Blue Oat Mite

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Blue oat mites (BOM) (Penthaleus spp.) are species of earth mites which are major agricultural pests of southern Australia and other parts of the world, attacking various pasture, vegetable and crop plants. BOM were introduced from Europe and first recorded in New South Wales in 1921. Management of these mites in Australia has been complicated by the recent discovery of three distinct species of BOM, whereas prior research had assumed just a single species.

Identification

Figure 1: Adult blue oat mite (Penthaleus spp.). Photo: A. Weeks (CESAR).

Adult BOM are 1 mm in length and approximately 0.7-0.8 mm wide, with 8 red-orange legs. They have a blue-black coloured body with a characteristic red mark on their back (Figure 1). Larvae are approximately 0.3 mm long, are oval in shape and have three pairs of legs. On hatching, BOM are pink-orange in colour, soon becoming brownish and then green.

BOM are often misidentified as redlegged earth mites (RLEM) in the field, which has meant that the damage caused by BOM has been under-represented. Despite having a similar appearance, RLEM and BOM can be readily distinguished from each other. RLEM have a completely black coloured body and tend to feed in larger groups of up to 30 individuals. BOM have the red mark on their back and are usually found singularly or in very small groups.

Distribution
The distribution of BOM is likely to be limited by the environmental conditions needed to successfully enter and complete the over-summering phase (known as diapause), as well as conditions needed for emergence to coincide with the growth of winter pastures and crops.

BOM are widespread throughout most agricultural regions of Australia with a Mediterranean-type climate. BOM are one of the most important pest mites in cropping and pastoral areas of New South Wales, Victoria and Tasmania. They are also a pest in southern Queensland, the south-east of South Australia and the south-west of Western Australia (Figure 2). Recent surveys have shown an expansion of the range of BOM in Australia over the last 30 years.

During winter, individual adult BOM move between plants over distances of several metres. Long range dispersal is thought to occur via movement of eggs carried on soil adhering to livestock and farm machinery, and through the transportation of plant material. Movement also occurs during summer when diapause eggs are blown by winds.

**Biology**

There are three pest species of BOM in Australia, which complicates control. These species differ in their distribution, pesticide tolerance and crop plant preferences. Despite these differences, all BOM species are often treated identically in terms of control. This is a concern as eradication of one species may result in another BOM species becoming relatively more abundant.

Distinguishing between the BOM species in the field is difficult because a microscope is needed to see the morphological traits that separate each species. Preliminary work has started on developing a rapid and simple paddock test to determine the mite species present in individual properties.

The main difference between species is the length and number of setae (bristle or hair-like structures) on the back of the mite (Figure 3). Penthaleus major has long setae arranged in four to five longitudinal rows, while Penthaleus falcatus has a higher number of short setae scattered irregularly. Penthaleus tectus has setae of medium length and number.

**Life-cycle**
BOM are active in the cool wet part of the year, usually between April and late October. During this time they pass through two or three generations, with each generation lasting eight to ten weeks. They spend the remaining months protected as 'diapause' or over-summering eggs that are resistant to the heat and dessication of summer. These hatch in autumn following cool temperatures and adequate rainfall, when conditions are optimal for mite survival. Swarms of mites may then attack emerging crop and pasture seedlings.

Female mites deposit eggs either singly or in clusters of three to six on the leaves, stems and roots of food plants or on the soil surface. Those on the leaves are usually fastened by a slimy substance that is secreted next to and on the stem of plants.

Unlike many agricultural pests in Australia, BOM reproduce asexually. This mode of reproduction results in populations made up of female 'clones' that can respond differently to environmental and chemical conditions. This may influence the likelihood of populations developing resistance and means BOM populations could respond differently to control strategies.

**Behaviour & Damage**

Figure 3: Blue oat mite species (a: P.
major; b: P. falcatus; c: P. tectus) highly magnified to show the rows of setae along the back of the mite. Photos: A. Weeks (CESAR).

BOM spend the majority of their time on the soil surface, rather than on the foliage of plants. They are most active during the cooler parts of the day, tending to feed in the mornings and in cloudy weather. They seek protection during the warmer part of the day on moist soil surfaces or under foliage, and may even dig into the soil under extreme conditions.

BOM attack a variety of agriculturally important plants, including cereals, grasses, canola, field peas, legumes and numerous weeds. There are differences in the plant types attacked by the three BOM species (Table 1). P. major primarily feeds on oats and thick-bladed grasses within pastures. P. falcatus predominantly attacks canola and broad-leaved weeds, while P. tectus prefers cereals. These preferences can be used as an indication of the species present in a particular paddock, however confirmation by an expert is recommended.

Table 1: List of agriculturally important crops attacked by blue oat mites in Australia.

<table>
<thead>
<tr>
<th>Species</th>
<th>P. major</th>
<th>P. falcatus</th>
<th>P. tectus</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pasture</td>
<td>++</td>
<td>+</td>
<td>++</td>
</tr>
<tr>
<td>Cereals</td>
<td>++</td>
<td>+</td>
<td>++</td>
</tr>
<tr>
<td>Canola</td>
<td>-</td>
<td>++</td>
<td>-</td>
</tr>
<tr>
<td>Lucerne</td>
<td>+</td>
<td>-</td>
<td>+</td>
</tr>
<tr>
<td>Lentils</td>
<td>+</td>
<td>-</td>
<td>+</td>
</tr>
<tr>
<td>Peas</td>
<td>+</td>
<td>+</td>
<td>-</td>
</tr>
</tbody>
</table>

- rarely attacked;
+ occasionally attacked;
++ commonly attacked

Figure 4: Typical blue oat mite feeding damage to a canola seedling.

Typical mite damage appears as 'silvering' or 'whitening' of the attacked foliage. Mites use adapted mouthparts to lacerate the leaf tissue of plants and suck up the discharged sap. Resulting cell and cuticle destruction promotes desiccation, retards photosynthesis and produces the characteristic silverying that is often mistaken as frost damage (Figure 4). BOM are most damaging to newly establishing pastures and emerging crops, greatly reducing seedling survival and retarding development.
Young mites prefer to feed on the sheath leaves or tender shoots near the soil surface, while adults feed on more mature plant tissues. BOM feeding reduces the productivity of established plants and is directly responsible for reductions in pasture palatability to livestock. Even in established pastures, damage from large infestations may significantly affect productivity.

The impact of mite damage is increased when plants are under stress from adverse conditions such as prolonged dry weather or waterlogged soils. Ideal growing conditions for seedlings enable plants to tolerate higher numbers of mites.

Carefully inspect susceptible pastures and crops from autumn to spring for the presence of mites and evidence of damage. It is especially important to inspect crops regularly in the first three to five weeks after sowing. Mites are best detected feeding on the leaves in the morning or on overcast days (Figure 5).

Control

![Pasture seedling](image.png)

*Pasture seedling. Photo: A. Weeks (CESAR).*

Chemical control

Chemicals are the most common method of control against earth mites. Unfortunately, all currently registered pesticides are only effective against the active stages of mites; they do not kill mite eggs.

While a number of chemicals are registered in pastures and crops, differences in tolerance levels between species complicates management of BOM. *P. falcatus* has a high natural tolerance to a range of pesticides registered against earth mites in Australia and is responsible for many control failures involving earth mites. The other BOM species have a lower level of tolerance to pesticides and are generally easier to control with chemicals in the field.

Chemical sprays are commonly applied at the time of infestation, when mites are at high levels and crops already show signs of damage. Control of first generation mites before they can lay eggs is an effective way to avoid a second spray. Hence, pesticides used at or after sowing should be applied within three weeks of the first appearance of mites, as adults will then begin laying eggs. While spraying pesticides in spring can greatly reduce the size of RLEM populations the following autumn, this strategy will generally not be as effective for the control of BOM.

Pesticides with persistent residual effects can be used as bare-earth treatments. These treatments can be applied prior to, or at sowing to kill emerging mites and protect the plants throughout their seedling stage.
Systemic pesticides are often applied as seed dressings to maintain the pesticide at toxic levels within the plants as they grow. This can help minimise damage to plants during the sensitive establishment phase, however, if mite numbers are high, significant damage may still occur before the pesticide has much effect.

To prevent the build up of resistant populations, spray pesticides only when necessary and rotate pesticides from chemical classes with different modes of action. To avoid developing multiple pesticide resistance, rotate chemical classes across generations rather than within a generation.

Information on the registration status, rates of application and warnings related to withholding periods, OH&S, residues and off-target effects should be obtained before making decisions on which pesticide to use. This information is available from the DEPI Chemical Standards Branch, chemical resellers, APVMA and the pesticide manufacturer. Always consult the label and MSDS before using any pesticide.

**Biological & cultural control**

Integrated pest management programs can complement current chemical control methods by introducing non-chemical options, such as cultural and biological control.

Although no systematic survey has been conducted, a number of predator species are known to attack earth mites in Australia. The most important predators of BOM appear to be other mites, although small beetles, spiders and ants may also play a role. The French anystis mite is an effective predator but is limited in distribution. Snout mites will also prey upon BOM, particularly in pastures. The fungal pathogen, Neozygites acaracida, is prevalent in BOM populations during wet winters and could be responsible for observed 'population crashes'.

Preserving natural enemies when using chemicals is often difficult because the pesticides generally used are broad-spectrum and kill beneficial species as well as the pests. Impact on natural enemies can be reduced by using a pesticide that has the least impact and by minimising the number of applications. Although there are few registered alternatives for BOM control, there are groups such as the chloronicotinyls, which are used in some seed treatments, that have low-moderate impacts on many natural enemies.

Cultural controls such as rotating crops or pastures with non-host crops can reduce pest colonisation, reproduction and survival, decreasing the need for chemical control. When P. major is the predominant species, canola and lentils are potentially useful rotation crops, while pastures containing predominantly thick-bladed grasses should be carefully monitored and rotated with other crops. In situations where P. falcatus is the most abundant mite species, farmers can consider rotating crops with lentils, while rotations that involve canola may be the most effective means of reducing the impact of P. tectus.

Many cultural control methods for BOM can also suppress other mite pests, such as RLEM. Cultivation will significantly decrease the number of over-summering eggs, while hot stubble burns can provide a similar effect. Many broad-leaved weeds provide an alternative food source, particularly for juvenile stages. As such, clean fallowing and the control of weeds within crops and around pasture perimeters, especially of bristly ox tongue and cats ear, can help reduce BOM numbers.
Appropriate grazing management can also reduce mite populations to below damaging thresholds. This may be because shorter pasture results in lower relative humidity, which increases mite mortality and limits food resources. Grazing pastures in spring to less than 2 t/ha Feed On Offer (dry weight), can reduce mite numbers to low levels and provide some level of control the following year.

Acknowledgement


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