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RESISTANCE MANAGEMENT STRATEGY FOR THE REDLEGGED EARTH MITE IN AUSTRALIAN GRAINS AND PASTURES

GRDC
GRAINS RESEARCH & DEVELOPMENT CORPORATION

NEW SOUTH WALES, SOUTH AUSTRALIA, TASMANIA AND VICTORIA

KEY POINTS

- The redlegged earth mite (RLEM) is an important pest of germinating crops and pastures across NSW, SA, Tasmania and Victoria.
- Four chemical sub-groups are registered to control RLEM in grain crops: organophosphates (Group 1B); synthetic pyrethroids (Group 3A); phenylpyrazoles (Group 2B); and neonicotinoids (Group 4A). The latter two are registered only for use as seed treatments.
- Insecticide resistance in RLEM is presently confined to Western Australia. There are high levels of resistance to pyrethroids within WA populations; resistance to organophosphates has also recently evolved.
- A strategy to manage insecticide resistance in RLEM populations is available for use by grain growers and their advisers. The strategy varies across regions.

PHOTO: A. WEEKS (cesar)

The use of chemicals to target the redlegged earth mite in grain crops and pastures continues to grow, placing strong selection pressure for the development of resistance.

Redlegged earth mites and insecticide resistance

The redlegged earth mite (RLEM), *Halotydeus destructor*, is a major threat to a variety of Australian crops and pastures, with canola, lupins and legume seedlings the most susceptible to attack. RLEM are also a pest of several vegetable crops, while weeds (particularly capeweed) can act as important hosts. Mite feeding can lead to distortion or shrivelling of leaves and affected seedlings may die at emergence when mite populations are high.

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. High levels of resistance to synthetic pyrethroids (SPs), including bifenthrin and alpha-cypermethrin, are becoming more common across the Western Australian grainbelt. Localised resistance to organophosphates (OPs), including omethoate and chlorpyrifos, has recently been discovered on multiple WA properties. At present, there is no confirmed resistance to any insecticide outside of WA. Growers need to understand how to minimise the development of further resistance.

Resistance management and minimisation strategy

Chemicals within a specific chemical group usually share a common target site within the pest, and thus share a common mode of action (MoA). The basis of this strategy is to minimise the selection pressure for resistance to the same chemical group across consecutive generations of RLEM. As the dispersal of adult mites is limited, resistance tends to remain relatively localised and spreads slowly, although it is important to recognise that spread over larger distances does occasionally occur. Due to local differences in resistance levels, there is a need to implement a resistance management strategy that is locally relevant. Importantly however, long-range dispersal is achieved via diapause eggs, which are likely to move large distances by intense summer winds (especially on overgrazed erosion-prone soils) and possibly by adhering to livestock, farm machinery and plant material (such as fodder shipments). It is therefore critical that strategies are implemented in all regions of Australia where RLEM are found. **This strategy has been devised specifically for growers in South Australia, Victoria, Tasmania and New South Wales.**

Key recomendations for control

Tables 1 and 2 will guide growers' selection of control options and allow for a wider selection and rotation of chemicals in some seasons. The key recommendations are:

- **Do not use the same chemical group across successive spray windows (on multiple generations of mites) as this will select for resistance to that chemical group.** Bare earth, pre-emergent and seed treatments are likely to target the early season or first generation of RLEM in most situations. Post-emergent sprays will target the first or second generations of RLEM depending on the crop type, occurrence of mite hatchings, sowing dates and post-emergent spraying dates.
- **Co-formulations or chemical mixtures are best reserved for situations where damaging levels of RLEM and other pest species are present, and a single active ingredient is unlikely to provide adequate control.** If applying a mixture or co-formulation, ensure a full dose rate of each chemical is applied (i.e. sufficient to control RLEM if applied as a stand-alone product).

Other general recommendations include:

- Consider the impact on target and non-target pests and beneficial invertebrates when applying insecticide sprays. Where possible, use target-specific 'soft' chemicals, especially in paddocks with resistant RLEM. For aphids, this includes pirimicarb (canola, pastures, cereals and some pulses) and sulfoxaflor (canola and cereals). For caterpillars, use *Bt* (cereals, canola and pulses), NPV (canola, cereals and some pulses), emamectin benzoate (canola and pulses), spinetoram (canola amd forage brassicas), indoxacarb (some pulses) and chlorantraniliprole (some pulses).
- Identify correctly the mite species to ensure the most effective insecticide and **recommended label rate** is used. Misidentification and incorrect insecticide selection results in poor control and contributes to selection for resistance.
- Assess mite and beneficial populations over successive checks to determine if chemical control is warranted. Use economic spray thresholds where available and do not spray if pest pressure is low.
- If spraying autumn pastures, aim to control the first generation of mites before adults lay eggs (within 3 weeks of mite appearance). This works well in years where there is a mass hatching over a short period. Chemical sprays do not kill mite eggs – apply sprays when most mites have emerged.
- Do not re-spray a paddock in the same season where a known spray failure has occurred using the same product or another product from the same insecticide group, or if a spray failure has occurred where the cause has not been identified.
- Comply with all directions for use on product labels.
- Ensure spray rigs are properly calibrated and sprays achieve good coverage, particularly in crops with a bulky canopy.

TABLE 1 IPM strategies for the redlegged earth mite.

Season	Management option	Comment
Previous year (winter/spring)	Keep pastures short in early spring	Ideally graze to <1.4t/ha Food on Offer 3-4 weeks prior to the Timerite® date[1]. Heavily grazed spring paddocks will not require an insecticide spray.
	Keep fencelines clean	Spray out broadleaf weeds (especially capeweed) along fencelines of paddocks that contain RLEM.
	Use selective chemicals	Where possible avoid using organophosphates (OPs) or synthetic pyrethroids (SPs) for control of spring pests other than RLEM. For example, use pirimicarb for control of aphids and *Bt*, NPV, spinetoram or emamectin benzoate for control of caterpillars.
	Use mite-tolerant pasture species	For continuing pastures, consider selecting varieties with known mite tolerance. The pasture legume *Trifolium glanduliferum* (cv Prima gland clover) is less susceptible to RLEM feeding. Subterranean clovers – Narrikup⦶, Bindoon⦶ and Rosabrook⦶ – may suffer less damage from RLEM than other varieties.
	Plan for less susceptible crop types	In situations where significant resistance issues exist, consider selecting crop types that are less susceptible to RLEM. Cereals are more tolerant than canola, and are typically better at compensating for early RLEM feeding damage. Some pulse crops, such as lentils and chickpeas, are not favoured by RLEM.
Pre-sowing	Control weeds 2 weeks before sowing	Control all weeds (especially capeweed & Paterson's curse) using herbicides or cultivation within paddocks and along fencelines at least 2 weeks in advance of intended sowing date. This is especially important in 'late break' years where mites have hatched and are feeding on pre-sowing weeds.
	Avoid bare earth sprays prior to mite hatch	Do not apply preventative insecticides against RLEM in seasons where crops are sown in advance of known mite-hatching events.
	Use higher seed rates	Consider higher seeding rates to allow for some mite-feeding damage and plant loss (especially in canola).
Emergence & crop establishment	Monitor and use spray thresholds	Monitor susceptible crops through to establishment using direct visual searches, and use thresholds to inform spray decisions. Avoid preventative or prophylactic sprays.
	Use border sprays if mites invade from edges	Be aware of edge effects; mites move in from weeds around paddock edges. Where RLEM are colonising crop margins and fencelines in the early stages of population development, consider a border spray with an insecticide to prevent/delay the build-up of RLEM and to retain beneficial species.

1 Timerite® is a carefully timed chemical application in spring. This approach can drastically reduce the number of 'over-summering' diapause eggs produced by RLEM. If applied correctly, Timerite® will decrease the density of mites that emerge the following autumn. Further information is available at: www.wool.com/timerite

TABLE 2 Chemical control strategies for redlegged earth mite – NSW, SA, Tasmania and Victoria.

SP = synthetic pyrethroid (chemical Group 3A), OP = organophosphate (chemical Group 1B); Refer to Table 3 below for more detailed information on relevant insecticide groups.

SPRAY WINDOWS (rotate chemical groups through windows)				Rationale
1	2	3	4	
Timerite® used in previous spring?	Pre-emergence (bare earth) & insecticide seed treatment [1,2,3]	Early post-emergence [1,2] (Oilseeds – up to 6-leaf) (Cereals – up to tillering) (Pulses – up to 2nd true leaf)	Later crop stages (incidental RLEM control when targeting other pests)	
Yes, used omethoate (1B) as per label recommendation.	**Seed treatment:** Imidacloprid (4A) or Poncho® Plus (2x4A) or fipronil (2B) or Cruiser® Opti (4A+3A) if SPs (3A) will not be used at post-emergence (Window 3). **Pre-emergence/bare earth:** Avoid wherever possible. If unavoidable, select any registered SP (3A).	Any registered OP (1B) or Any registered SP (3A) only if SPs not used in Window 2.	Avoid the use of SPs and OPs if already used in Windows 2 & 3. Instead use pirimicarb, sulfoxaflor, *Bt*, NPV, emamectin benzoate, spinetoram, indoxacarb or chlorantraniliprole. If unavoidable, use OPs if SPs used at post-emergence (Window 3). or Use SPs if OPs used at post-emergence (Window 3).	Avoid OPs (1B) at pre-emergence as omethoate used in Timerite® spray.
No	**Seed treatment:** Imidacloprid (4A) or Poncho® Plus (2x4A) or fipronil (2B) or Cruiser® Opti (4A+3A) if SPs (3A) will not be used at post-emergence (Window 3). **Pre-emergence/bare earth:** Avoid wherever possible. If unavoidable, select any registered SP (3A) or OP (1B), or a mixture of SP/OP (1B+3A). If applying a mixture or co-formulation, do not apply a mixture or co-formulation at post-emergence (Window 3).	Any registered OP (1B) or SP (3A) or A single application of a mixture or co-formulation. If one chemical group was applied in Window 2, select a different chemical group.	Avoid the use of SPs and OPs if already used in Windows 2 & 3. Instead use pirimicarb, sulfoxaflor, *Bt*, NPV, emamectin benzoate, spinetoram, indoxacarb or chlorantraniliprole. If unavoidable, use OPs if SPs used at post-emergence (Window 3) or Use SPs if OPs used at post-emergence (Window 3).	Co-formulations or mixtures of chemicals from two groups should only be applied once per season.

1 Where co-formulations or mixtures are used, they should be considered as two independent applications (one for each chemical group), and need to be reconciled by reducing applications from the same insecticide groups at another stage.

2 This includes applications targeted at pests other than RLEM (e.g. weevils, aphids, caterpillars, other mites).

3 Bare earth applications should be avoided, particularly in cases where Timerite® has been used the previous spring and insecticide seed treatments have been applied.

TABLE 3 Insecticide Resistance Action Committee (IRAC) mode of action (MoA) classification of insecticides and acaricides, including active ingredients registered against redlegged earth mites in Australian grain crops, and example trade names of chemical products.

IRAC MoA group	Insecticide category	Active ingredient(s)	Example trade names
GROUP 1B INSECTICIDE	Organophosphates (OPs)	Chlorpyrifos, dimethoate, methidathion, omethoate, phosmet	Strike Out®, Danadim®, Suprathion®, LeMat®, Imidan®, Pyrinex Super®[1], Cobalt Advanced[1]
GROUP 2B INSECTICIDE	Phenylpyrazoles	Fipronil	Cosmos®, Legion®
GROUP 3B INSECTICIDE	Synthetic pyrethroids (SPs)	Alpha-cypermethrin, cypermethrin, bifenthrin, gamma-cyhalothrin, lambda-cyhalothrin, esfenvalerate.	Fastac®, Scud Elite®, Talstar®, Venom®, Trojan®, Karate Zeon®, Sumi-alpha Flex®, Pyrinex Super®[1], Cobalt Advanced®[1], Cruiser® Opti[2]
GROUP 4B INSECTICIDE	Neonicotinoids	Imidacloprid, clothianidin, thiamethoxam	Gaucho®, Emerge®, Poncho® Plus, Cruiser® Opti[2]

1 Co-formulation containing Group 1B and 3A insecticides

2 Co-formulation containing Group 3A and 4A insecticides

FREQUENTLY ASKED QUESTIONS

What is the likelihood I will have a spray failure?

This will depend on previous pest management practices and whether insecticide resistance is present in the target pest population. If you suspect resistance, consult Dr Paul Umina or your local entomologist.

How do I prevent spray failures into the future?

Avoid the practice of 'insurance' sprays at all costs. Using the broadest range of integrated pest management (IPM) strategies (Table 1) is the best way to avoid future spray failures and prevent or delay the development of insecticide resistance. Make use of thresholds and spray only when absolutely necessary. Follow the guidelines outlined in Tables 1 and 2, ensuring insecticides across different chemical groups are rotated within a cropping season.

Is resistance in RLEM a concern for growers outside WA (NSW, SA, Tasmania and Victoria)? Yes, absolutely. Resistance could spread or evolve independently in NSW, SA, Tasmania and Victoria. Occasional long-range dispersal is known to occur in RLEM and is likely to happen during summer via the airborne movement of diapause eggs in summer dust storms. Eggs may also be dispersed on soil adhering to livestock and farm machinery and through transportation of plant material, particularly fodder/hay during periods of drought. Recent genetic analysis of mite populations has revealed insecticide resistance to SPs has evolved on more than one occasion in WA, demonstrating the potential for resistance in areas outside WA.

This strategy was developed by the National Insecticide Resistance Management (NIRM) working group of the Grains Pest Advisory Committee (GPAC), and endorsed by CropLife Australia. GPAC is a GRDC-funded project which provides strategic advice to GRDC on pest issues. NIRM, chaired by Dr Paul Umina, is responsible for developing insecticide resistance management strategies for a number of grains pests. The group's representative membership ensures engagement of agro-chemical industries, researchers, advisers and CropLife Australia.

MORE INFORMATION

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USEFUL RESOURCES

Science behind the Resistance Management Strategy for the redlegged earth mite (*Halotydeus destructor*) in Australian grains and pastures.

National Insecticide Resistance Management, www.ipmguidelinesforgrains.com.au/ipm-information/resistance-management-strategies

Redlegged earth mite – PestNote. www.cesaraustralia.com/sustainable-agriculture/pestnotes/insect/Redlegged-earth-mite

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