Proven control of earth mites, lucerne flea and some aphids in pastures, cereals, oilseed and legume crops.
INTRODUCTION

Le-mat® is an outstanding management tool for mite and aphid control in crops and pastures that has kept proving its worth for over thirty years.

When Jim Watt joined Bayer as a Research & Development Officer in the late 1960s, one of his first jobs was to help prepare Le-mat for release. But the then Technical Manager, Lou Campbell-Smith told him: “The sales people have enough new products without this one. Take a year and try to break it.”

So Jim tried it on dense pasture, spraying it onto crackling frost and dew. He applied rain to it and tested it in real rain. He set the product continuous challenges and tried in every way he could think of to make it fail.

When Jim found he still couldn’t break it, Le-mat was launched. As this guide explains, the qualities that kept Le-mat working under the most extreme conditions way back then still make it the most reliable miticide available today.

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Disclaimer

The information and recommendations set out in this brochure are based on tests and data believed to be reliable at the time of publication. Results may vary, as the use and application of the products is beyond our control and may be subject to climatic, geographical or biological variables, and/or developed resistance. Any product referred to in this brochure must be used strictly as directed, and in accordance with all instructions appearing on the label for that product and in other applicable reference material. So far as it is lawfully able to do so, Bayer CropScience Pty Ltd accepts no liability or responsibility for loss or damage arising from failure to follow such directions and instructions.

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BEHAVIOUR IN THE ENVIRONMENT

We are all responsible for protecting our natural environment. Pesticides should be effective without causing harm to waterways, the soil and vegetation and any of the non-target species that live there. Responsible and effective use of pesticides will ensure nil or minimal effect on the environment.

Le-mat is a highly selective insecticide. Its low rate of use and selectivity ensure minimal impact on non-target species.

In soil
Le-mat breaks down rapidly in the soil. It has a half-life of 16 days. Potential contamination is small due to the minute amount of chemical applied (29 g omethoate/ha) and an even smaller amount reaches the soil with normal use.

In water
Le-mat breaks down readily in water, leaving no toxic residue.

EFFECTS ON FLORA AND FAUNA

Rhizobia in the soil
Naturally-occurring rhizobia in the soil have been shown not to be affected by Le-mat.

Marine species
Fish and freshwater crayfish are not affected when Le-mat is used according to the label.

Earthworms
Detailed studies on commonly occurring earthworm species indicate that Le-mat is safe to earthworms when used as directed.

Bees
Flowers and foliage sprayed with Le-mat repel bees, so they do not transport toxic nectar back to the hive. However, Le-mat is toxic to bees when sprayed directly onto them and farmers must ensure bees are not active in the area to be sprayed. Bees are repelled from sprayed foliage for about three days.

Predators and parasites
Pasture is a dynamic ecosystem where pests and native fauna exist in a delicate balance. Sometimes the balance is upset when conditions favour a particular pest and the natural predators and parasites cannot prevent that pest from becoming dominant.

Many of the major insect pests such as earth mites are introduced species. There is a lack of native beneficial species to keep their numbers in check.

Several predators have been introduced to overcome this deficiency.

Dr. David James (Plant Protection Quarterly Vol. 10(2) 1995) has identified 20 endemic natural enemies of redlegged earth mite and blue oat mite. The importance of these native beneficials needs to be quantified.

RESISTANCE MANAGEMENT

Insecticide resistance may develop if farmers rely entirely on insecticides for pest control in pastures and crops.

Reliance on pesticides alone is not always a satisfactory method of pest control. The adoption of IPM using a combination of biological, cultural and chemical methods will deliver the best sustainable results for the farmer.

To protect the long-term survival of insecticides in pastures and crops, the following strategies can be adopted by farmers:

1. Sow resistant or tolerant species of crops and pastures – e.g. chickpeas are less affected by earth mite (Reference: McDonald and Ballinger Australian Grain Feb-Mar 1996).
2. Use border sprays (5–10 m wide) to prevent mite movement into a crop.
3. Time sprays for maximum effectiveness so that repeat spraying is not necessary, e.g. early spring spraying prevents mite egg-aying.
4. Only spray if pests reach an economic threshold, e.g. 5–10 mites per 10 cm² in canola.
5. Rotate chemical types, e.g. endosulfan, pyrethroids, organophosphates.
6. Heavily graze paddocks in spring to prevent build-up of earth mites and lucerne fleas. This creates an unfavourable environment.
7. Monitor the numbers of predators and parasites, e.g. lacewing and ladybirds eat aphids; Anystis sp. eat earth mites. Use insecticides which are favourable to their survival.

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APPLICATION

Ground-boom application

Le-mat is suited to a wide range of boom-sprays. Boom-sprays set up for herbicide application give good coverage and are very suitable for Le-mat. Although Le-mat is systemic, good coverage will always maximise effectiveness and reliability.

- **Water volume:** Down to 30 L/ha is successful. At lower volumes, smaller droplets are needed to give good coverage.
- **Droplet spectrum:** 100 to 300 microns (<100 may cause drift and >300 compromises coverage)
- **Nozzles:** Flat fans (110˚ or 80˚), e.g. spraying systems 8001, 8015 and 8002.
- **Pressure:** 200–400 kPa (30–50 psi)
- **Surfactants:** No surfactants are needed with Le-mat. Le-mat is a water-soluble product and readily penetrates the leaf cuticle. Booms are easily cleaned with flushes of water.

The best time to apply Le-mat is late afternoon, when mites are active and often seen feeding on the upper parts of plants. Le-mat can be applied to a light dew without problems. It is rainfast within one hour, but avoid spraying if heavy rain is imminent. If Le-mat is applied with another product such as a herbicide, the rainfastness period of the herbicide must be adhered to.

**Misting machines**

While misters can do an excellent job, they can be inefficient if the settings and conditions are not ideal.

- **Droplet size** should be small and uniform. A mister which has a wide droplet spectrum will deposit most of the Le-mat as large drops close to the machine.
- **Cross-winds** are vital, because they ensure swath overlap and give a more uniform deposit. (Remember that there must be overlap, i.e. the minimum swath width must be greater than the track spacing.)
- **Last run.** For the last run on the upwind side, there will be no overlap, so an extra run will be needed. This is the equivalent of the aircraft’s ‘clean-up’ runs.

**CAUTIONS:**

- **Light and variable winds** can turn through 180˚ so that whole strips are missed and the driver can become contaminated. Such winds are to be avoided, especially if the direction is variable.
- **Inversions and dead calms** are to be avoided because the deposit of Le-mat could be highly variable and even drift outside the sprayed area.

Provided these common-sense precautions are observed, there is no reason why misting machines should not do a reliable job of spraying. They are especially useful in rough country where using aircraft is impracticable.

**Aircraft**

Le-mat can be successfully applied by aircraft in 10 L/ha of water.

**Points to note:**

- A cross-wind is essential to give uniform deposit. Aim for a droplet size between 150 and 300 microns. Both micronair and hydraulic fan nozzles are suitable.
- Do not spray in light and variable winds unless smoke generators or the spray cloud show that the spray is going down into the crop. Do not spray in calm or inversion conditions.
- When mixing Le-mat with herbicides at low volume/ha, a very concentrated mix may result. In this situation, it is best to apply 20–30 L/ha to avoid any compatibility problems, especially in cold water.
- Use professional aerial operators, e.g. AAAA (Aerial Agricultural Association of Australia) members.
- Le-mat is toxic to bees, so aircraft application must be planned to avoid spraying them. Close co-operation with apiarists is an important stewardship practice.

**Herbicide compatibility with Le-mat 290SL**

<table>
<thead>
<tr>
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<tr>
<td>Ally^ + Roundup^</td>
<td>Butoxide® MA</td>
</tr>
<tr>
<td>Atlantis^</td>
<td>Butoxide® 400</td>
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<tr>
<td>Atrazine WP &amp; FL</td>
<td>Correct®</td>
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<tr>
<td>Balance^</td>
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<td>Dimec®</td>
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<tr>
<td>Broda^</td>
<td>Dicamba + MCPA 500 EC</td>
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Le-mat is mixed with:

- Hard and soft water over a wide pH range
- Fertilisers – Foli-fert, sodium molybdate, zinc hepta hydrate
- Fungicides – Folicur®, Dithane®
- Le-mat is compatible with rhizobia in the soil

Le-mat is NOT compatible with:

- Broadside®, Igran®, Bond®
- ULV insecticides

Caution should be exercised when mixing concentrates. Do not allow undiluted chemicals to come together. Add each product to water in the spray tank separately. When using direct injection equipment, ensure the lines are rinsed clean before adding the next concentrated chemical.

Caution should also be exercised when using water at <5˚ C, as it may cause incompatibility problems with herbicides.

COMPATIBILITY

Le-mat is compatible with:

- Herbicides – Atrazine, 2,4-D, MCPA, Roundup & Roundup CT
- Fertilisers – Foliar fertilizer, sodium molybdate, zinc hepta hydrate
- Fungicides – Folicur®, Dithane®
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DIRECTIONS FOR USE

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<tr>
<th>Crop, Pastures, cereals, oilseed and legume crops</th>
<th>Pest</th>
<th>Rate</th>
<th>AUTUMN/WINTER: Spray 2–5 weeks after opening rains when mites have hatched to prevent seedling damage or loss. Le-mat is rainfast within 1 hour of spraying. Residual control is less on 1–2 true leaf plants. SPRINT: Spray mite-infested pastures and legumes to prevent damage, yield loss and to reduce infestation pressure in the following autumn. Le-mat may be added to pasture herbicides.</th>
<th>Critical comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pastures, cereals, oilseed and legume crops</td>
<td>Redlegged earth mite (Not Qld)</td>
<td>100 mL/ha</td>
<td>Spray on appearance and before damage occurs. If second hatching occurs, a follow-up spray may be required.</td>
<td>Pastures, cereals, oilseed and legume crops</td>
</tr>
<tr>
<td>Pasture mite (bryobia mite) (NSW only)</td>
<td>120 mL/ha</td>
<td>Spray on appearance and before damage occurs.</td>
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<td></td>
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<tr>
<td>Pasture legumes, lucerne, faba bean, vetch</td>
<td>Bluegreen aphid</td>
<td>100 or 200 mL/ha</td>
<td>Spray when aphids start to build up. Use the higher rate when faster knockdown is required.</td>
<td>Pasture legumes, lucerne, faba bean, vetch</td>
</tr>
<tr>
<td>Cowpea aphid</td>
<td>200 mL/ha</td>
<td>Spray when aphids start to build up.</td>
<td>Cowpea aphid</td>
<td></td>
</tr>
<tr>
<td>Pasture clover</td>
<td>Spotted aphid</td>
<td>100 mL/ha</td>
<td>Apply at first sign of aphid activity.</td>
<td>Pasture clover</td>
</tr>
<tr>
<td>Barrier spraying</td>
<td>Redlegged earth mite (NSW, WA only)</td>
<td>300 mL/ha</td>
<td>To prevent invasion, spray bare earth outside crop as well as weeds along the fenceline using an offset jet. <strong>Note:</strong> Rain will reduce the efficacy of the bare-earth treatment but leave an effective barrier on the weeds.</td>
<td>Barrier spraying</td>
</tr>
<tr>
<td>Poppy</td>
<td>Redlegged earth mite (tas. only)</td>
<td>100 mL/ha</td>
<td>Spray on appearance and before damage occurs.</td>
<td>Poppy</td>
</tr>
</tbody>
</table>

Withholding periods **DO NOT GRAZE OR CUT FOR STOCK FOOD FOR 1 DAY AFTER APPLICATION**

IMPACT ON INSECT PREDATORS

The insecticide chosen for the control of earth mite, lucerne flea and aphids should have minimal impact on the native or introduced predator and parasite population.

The key biological agents include:

<table>
<thead>
<tr>
<th>Biological agent</th>
<th>Common name</th>
<th>Pest attacked</th>
<th>Origin</th>
</tr>
</thead>
<tbody>
<tr>
<td>Balatrustum munorum</td>
<td>Balatrustum mite</td>
<td>Other mite and lucerne flea</td>
<td>Native</td>
</tr>
<tr>
<td>Neozygites sp.</td>
<td>Fungal disease</td>
<td>Other mite</td>
<td>Native</td>
</tr>
<tr>
<td>Bdellodes lapidaria</td>
<td>Pasture snout mite</td>
<td>Lucerne flea</td>
<td>Native</td>
</tr>
<tr>
<td>Neomolgus capillatus</td>
<td>Spiney snout mite</td>
<td>Lucerne flea</td>
<td>Introduced</td>
</tr>
<tr>
<td>Anystis sp.</td>
<td>Whirligig mite</td>
<td>Other mite</td>
<td>Native and introduced</td>
</tr>
</tbody>
</table>

Tests have found that Le-mat has little effect on key predators. The beneficial populations may show a temporary decline but recovery is rapid.

Dialectia scalaria is a leaf-mining moth introduced for the biological control of Paterson’s curse. Le-mat has been tested against this beneficial insect and has been found to be safe.

GRAPH 2: Leaf miner parasite (Dialectia scalaria).

Source: JWW 287, 1990, Yanco NSW
THE VALUE OF PASTURE PEST CONTROL

Earth mite, lucerne flea and bluegreen aphid infestations cost the wool industry hundreds of millions of dollars in lost production every year.

Such enormous losses to the industry can be avoided by the judicious use of cost-effective insecticides such as Le-mat.

As this graph shows, an autumn application of Le-mat that would now cost around $3/ha resulted in maximum pasture production, simply because a miticide was applied at the right time.

The first steps towards limiting the loss and damage from pasture pests are to:

• Monitor the pasture and crops.
• Make a record of your observations.
• Record the scale of damage.
• Get the pests identified. This is critical.

Crop monitoring for mites

Mites prefer high humidity and therefore tend to spend sunlight hours down in the crop or pasture. The best time to check for mites is at dusk or during cloudy days.

Samples can be collected by either swiping leaves and brushing the resulting catch onto a white paper or by using a small self-powered vacuum cleaner. Using a margarine container and sweeping the pasture with an arm’s-length stroke is also effective.
It is very important that farmers appreciate the need for frequent monitoring, especially at and after the autumn break and in the early spring. These are the times mites can do the most damage and when numbers can reach 20,000 per m². Monitoring should be done around the paddock and in it. A brief look at only one section, especially at the edge of the crop or pasture, can lead to an incorrect assessment. Heavy and unnecessary loss can be the result.

Every year newly sown pastures are wiped out because monitoring was not carried out.

**Damage symptoms**

Earth mites feed by rasping and sucking the plant cell contents, creating a silvering/whitish look on leaves. Mite damage can be distinguished from that of lucerne flea as mites leave no holes in the foliage.

**When to use an aphicide**

There are many species of aphids that can attack pastures and crops. Le-mat is registered for control of a number of them – but not all. Some aphids are more difficult to control and require a specific aphicide.

It is important that the species of aphid attacking the crop or pasture is identified. A decision can then be made as to product choice.

It is impossible to identify pests reliably with the naked eye. Use a magnifying glass, hand lens or low-powered microscope to accurately identify the pests that are present – remembering that it is common for more than one species to proliferate at the same time.

**The economic threshold levels for treatment**

If you have any two pests (mites and fleas or mites and aphids), you will already have passed the economic threshold – the point at which effective spraying will save you money.

Lucerne fleas should be sprayed within one week of being sighted, since they build up rapidly and chew ‘window-pane’ holes in the leaves. Once the holes appear, yield will have been lost and palatability greatly decreased.

Thresholds have not been formally determined for mites, but they are quite low because mite damage can be so extensive and Le-mat only costs a few dollars per hectare.

**MAJOR PASTURE PESTS**

**Redlegged earth mite** (Halotydeus destructor)

Redlegged earth mites (RLEM) are found throughout the temperate areas of Australia. The autumn break is traditionally regarded as earth mite time. RLEM eggs hatch with the onset of cooler weather – with the autumn break, rain and temperatures below 20˚C.

Being the best known mites, RLEMs are readily identified. They have black bodies and the adults have eight red legs. They are approximately 1 mm in length. The life-cycle proceeds through a six-legged nymphal stage to the eight-legged adult.

The winter generations take four to six weeks to reach maturity. This is why it is important to control them before they reach maturity and begin laying their own eggs. Best spray timing practices are further discussed on page 18.

RLEM are more gregarious than blue oat mites and tend to feed in clusters. They also seem to prefer legumes and some grasses to cereals, whereas blue oat mites are thought to prefer grasses.

In the spring, RLEM change from laying winter eggs to producing diapause eggs which are capable of over-summering on their own or within the body of the dead female.

**Effect of seasonal conditions on RLEM survival**

<table>
<thead>
<tr>
<th>SEASON</th>
<th>FAVOURABLE</th>
<th>UNFAVOURABLE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Summer</td>
<td>Dry &amp; hot</td>
<td>Wet &amp; hot</td>
</tr>
<tr>
<td>Autumn</td>
<td>Dry, cold &amp; mild</td>
<td>Wet, cold &amp; mild</td>
</tr>
<tr>
<td>Winter</td>
<td>Dry, cold &amp; mild</td>
<td>Wet, cold &amp; mild</td>
</tr>
<tr>
<td>Spring</td>
<td>Wet &amp; mild</td>
<td>Dry &amp; warm</td>
</tr>
</tbody>
</table>

This table shows which weather conditions have a major effect on the RLEM population.

**Graph 7:** Redlegged earth mite control in pasture.
Blue oat mite (*Pentakeus major*)

Traditionally, it was thought that blue oat mite (BOM) was only a pest of the warmer summer rainfall area north of Dubbo, NSW. Surveys have now shown it is found throughout Australia but population levels may well be lower in cooler areas.

BOM can be distinguished from RLEM by the red spot on the back of the BOM. There are also a number of differences in the two pests’ life-cycles and feeding habits.

BOM tend to prefer grasses and cereals and have less tendency to form clusters than RLEM.

BOM lay aestivating eggs from late winter onward and these perform the same function as the RLEM diapause eggs in that they allow the pest to over-summer and hatch with the following autumn break.

The main characteristic difference in the over-summering egg type is that the BOM, being adapted to more northern areas, requires an egg that will survive during the heavy summer rains.

There are usually two generations per year. The first generation lays about 60 winter eggs. These hatch and pass through the usual mite larval and nymphal stages before becoming adults. The first generation of winter mites appears to live only one to two months, whilst the second generation is longer lived and peak numbers are to be found around September and early October.

The traditional range of chemicals used to control RLEM produces a range of varying efficacy against BOM – from poor to good results. Trial results show that Le-mat is very effective at controlling BOM.

**GRAPH 8:** Blue oat mite in 2-leaf wheat.

Pasture mite (*Bryobia repensii*)

The pasture mite is one of the four species of bryobia mite. *Bryobia* mites are usually associated with orchards (e.g., *Bryobia rubriculosis*).

*Bryobia* mites are predominantly a spring, summer and autumn pest. They do not like cold, wet winters and are best served by a wet summer and a warm mild autumn. When pasture mites appear in broadacre situations, they tend to prefer pulse or oilseed crops such as lupins, faba beans or canola.

*Bryobia* mites are more suited to northern NSW and southern Queensland and to many parts of Western Australia. Their life-cycle stages are similar to the two major pasture mites, in that they hatch into a six-legged nymph which is at first orange in colour, but then turns green. Later they moult into the eight-legged adult. Their basic colouring is similar to that of RLEM and BOM, except that their front legs are much longer and their bodies are more of a brown/green with lighter orange legs.

Unlike RLEM or BOM, *Bryobia* mites lay eggs over winter. They hatch as the spring or summer dries and warms. These over-wintering eggs are laid in batches, whilst summer-laid eggs are laid individually.

Pasture mites can be confused with other mites, so it is important to get an accurate identification. Control procedures can then be tailored to match their different life-cycle.

*Le-mat* is the only insecticide registered in pasture for this pest and other insecticides such as the pyrethroids have been found to be ineffective.

**GRAPH 9:** Lucerne flea control in pasture.

Lucerne flea (*Sminthurus virdis*)

Lucerne fleas are small, yellow or white, and globular in shape with a characteristic jumping or springing movement. They are widely distributed throughout southern Australia.

Before the heat in late spring 40–200 eggs can be laid in two batches by each female. Each batch is covered with a gluey, semi-waterproof mass secreted by the adult. This enables the eggs to carry through the summer and early autumn, unaffected by light or heavy rain.

In autumn, when the drying process is slower, eggs will be triggered to hatch after substantial rain. Slow drying conditions at this time will promote fairly fast, uniform hatching. Light falls of rain and fast drying will tend to prolong hatching, which may go on for several months. Under favourable conditions, eggs will hatch in about eight days at 25°C and 12 days at 20°C.

Under unfavourable conditions, egg batches may remain unhatched for 12–13 months. If the weather is dry, newly hatched fleas will die if the temperature rises above 20°C.

Spraying is best carried out in autumn, after the fleas have hatched, but before they can commence their own egg laying. This spray should then be three to four weeks after the initial hatching, or later if the hatching has been staggered.

**GRAPH 10:** Lucerne flea control.
Bluegreen aphid (*Acyrthosiphon kondoi*)

The bluegreen aphid (BGA) is usually found in lucerne or clover pastures. It is widespread throughout Australia. Like all aphids, BGA are all females and give birth to live offspring. Over several weeks, they can produce as many as 100 young.

BGA appear mainly in the autumn and spring. They usually colonise the tops of plants and suck sap from leaf cells, causing wilting and distortion of leaves.

Le-mat gives satisfactory control of BGA, however if the population is heavy and a rapid knockdown and long residual control are needed, then a "true" aphicide should be used.

**GRAPH 11: Bluegreen aphid control.**

Source: JES 342, Cowra, NSW.

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Spotted alfalfa aphid (*Theroioaphis trifolii*)

The spotted alfalfa aphid (SAA) is mainly a pest of lucerne and is found in southern Australia. Like other pasture aphids, it can be carried in by the wind and build up in numbers very quickly. This aphid also produces live young. One female can produce up to 100 nymphs, at a rate of six or seven per day if conditions are favourable.

Research work indicates there can be as many as 20–40 generations per year. They thrive in warm temperatures and can reach maturity in one to two weeks. In cooler weather it will take three to four weeks. Whilst the SAA prefers warmer conditions, it can survive freezing weather – development can still take place from 6˚C up to a top of 32˚C, 26–29˚C is the optimum range for speedy development.

Both winged and wingless adult females will be evident in a population. The development of the wings is induced as a counter measure against over-crowding amongst nymphs.

Le-mat does not give satisfactory control of SAA.

Spotted clover aphid (Biotype of *Theroioaphis trifolii*)

The spotted clover aphid (SCA) is a relatively recent addition to the Australian scene, and the Le-mat label has been extended to include it. Researchers are still trying to establish if SCA is a biotype of the spotted alfalfa aphid or a different subspecies.

It has now been found in Western Australia, the Riverina, the Murray Valley and a number of New South Wales coastal districts.

Whilst similar to the spotted alfalfa aphid, the SAA tends to be found more on lucerne and medics, whilst the SCA prefers clovers. The fact that it lives on a wider range of plant host species supports the theory that this pest might be a new subspecies.

Research indicates that the optimum temperature range for growth and reproduction is very similar to the other aphids.

SCA are particularly damaging on stressed clover pasture in the autumn. This aphid is thought to transmit a virus and infestations have been known to kill established plants.

Bayer trials have shown that Le-mat will control this aphid at 100 mL/ha. In the SAA/SCA debate, it is interesting to note that the SCA can be controlled with Le-mat, whilst SAA needs an application of a specific aphicide.

**% control of aphids (No/m² in untreated)**

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Days after control</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>+7</td>
</tr>
<tr>
<td>UTC</td>
<td>85</td>
</tr>
<tr>
<td>Le-mat</td>
<td>97</td>
</tr>
</tbody>
</table>

Source: JES 492, Finley NSW. Clover Pasture

---

Cowpea aphid (*Aphis craccivora*)

This aphid is a pest of lupins, vetch and faba beans. It has been found across Australia.

The cowpea aphid first appears in early winter. Winged adults will colonise a few plants and then give birth to live wingless nymphs.

Aphids attack the leaves and growing points and damage plants by sucking the sap. Plants become distorted and flowering can be seriously affected.

Cowpea aphids can also transmit virus diseases.
Research into the life-cycle and habits of red-legged earth mites has shown there are two critical application times:

From 2 to 5 weeks after the autumn break
Earth mites hatch after the opening rains in autumn. The young nymphs take 4 to 8 weeks to reach maturity and lay their eggs. If a spray is applied prior to mite maturity, then the life-cycle is broken.

Start of spring
During spring, earth mites begin to lay a special type of egg (over-summer or diapause egg) that can survive the harsh summer conditions and then hatch next autumn. If the mites are killed prior to laying these diapause eggs, then very few eggs will be laid to carry-over.

Limited research work indicates that these spray timings are also suitable for blue oat mite and lucerne flea despite the differences in their life-cycles.

Benefits of autumn application
Superphosphate/Le-mat Interaction
In WA in 1990, a trial on medic pasture showed that the addition of superphosphate did not improve pasture production unless earth mites were removed.

Greater pasture production
In WA in 1974, a trial conducted by Nicholas and Hardy (WA Dept of Agriculture Journal) clearly showed the impact of earth mites on pasture growth (graph 13). Pasture was sprayed on 2nd May and growth assessed on 26th June. Mite numbers reached 5,000 per m² in the untreated area, which is a typical farm situation.

Benefits of spring application
Sheep prefer grazing areas treated with Le-mat
In a trial at the CSU Wagga, the grazing behaviour of sheep was recorded after half the paddock had been sprayed with Le-mat.

The sheep preferred to graze the Le-mat treated area, presumably because the lack of mites improved the digestibility and palatability of the herbage. Earth mites and lucerne fleas suck the nutrients from leaves, damaging the leaves and soiling of the foliage. A drop in pasture quality results.

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Le-mat v Pyrethroid pasture trial. Pasture quality analysis (NIR)

<table>
<thead>
<tr>
<th>Pasture treatment</th>
<th>Analysis type</th>
<th>Crude protein %</th>
<th>Digestibility %</th>
<th>Established metabolisable energy MJ/kg</th>
</tr>
</thead>
<tbody>
<tr>
<td>Untreated</td>
<td></td>
<td>24.1 b</td>
<td>71.3 b</td>
<td>10.1 b</td>
</tr>
<tr>
<td>Alphacypermethrin</td>
<td></td>
<td>24.7 b</td>
<td>72.2 b</td>
<td>10.3 b</td>
</tr>
<tr>
<td>Le-mat</td>
<td></td>
<td>26.1 a</td>
<td>75.0 a</td>
<td>10.8 a</td>
</tr>
<tr>
<td>LSD 0.05</td>
<td></td>
<td>1.099</td>
<td>1.754</td>
<td>0.307</td>
</tr>
</tbody>
</table>

Source: JES 487, Walla Walla, NSW

Near Infra Red Spectrophotometry (NIR) is a method of determining pasture quality using photometric comparison.

In another replicated pasture trial (JES 487) at Walla Walla in 1995, one spray was applied on September 1st to control earth mite and lucerne flea.

Le-mat controlled both pests and produced a significant improvement in pasture quality.

Alphacypermethrin controlled earth mite but not lucerne flea and did not significantly improve pasture quality.

**Improved clover % in pasture**

After two years of the CSU trial (JES 337), the subterranean clover component in the unsprayed area had declined so significantly it had reached an unacceptable level. Interestingly, the main pasture component that replaced the clover in the unsprayed plots was silver grass (*Vulpia* spp.).

**GRAPH 16: % sub clover in sward.**

Greater hay production

Numerous trials over the years have illustrated the effect earth mites have on hay production.

In the CSU trial at Wagga, the seed-set of pasture in the sprayed and unsprayed areas was measured. Protecting the flowers from earth mite attack significantly increased the quantity of seed-set and increased the size of the seed. This has clear ramifications for increased pasture longevity.

**Subterranean clover seed-set**

<table>
<thead>
<tr>
<th>Seed yield g/m²</th>
<th>Unsprayed</th>
<th>Le-mat</th>
<th>Increase</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>53</td>
<td>94</td>
<td>77%</td>
</tr>
<tr>
<td>1000 seed weight (g)</td>
<td>4.5</td>
<td>8</td>
<td>78%</td>
</tr>
<tr>
<td>Autumn emergence plants/m²</td>
<td>1510</td>
<td>3593</td>
<td>137%</td>
</tr>
</tbody>
</table>

Source: CSU, 1992, Wagga Wagga, NSW

**GRAPH 17: Leaf damage in sub clover.**

Fewer earth mites in autumn with a spring spray

One of the major benefits of the spring spray is the breaking of the life-cycle of the earth mite. Mites begin to lay over-summering (or diapause) eggs during the latter part of spring.

The reason why mites begin the production of diapause eggs has not been clearly identified but is certainly a response to the less favourable seasonal conditions as summer approaches.

These eggs are able to survive the harsh summer, then hatch in the autumn and attack newly emerging crops and pasture plants. If the adult mites are killed before they lay their diapause eggs, then the life-cycle is effectively broken and mite numbers reduced next autumn.

In the CSU trial at Wagga, the pasture trial area was sown to canola. The emergence of earth mite was greatly reduced where a spring spray was applied and this resulted in improved canola establishment.

**Canola establishment after a spring spray**

Earth mite and lucerne flea have a significant impact on pasture and crop productivity. Timely application of Le-mat will provide maximum benefit for minimal outlay.
Bare-earth spraying

When earth mite hatching coincides with seedling emergence there is potential for significant seedling mortality. Seedlings are most susceptible just as the cotyledons break the soil surface. If a timely spring spray has not been applied, mite pressure may be extreme and a bare earth spray is needed.

Le-mat (omethoate)

Thiodan® (endosulfan) is still the best bare-earth insecticide. However, Le-mat is as good as Supracide and Imidan® on bare earth. Work at Yanco showed the potential for Le-mat:

a) Yanco, NSW Agric, 1989
As a bare-earth spray at 150 mL/ha under low rainfall conditions (3.3 mm), Le-mat controlled earth mites for 11 days.

b) Bayer, Pot Trial, 1991
Soil in pots was treated at 50 mL/ha in 213 L water/ha. Earth mites were introduced to treated and untreated pots 2, 4, 6, 8, 12 and 14 days after treatment. In each case, Le-mat killed mites within 48 hours of exposure to the treated soil. So Le-mat, applied to the soil, may kill mites for at least two weeks after treatment.

c) Yanco, NSW Agric, 1991
Under dry conditions, Le-mat at 100 mL/ha applied to the soil (in 50 L of water/ha) provided 82% control after 6 days and 27% control after 20 days.

Field trials in 1994 confirmed that, under dry conditions, Le-mat will give effective control of earth mite (even better than pyrethroids), but when rain falls the deposit is destroyed. It is difficult to define the type/amount of rain, but a light shower does not reduce control.

At Langkoop (PJH 94), 10 mm of rain fell overnight after spraying. These results clearly demonstrate that Le-mat works on bare soil under dry conditions, but control is poor when rain falls.

Near-bare-earth spraying

Emerging winter legume and cereal crops may be attacked by earth mite and lucerne flea. Spraying at this stage mainly relies on knockdown, because the small amount of green leaf area present limits residual control.

Numerous trials have shown that Le-mat performs as well under these conditions as Supracide and Imidan.

There is a possibility that the widespread use of the pyrethroids will shift the pest spectrum and lucerne flea may come to predominate.

However, the pyrethroids are a different chemical group to the organophosphates (OPs) and for a resistance strategy, the alternation of pyrethroids (where there are no lucerne flea present) and OPs may be a sensible approach.
**Spring spraying**

Earth mites hatch in the autumn after sufficient opening rains. This hatching often coincides with the emergence of newly sown crops and regenerating pasture. The most susceptible stage for grass and legume plants to earth mite attack is during this emergence period. The traditional approach to earth mite control has been to spray when earth mite damage is apparent. Farmers may apply a bare-earth spray or a foliar spray to limit mite damage at this critical stage. However these applications may not be totally successful for a number of reasons including poor timing or being accessible in inclement weather.

The alternative management practice is to take preventive action by removing the threat of mite attack. This is done by controlling earth mites in the previous spring.

The major benefit of the spring spray is to break the life-cycle of the earth mite. Mites begin to produce over-summering (or diapause) eggs during the spring. These eggs survive the harsh summer. They hatch in the autumn and the mites attack newly emerging crop and pasture plants. If the adult mites are killed before they lay their over-summering eggs then the life-cycle is effectively broken and mite numbers will be reduced next autumn. This practice has been adopted by a number of farmers, particularly canola growers.

**When is the best spray timing in the spring to break the life-cycle?**

A large scale unreplicated trial was initiated at Yerong Creek, NSW in the spring of 1992. A 16-hectare paddock was divided into four blocks, each of four hectares. Three of the blocks were treated with Le-mat at the label rate and at one of the following timings:

- Untreated (not sprayed)
- Sprayed in early September
- Sprayed in late September
- Sprayed at spray-topping time

The egg numbers in the adult earth mites were monitored over the spring period. Mites were dissected to reveal the total number of eggs present. Work by Dr. David James at the Agricultural Research Institute, Yanco, has determined that when total egg numbers in each female earth mite reach approximately 20, then diapause egg production has begun. The first two spray timings were applied when few diapause eggs had developed but the spray-topping timing was applied after the development of many diapause eggs.

All spring spray treatments gave virtually total control of the earth mite (adult and nymph) population.

The early September spray timing provided the best control of earth mite the following autumn. This control endured until the spring. The late September timing was nearly as effective, but the earth mite population exhibited substantial recovery by the following spring. The spray topping timing reduced mite numbers the next autumn by only 60%. This reduction may not be sufficient to adequately protect emerging autumn crop and pasture plants.

The specific timing of the spring spray has been determined for each district and the timing is constant each year, irrespective of crop or environmental conditions.

**Spring spraying with Le-mat**

**Date assessed**

<table>
<thead>
<tr>
<th>Date assessed</th>
<th>Untreated</th>
<th>Early Sept</th>
<th>Late Sept</th>
<th>Spray Top</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nov 1992</td>
<td>1012</td>
<td>980</td>
<td>358</td>
<td></td>
</tr>
<tr>
<td>July 1993</td>
<td>0%</td>
<td>20%</td>
<td>12%</td>
<td></td>
</tr>
<tr>
<td>Sept 1993</td>
<td>100%</td>
<td>89%</td>
<td>63%</td>
<td></td>
</tr>
</tbody>
</table>

```
Mean number of earth mites per sweep

<table>
<thead>
<tr>
<th>Date of assessment</th>
<th>Untreated</th>
<th>Early Sept</th>
<th>Late Sept</th>
<th>Spray Top</th>
</tr>
</thead>
<tbody>
<tr>
<td>03-11-92</td>
<td>27.4*</td>
<td>1.2</td>
<td>0.5</td>
<td>21.0</td>
</tr>
<tr>
<td>01-12-92</td>
<td>18.5</td>
<td>0</td>
<td>0.1</td>
<td>0</td>
</tr>
</tbody>
</table>

* Core sample recorded 1012 mites/m² Source: JES 398, Yerong Creek, NSW
```

In the following autumn, the numbers of earth mites hatched in each treated area were counted. Mites were collected by use of a vacuum cleaner and numbers (adults and nymphs) were counted.

**Conclusion**

Prevention of a problem is much better than the ‘fire brigade’ approach. To protect emerging crop and pasture plants in the autumn, an application of Le-mat to control earth mite and lucerne flea in the early spring can result in the following benefits:

- Improved palatability of pasture
- Increased stock intake
- Improved clover % in pasture
- Greater pasture feed value
- Increased hay yields
- More $ return
- Protection of seed-set of legumes
- Increase pasture longevity

**Strategy for the manipulation of a redlegged earth mite population**

Further research will be required to determine if these basic principles can be also used for the control of blue oat mite (*Penthaleus major*). Considerable benefits for pasture quality and quantity can also result from removing earth mites early in the spring period. Research by Bayer and the Charles Sturt University at Wagga Wagga has clearly shown that using Le-mat to control earth mite and lucerne flea in the early spring can result in the following benefits:

- Improved palatability of pasture
- Increased stock intake
- Improved clover % in pasture
- Greater pasture feed value
- Increased hay yields
- More $ return
- Protection of seed-set of legumes
- Increase pasture longevity

**Conclusion**

Prevention of a problem is much better than the ‘fire brigade’ approach. To protect emerging crop and pasture plants in the autumn, an application of Le-mat in early spring of the previous year is the best timing for earth mite control.

**Strategic spring sprays offer an excellent management tool for the manipulation of a redlegged earth mite population. Further research will be required to determine if these basic principles can be also used for the control of blue oat mite (*Penthaleus major*).**
QUESTIONS & ANSWERS

Can Le-mat be used with pre-emergence incorporated herbicides?
Yes, Le-mat is compatible with many pre-emergent herbicides. The drawback is that Le-mat will only kill the mites it comes into contact with. Once incorporation is complete, Le-mat will be inactivated.

When should you use a barrier spray?
Whenever there is a mite-infested pasture alongside a new crop or pasture. The barrier will provide residual protection (even if it rains) for up to 6 weeks. At the rate of 300 mL/ha, the length of control has not been established under trial conditions, but the protection should last until the cold winter weather suppresses mite activity anyway.

How wide should the barrier be?
The effectiveness of the barrier really depends on how many broadleaf weeds it contains. A narrow band of tall thistles and capeweed could be just as effective as a wider band of small broadleaf weeds. Three metres used to be quoted as a standard distance, but that was just because it is a convenient swath width for an offset jet. Unless the weed coverage is quite dense, a wider barrier would be better still.

How can Le-mat be rainfast if it is soluble in water?
Because it is systemic and moves rapidly into the plant. Once inside it is not affected by rain. Less systemic treatments like Rogor® are seriously affected by rain.

How does rain affect bare-earth treatments?
With no plants to absorb them, even 6 mm rain will make Le-mat and other treatments like Imidan and Supracide ineffective when they are applied to bare earth, by diluting the surface barrier further into the soil.

Does Le-mat kill eggs?
No. No chemicals currently available kill over-summering or over-wintering eggs. The advantage of Le-mat is that it has enough residual longevity to kill the mites that emerge from a staggered hatching 3 weeks after application.

Will yields increase if the rate of Le-mat is increased?
The 100 mL rate of Le-mat gives increased plant numbers and weight at establishment, increased pasture and crop yields in both autumn and spring, increased legume seed yields and improved pasture quality. Increased rates are unnecessary, since they do not enhance the knockdown effect or extend Le-mat’s residual control.

THE KEY ADVANTAGES OF LE-MAT

• Versatility. Le-mat can be used as a foliar, barrier or bare-earth spray.
• Reliability. Le-mat has provided many years of dependable knockdown mite control and residual plant protection.
• Compatibility. Le-mat can be mixed with a variety of herbicides without affecting their herbicidal activity.
• Systemic activity. Le-mat will kill mites in the densest pasture.
• Rainfastness. Le-mat is not affected by frost, dew or rain that occurs later than one hour after spraying.
• Registrations. Le-mat is registered on several pests in a wide range of crops as well as pasture.
• Cost-effectiveness. Just one litre of Le-mat will protect 10 ha of crop or pasture.
For more information on using Le-mat in your crops or pasture, contact your local Bayer CropScience specialist:

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