the paddock. Use visual monitoring, preferably when the conditions are dry.

ECONOMIC THRESHOLDS FOR RLEM

CANOLA

Cotyledon: RLEM is clearly visible and mite damage (silvering) affects 20 per cent of plants

One true leaf: 10 mites/plant

Two true leaves: RLEM is clearly visible and fewer than 30 plants/m^2

More than three true leaves: 2000 mites/m^2 and plants under stress

OTHER CROPS

Cereals: 5000 mites/m^2

Pulses: 5000 mites/m^2

Establishing medic pastures: 2000 mites/m^2

Key actions

1. Only spray for RLEM if risk is high.
2. If spraying for other pests, avoid the use of synthetic pyrethroids and organophosphates and instead use 'selective' insecticides.

LOW RISK
- Do not spray.

MODERATE RISK
- Do not spray.

HIGH RISK
- If spraying for RLEM, select a MOA group according to the chemical windowing strategy on pages 14–17.

Considerations

- RLEM does not typically warrant chemical control at later crop stages.
- If applying an insecticide mixture or co-formulation for RLEM, ensure a full dose rate of each chemical is applied (i.e. sufficient to control mites if applied as a standalone product).
- Use selective insecticides to control aphid and caterpillar pests during vegetative, flowering and grain fill stages (for example, chlorantraniliprole for caterpillars).
- Avoiding synthetic pyrethroids and organophosphates when controlling other pests will reduce the selection pressure for resistance in RLEM.

PHOTO: CESAR AUSTRALIA

Chemical windowing strategy for situations where RLEM has no resistance.

Crop stage	Insecticide recommendations	Rationale
Previous spring	If RLEM is abundant in pastures, apply Timerite® using omethoate (1B).	Omethoate has a long residual and will better compensate for annual variations in RLEM diapause than other OPs.
Pre-emergence and sowing	Apply a single seed treatment of: • imidacloprid (4A); • clothianidin + imidacloprid (4A + 4A); • lambda cyhalothrin + thiamethoxam (3A + 4A) • thiamethoxam + isocycloseram (4A + 30); or • fipronil (2B). Avoid pre-emergence/bare-earth sprays wherever possible. If unavoidable, use an SP if an OP was used at Timerite®.	Avoiding spray applications will allow greater flexibility in chemical choice at later crop stages. Applying an OP at Timerite® and again at pre-emergence should be avoided, as these will be consecutive mite generations and increases the risk of OP resistance.
Early post-emergence (oilseeds – up to six-leaf; cereals – up to tillering; pulses – up to four-leaf; annual pastures – up to five weeks post-emergence)	In canola, apply a single application of diafenthiuron (12A). In pastures and other crops, apply a single application of an OP or an SP. If an insecticide from one chemical group has been used at pre-emergence or as a seed treatment, use an insecticide from the other group. If neither an OP or SP has been applied at pre-emergence or as a seed treatment, apply a mixture of an OP + SP.	There is no current resistance to diafenthiuron in RLEM. Using this chemical over SPs and OPs will decrease the likelihood of resistance emerging. Applying a co-formulation or mixture of two chemical groups can be effective if there is no resistance present and neither chemical group is used in adjacent crop stages.
Later crop stages	Do not apply insecticides unless absolutely necessary.	RLEM does not typically warrant chemical control. Unnecessary sprays will select for resistance. Avoid the use of SPs and OPs when targeting other pests.

Key: OP – organophosphate (1B); SP – synthetic pyrethroid (3A).

Chemical windowing strategy for situations where RLEM has resistance to OPs only.

Crop stage	Insecticide recommendations	Rationale
Previous spring	If RLEM is abundant in pastures, apply Timerite® using omethoate (1B). Monitor after Timerite® spray to determine if RLEM has been effectively controlled[1].	Omethoate has a long residual and will better compensate for annual variations in RLEM diapause than other OPs.
Pre-emergence and sowing	Apply a single seed treatment of: • imidacloprid (4A); • clothianidin + imidacloprid (4A + 4A); • lambda cyhalothrin + thiamethoxam (3A + 4A); • thiamethoxam + isocycloseram (4A + 30); or • fipronil (2B). Avoid pre-emergence/bare-earth sprays wherever possible. If unavoidable, use an SP. Do not use a mixture or co-formulation containing an OP.	Avoiding spray applications will allow greater flexibility in chemical choice at later crop stages. Use of OPs not recommended due to resistance. Minimising the use of OPs will decrease the risk of this chemical group becoming completely ineffective against RLEM.
Early post-emergence (oilseeds – up to six-leaf; cereals – up to tillering; pulses – up to four-leaf; annual pastures – up to five weeks post-emergence)	In canola, apply a single application of diafenthiuron (12A). In pastures and other crops, a single application of an SP, if not used at pre-emergence. Do not use a mixture or co-formulation containing an OP.	Use of OPs not recommended due to resistance. Minimising the use of OPs will decrease the risk of this chemical group becoming completely ineffective against RLEM.
Later crop stages	Do not apply insecticides unless absolutely necessary. If unavoidable, only use SPs if not used at post-emergence.	RLEM does not typically warrant chemical control. Unnecessary sprays will select for resistance. Use of SPs across consecutive crop stages increases the risk of resistance to this chemical group. Avoid the use of SPs and OPs when targeting other pests.

[1] Some RLEM populations resistant to omethoate and dimethoate have not demonstrated cross-resistance to chlorpyrifos, and vice versa. Thus, OPs may offer effective control in the short term and rotating between OPs may be an option.

Key: OP – organophosphate (1B); SP – synthetic pyrethroid (3A).

Chemical windowing strategy for situations where RLEM has resistance to SPs only.

Crop stage	Insecticide recommendations	Rationale
Previous spring	If RLEM is abundant in pastures, apply Timerite® using omethoate (1B).	Omethoate has a long residual and will better compensate for annual variations in RLEM diapause than other OPs.
Pre-emergence and sowing	Apply a single seed treatment of: • imidacloprid (4A); • clothianidin + imidacloprid (4A + 4A) • thiamethoxam + isocycloseram (4A + 30) • fipronil (2B). Avoid pre-emergence/bare-earth sprays wherever possible. If unavoidable, use an OP, but not omethoate if it was used at Timerite®. Do not use a mixture or co-formulation containing an SP.	Avoiding spray applications will allow greater flexibility in chemical choice at later crop stages. Use of SPs not recommended due to resistance. Applications of SPs will not provide adequate control of RLEM and will rapidly select for further resistance.
Early post-emergence (oilseeds – up to six-leaf; cereals – up to tillering; pulses – up to four-leaf; annual pastures – up to five weeks post-emergence)	In canola, apply a single application of diafenthiuron (12A). In pastures and other crops, apply a single application of an OP, if not used at pre-emergence. Do not use a mixture or co-formulation containing an SP.	Use of SPs not recommended due to resistance. Applications of SPs will not provide adequate control of RLEM and will rapidly select for further resistance.
Later crop stages	Do not apply insecticides unless absolutely necessary. If unavoidable, only use OPs if not used at post-emergence.	RLEM does not typically warrant chemical control. Unnecessary sprays will select for resistance. Use of OPs across consecutive crop stages increases the risk of resistance to this chemical group. Avoid the use of SPs and OPs when targeting other pests.

Key: OP – organophosphate (1B); SP – synthetic pyrethroid (3A).

Chemical windowing strategy for situations where RLEM has resistance to both SPs and OPs.

Crop stage	Insecticide recommendations	Rationale
Previous spring	If RLEM is abundant in pastures, apply Timerite® using omethoate (1B). Monitor after Timerite® spray to determine if RLEM has been effectively controlled[1].	Omethoate has a long residual and will better compensate for annual variations in RLEM diapause than other OP.
Pre-emergence and sowing	Apply a single seed treatment of: • imidacloprid (4A); • clothianidin + imidacloprid (4A + 4A); • thiamethoxam + isocycloseram (4A + 30); and • fipronil (2B). Avoid pre-emergence/bare-earth sprays wherever possible.	Use of SPs and OPs not recommended due to resistance. Applications of SPs will not provide adequate control of RLEM and will rapidly select for further resistance. Minimising the use of OPs will decrease the risk of this chemical group becoming completely ineffective against RLEM.
Early post-emergence (oilseeds – up to six-leaf; cereals – up to tillering; pulses – up to four-leaf; annual pastures – up to five weeks post-emergence)	In canola, apply a single application of diafenthiuron (12A). In pastures and other crops, a single application of an OP[1], if not used at pre-emergence. Do not use a mixture or co-formulation containing an SP.	Applications of SPs will not provide adequate control of RLEM and will rapidly select for further resistance.
Later crop stages	Do not apply insecticides unless absolutely necessary.	RLEM does not typically warrant chemical control. Unnecessary sprays will select for resistance. Avoid the use of SPs and OPs when targeting other pests.

[1] Some RLEM populations resistant to omethoate and dimethoate have not demonstrated cross-resistance to chlorpyrifos, and vice versa. Thus, OPs may offer effective control in the short term and rotating between OPs may be an option.

Key: OP – organophosphate (1B); SP – synthetic pyrethroid (3A).

Insecticide	IRAC MOA group	Considerations
Organophosphates (OPs)	1B	OP resistance is present in WA, SA and Victoria. The levels of resistance in RLEM are low to moderate and there is not always cross-resistance across OP active ingredients. Thus, OPs may offer effective control in the short term; although undesirable, rotating between OPs is an option. Growers should test the response of RLEM in a small area first. Be aware that water quality and pH can affect the efficacy of some OPs through alkaline hydrolysis.
Fipronil (e.g. Cosmos®)	2B	Registered as seed treatment (canola only). Only provides adequate protection from low RLEM pressure.
Synthetic pyrethroids (SPs)	3A	SP resistance is common in WA and parts of SA. The levels of SP resistance are always high, and there is cross-resistance across this entire chemical group. Applications of SPs on resistant mites are ineffective.
Neonicotinoids (e.g. Gaucho®)	4A	Registered as seed treatments. No resistance in Australian RLEM.
Diafenthiuron (e.g. Receptor®)	12A	Registered as a foliar spray in canola only. Thorough coverage is needed and best applied after the two-leaf stage. No resistance in Australian RLEM.
Isocycloseram (Equento®)	30	Registered as seed treatment (canola only). No resistance in Australian RLEM.

NB: Comply with all directions for use on product labels, ensure spray rigs are properly calibrated and sprays achieve good coverage.
Growers should regularly check for available permits for RLEM by visiting the APVMA website, apvma.gov.au.

Economic threshold – a guide to rationalise insecticide use by indicating when control actions should be taken in order to prevent a pest population from reaching an economic injury level

IRAC – Insecticide Resistance Action Committee

MOA – mode of action; how a chemical compound works within the target species and the biological pathway(s) it disrupts

RLEM – redlegged earth mite

Seed treatments – chemical products applied to the seed prior to sowing for management of establishment pests

Selective insecticide – an insecticide that has fewer impacts on non-target organisms. Also called 'soft insecticides'

Timerite® – a strategy used for targeting RLEM based on a calculated best spray date that is specific to a location. Supports targeted control of RLEM in late winter to spring before the production of diapausing eggs that survive over summer and hatch the following autumn

Further resources

Cesar Australia:
Crop and pasture mite identification video.

Cesar Australia:
RLEM hatch timing tool.

Cesar Australia:
PestNotes –
Redlegged earth mite.

GRDC publication:
Crop mites (2012)
GRDC Back Pocket Guide, Grains Research and Development Corporation, Canberra.

GRDC publication:
McDonald G, Umina P, Lye J, Maino J, Perry K and Baker G (2019) *Insecticide resistance in the southern region: current status, future risk and best management practices*, GRDC Research Report, Grains Research and Development Corporation, Canberra.

IPM guidelines for grains:
Umina P et. al. (2024) *Science behind the Resistance Management Strategy for the redlegged earth mite (*Halotydeus destructor*) in Australian grains and pastures*, National Insecticide Resistance Management working group.

Australian Wool Innovation:
Timerite® tool

Published
First edition published February 2020
Second edition published November 2024

Contacts
Cesar Australia: Paul Umina
pumina@cesaraustralia.com
GRDC: 02 6166 4500
comms@grdc.com.au

Order copies
1800 11 00 44
ground-cover-direct@canprint.com.au

Cover image **Cesar Australia**
Illustrations Elia Pirtle and Alex Slavenko, Cesar Australia
Acknowledgement
Paul Umina (lead author), Garry McDonald, Aston Arthur, Jessica Lye, James Maino, Elia Pirtle (Cesar Australia);
Svetlana Micic (DPIRD WA);
Ary Hoffmann (University of Melbourne);
Greg Baker, Kym Perry (SARDI);
Kelly Angel (BCG);
Owain Edwards (CSIRO);
Craig Davis (Crop Consulting Services);
Chris Davey (Next Level Agronomy);
Rob Vitelli (Syngenta Australia);
CropLife Australia.

GRDC
GRAINS RESEARCH & DEVELOPMENT CORPORATION
Cesar Australia

P Level 4 | 4 National Circuit, Barton ACT 2600 | PO Box 5367, Kingston ACT 2604
T 02 6166 4500 **E** grdc@grdc.com.au **W** grdc.com.au

Produced by **coretext.com.au**