RLEM status and control

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Redlegged earth mite (RLEM), *Halotydeus destructor* is one of the worst pests of broadacre farming across winter rainfall areas of southern Australia. It attacks most crops and pastures as well as many common weeds and feeds on all stages of plants, but it is particularly damaging to seedlings in autumn.

Crops vary in their vulnerability to RLEM as do the life stages attacked. Seedlings of crops such as lupins and lentils are attacked but mature plants are not. But all stages of canola, pasture legumes such as vetches and clovers, and weeds such as capeweed and bristly ox-tongue are hosts of RLEM. Juvenile RLEM can also exist on algae and mosses on the soil surface. In pastures, RLEM spend most of their time sheltering on the soil surface under the cooler, more humid tall patches that are often dominated by capeweed. They move out of these to feed.

RLEM numbers can increase rapidly when conditions are favourable and, despite the recent appearance of pesticide resistance, most growers still rely on chemical control. Non-chemical control strategies include grazing, the use of tolerant plants such as cereals, resistant legume cultivars and avoiding rotations where RLEM host plants are grown in the year before susceptible crops such as canola. Natural enemies also play a part in mite control.

RLEM is active from May to October and normally has three generations a year. They survive summer as diapause eggs in the cadavers of females and emerge in autumn. RLEM reproduces sexually in contrast to closely related species, such as the blue oat mite, which are parthenogenetic (the eggs develop without fertilisation).

RLEM leaf damage.

Numbers of summer diapause eggs determine autumn numbers of RLEM. A late end to the growing season increases both mite survival and the production of diapause eggs. Conversely, an early end to the growing season means mites die before they can produce large numbers of diapause eggs.

Competition between RLEM and other pest mites can affect the composition of pest communities. There is evidence that in some years when populations of one species fall another one increases. Further work is required to investigate the significance of this interaction.

Feeding damage

RLEM is particularly damaging in the autumn seedling establishment stage of crops and pastures. In years with a late 'break of season' or with late-sown crops and pastures, the mites are well established when seedlings emerge and the consequent intensive feeding can necessitate the resowing of entire crops.

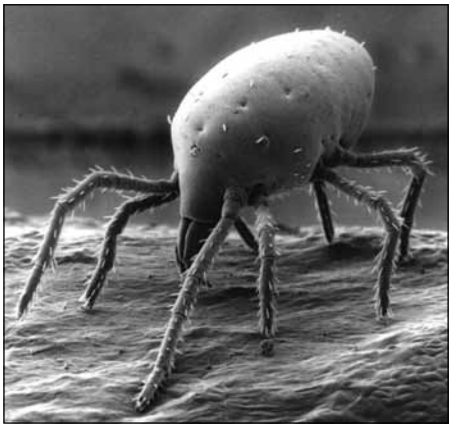
RLEM damage to grain legume seedlings is greatest in field peas and faba beans, and least in chickpeas. Damage to cereals is sometimes greater around the borders of paddocks. Canola is particularly vulnerable to mite attack, whereas lupins and other pulse crops are more tolerant. But RLEM feeding on lupin seedlings can reduce grain yield by up to 50 per cent.

In spring, in set-stocked pastures, pasture plant production of older plants was substantially greater after repeated sprays for RLEM. In Australian annual pastures, legumes are self-seeding and RLEM is contributing to a decline in pasture legume content.

The combination of high numbers of aphids and RLEM in a subterranean clover pasture in spring can cause a 50–90 per cent reduction in seed production and up to a 34 per cent reduction in dry matter produced. This leads to fewer seedlings the following year.

Chemical control

Chemicals will remain the major control tool for RLEM and other earth mites for the foreseeable future. For seedlings, control is recommended when there are 5000 mites per m^2 in cereals, but at the first sign of mite activity in winter oilseeds, winter pulses and winter pasture legumes.



RLEM under the microscope.

Later in the season, when plants are larger, control may be warranted in legume pastures to protect spring pasture and seed production.

Mite susceptible seedlings can be protected by coating seed with systemic chemicals (such as imidacloprid and fipronil), by using contact sprays on bare earth before germination (bifenthrin), or by foliar sprays to emerging seedlings (chlorpyriphos, methidathon). Many farmers sowing susceptible crops such as canola apply pesticide/herbicide mixes as pre-emergence sprays.

During the growing season, mites can be controlled in crops and pastures with a foliar spray about two weeks after the first rains and cool weather. This is after hatching but before the first generation of winter eggs. A 10 metre wide perimeter spray of weedy fence lines and adjacent pasture can prevent invasion of a susceptible crop from which mites are absent.

Resistance to pesticides

Multiple applications of chemicals against a number of pests over a season selects for the more tolerant individuals and some RLEM populations in Victoria have previously shown tolerance to one organophosphate.

Resistance in RLEM was first reported in 2006 in Western Australia with very high levels of heritable resistance to two synthetic pyrethroids, bifenthrin and œ-cypermethrin. There is also cross-resistance between synthetic pyrethroids.

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Reasonably advanced lupins are more tolerant of mite attack than canola but RLEM feeding on lupin seedlings can reduce grain yield by up to 50 per cent.

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It appears that future problems with pesticide resistance in RLEM are looming. A reduction in pesticide use and reduced dependence on a single control method is needed to at least delay this.

Timerite

Controlling RLEM in spring pastures reduces over-summering eggs and thus damaging mite populations in the following autumn resulting in increased seed yield and autumn seedling density. The package, Timerite, uses a single spring spray to control RLEM. The timing of this is based on predicting the date of onset of diapause egg production. This date remains constant for individual sites between years, but varies between sites.

Pasture trials of Timerite achieved control of 99 per cent after one week and 99 per cent the following autumn. Subterranean clover seed yield in summer was 45 per cent greater in the sprayed treatments, and clover seedling densities were 36 per cent higher at the initial break of season in autumn and 66 per cent higher one month later. Victorian studies showed a spring spray on the recommended date provided between 70 and 90 per cent control of RLEM at the following autumn break.

But repeated spraying in the same paddock on the same date for many years should be avoided as it could lead to a shift in the timing of the onset of diapause egg production. For example, corn rootworm has evolved different diapause strategies to circumvent control attempts.

This risk for RLEM could be avoided by monitoring populations and rotating Timerite with other control strategies, such as grazing management and crop rotations.

Although control using Timerite is high in autumn (May and June) in Victoria, control is lost by mid-season (August) and there can even be a significant increase in numbers. Why is unclear but it may be due to a reduction in natural enemies either from spraying or by the 'crash' of their prey. Timerite provides little control of other mite pests which lay their diapause eggs earlier or later.

Cultural control

Farming practices such as grazing in spring, crop rotations, border crops that repel mites and better weed management can be used to reduce RLEM numbers sustainably. But these are unlikely to be adopted wholeheartedly while chemical options remain cost effective and while outbreaks of mites remain unpredictable.

The potential benefits of careful grazing management have been demonstrated in Western Australia in set-stocked pastures in spring. RLEM populations were reduced substantially following a four-fold increase in grazing days (total number of sheep multiplied by the number of days grazing). The relative humidity is lower in grazed vegetation and this probably kills mites.

In addition, young mites feed on the soil surface microflora, which is more abundant under dense crop and pasture vegetation.

Heavy grazing of pastures in spring is recommended when sowing a susceptible crop the following year. While heavy grazing reduces RLEM populations, it also significantly reduces the abundance of predators, limiting their effectiveness.

The risk from RLEM is generally higher if paddocks have been in long-term pasture with high densities of broad-leafed plants where mites were uncontrolled. Pesticide use can be reduced by planting crops such as lentils or lupins before cereals, cereals or chickpeas before winter pulses, and lentils or chickpeas before canola. Planting a border of wheat or oats might protect canola from mite invasion from neighbouring mite-infested paddocks.

Broad-leaved weeds such as cat's ear, capeweed and bristly ox-tongue should be controlled along fence lines adjacent to crops. 'Weed-free' paddocks also harbour fewer mites. Weed management in crops and summer weed management in pastures are also recommended.

Direct drilling minimises soil damage, conserves moisture and promotes sustainability but can also result in more weedy hosts for RLEM.

Natural enemies

Australia already has several natural enemies of RLEM. The mite, *Anystis wallacei*, introduced from France, can be an effective predator of RLEM, blue oat mite and lucerne flea. As it spreads very slowly, its distribution needs to be boosted if it is to benefit farmers, and even then abundance levels may remain too low to exert effective control of RLEM at high densities.

A recent search for potential biocontrol agents in the Western Cape Province of South Africa led to the identification of 56 predatory mite species of which nine are already in Australia. The most promising, *Chaussieria capensis*, was assessed in more detail, but factors such as slow reproduction, long generation time, cannibalism and a broad prey range, make it unlikely that this species could be introduced to Australia.

Landscape management could enhance existing natural enemies. RLEM numbers are low in complex shelterbelts with trees, shrubs, small herbaceous plants and a dense, grassy understorey. Moreover, mite numbers are relatively low up to 50 metres into pasture adjacent to these shelterbelts which are a source of predators such as predatory mites and spiders.

Host plant resistance

One alternative pasture legume species, *Trifolium glanduliferum* (CV Prima), which contains chemicals that prevent RLEM from feeding has been released. Resistance to RLEM has been found in seedlings of some wild lines of yellow lupins which could be used in breeding. The mite also responds differently to different canola cultivars and grain legume species. Lines of

Medicago spp., with reduced seedling susceptibility to RLEM, have been identified.

While several hundred introductions of subterranean clover have been screened, few show reduced susceptibility to RLEM. Resistance in subterranean clover cotyledons comes from a combination of antifeeding chemicals and increased cotyledon toughness. Promising subterranean clover lines have been crossed with well-adapted cultivars and their progeny evaluated. A small number of these cultivars will be released commercially.

Integrated management

An integrated pest management program combines chemical, cultural and biological control and host plant resistance. But farmers have to deal with a suite of pests and while RLEM has remained the major pest in Western Australia and sometimes in eastern Australia, blue oat mites, Balaustium mites and Bryobia mites are responsible for many pest outbreaks. Soil type and host plants also influence pest abundance. While sandy soil suits RLEM better than loam, lucerne flea is more common on heavier soils. Different host plants favour blue oat mites and lucerne flea.

It is important to select the correct chemical because pest species vary in their tolerance of pesticides. The systemic chemicals dimethoate and omethoate are effective against RLEM and lucerne flea. Omethoate and chlorpyrifos were most effective against lucerne flea, whereas carbaryl was toxic to lucerne flea and earth mites but not aphids, and fenvalerate was toxic to aphids but not lucerne flea.

Because of these differences in tolerance, long time use of one pesticide regime could change the suite of pests present. The timing of application will also influence which species is controlled. For example,

Timerite controls only RLEM in autumn, not other species. 'Soft' chemicals that don't kill natural enemies should also be used. It appears that αcypermethrin and to a lesser extent bifenthrin can be used against RLEM without adversely affecting mite predators. But these are the two pesticides to which RLEM has developed resistance.

Future directions

Western Australian studies revealed that pastures should only be treated when damage is evident. Even with high pest numbers, vigorously growing pastures will provide sufficient stock feed. Using plants unfavourable to RLEM for several years would prevent mite numbers from building up thus boosting the impact of natural enemies.

The benefits of a resistance management strategy for pesticide resistance are highlighted by the successful management of pyrethroid and endosulfan-resistant cotton bollworm, *Helicoverpa armigera*, in Australian cotton.

Accurate mite identification is essential as incorrect treatment could lead to control failures and further select for resistance.

IPM packages which include practices such as increased grazing, the use of rotations and tillage practices, damage thresholds, 'softer' sprays to protect natural enemies and landscape-level changes need to be developed and tested so farmers have access to RLEM integrated management.

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