BARLEY

SECTION 7

INSECT CONTROL

INTEGRATED PEST MANAGEMENT | APHIDS | ARMYWORM (LEUCANIA CONVEXA) | HELICOVERPA SPP. | MITES | LUCERNE FLEA (SMINHURUS VIRIDIS) | WEBWORM (HEDNOTA SPP.) | CUTWORM (AGROSTIS SPP.) | PEST SLUGS AND SNAILS | EARWIGS | LOCUSTS AND GRASSHOPPERS | DESIANA OR SPOTTED VEGETABLE WEEVIL (STERIPHUS DIVERSIPES) | COCKCHAFERS (SERICESTHIS SPP.)
Insect control

Barley like other cereals can be damaged by a wide range of insect pests and other arthropod pests including blue oat mite (*Pentaleus* spp.), redlegged earth mite (*Halotydeus destructor*), Bryobia mites (*Bryobia* spp.), Balanusium mites, cutworms, aphids, earwigs, armyworms, *Helicoverpa* spp., pasture webworm, pasture cockchafers, grass anethelids, lucerne flea (*Sminthurus viridis*), leaf hoppers, slugs, snails, millipedes, slaters and locusts (Table 1 and Table 2). Mice may also cause damage.

For current chemical control options, refer to the Pest Genie or Australian Pesticides and Veterinary Medical Authority (APVMA) websites.  

Table 1: *Pests that pose a risk to cereal crops*  

<table>
<thead>
<tr>
<th>High risk</th>
<th>Moderate risk</th>
<th>Low risk</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Soil insects, slug and snails</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Some crop rotations increase the likelihood of soil insects.</td>
<td>Information on pest numbers prior to sowing from soil sampling, trapping and/or baiting will inform management</td>
<td>Slugs and snails are rare on sandy soils</td>
</tr>
<tr>
<td>Cereal sown into a long-term pasture phase</td>
<td>Implementing integrated slug management strategy (burning stubble, cultivation, baiting) where there is a history of slugs</td>
<td></td>
</tr>
<tr>
<td>High stubble loads</td>
<td>Increased sowing rate to compensate for seedling loss caused by establishment pests</td>
<td></td>
</tr>
<tr>
<td>Above-average rainfall over summer–autumn</td>
<td></td>
<td></td>
</tr>
<tr>
<td>History of soil insects, slugs and snails</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Summer volunteers and Brassica weeds will increase slug and snail numbers</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cold, wet establishment conditions expose crops to slugs and snails</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Earth mites**

| Cereals adjacent to long-term pastures may get mite movement into crop edges | Leaf curl mite populations (transmitters of Wheat streak mosaic virus) can be increased by grazing and mild wet summers | Seed dressings provide some protection, except under extreme pest pressure |
| Dry or cool, wet conditions that slow crop growth increase crop susceptibility to damage | | |
| History of high mite pressure | | |

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High risk | Moderate risk | Low risk
---|---|---
**Aphids**  
Higher rainfall areas where grass weeds are present prior to sowing—higher risk of Barley yellow dwarf virus (BYDV) transmission by aphids  
Wet summer and autumn promotes survival of aphids on weed and volunteer hosts  
Wet autumn and spring promote the growth of weed hosts; when weed hosts dry off, aphids move into crops  
Planting into standing stubble can deter aphids landing  
Using seed dressings can reduce levels of virus transmission and delay aphid colonisation  
Using synthetic pyrethroids and organophosphates to control establishment pests can kill beneficial insects and increase the likelihood of aphid survival  
**Armyworms**  
Large larvae present when the crop is at late ripening stage  
High beneficial insect activity (particularly parasitoids)  
Rapid crop dry-down  
**Table 2: Incidence of pests of winter cereals**  

<table>
<thead>
<tr>
<th>Crop stage</th>
<th>Emergence</th>
<th>Vegetative</th>
<th>Flowering</th>
<th>Grainfill</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wireworms</td>
<td>Damaging</td>
<td>Present</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cutworm</td>
<td>Damaging</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Blackheaded cockchafer</td>
<td>Damaging</td>
<td>Present</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Earth mites</td>
<td>Damaging</td>
<td>Present</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Slugs, snails</td>
<td>Damaging</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Brown wheat mite</td>
<td></td>
<td>Damaging</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Aphids</td>
<td>Present</td>
<td>Damaging</td>
<td>Present</td>
<td>Present</td>
</tr>
<tr>
<td>Armyworm</td>
<td>Present–damaging</td>
<td>Present</td>
<td></td>
<td>Damaging</td>
</tr>
<tr>
<td>Helicoverpa armigera</td>
<td></td>
<td></td>
<td></td>
<td>Damaging</td>
</tr>
</tbody>
</table>

**Identification and reporting tools**

Accurate pest, weed and disease identification is vital for appropriate pest or disease management. Most importantly it helps identify possible new threats to agriculture and the environment.

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Effective farm biosecurity practices help to underpin the quality of Western Australian (WA) grain and have the potential to deliver the surveillance data required to demonstrate country or regional area freedom from pests.

Continued productivity depends on access to new and existing grains markets and this hinges on being able to provide quality evidence of freedom from certain harmful pests. Smart ‘apps’ and mobile technologies can offer growers advanced diagnostic capabilities to help document pests or quantify the spread of insecticide resistance.

DAFWA has developed a number of apps which can be used to report the presence of unfamiliar pests and diseases. 4

Click on the links below to download an app, or to make an online report.

MyPestGuide—allows you to identify pests and report your observations. DAFWA will respond to reports within 48 hours.

PestFax Reporter—report observations of pests and diseases in your paddocks to the Western Australian PestFax newsletter editor.

Alternatively, please contact DAFWA’s Pest and Disease Information Service on 1800 084 881 or email info@agric.wa.gov.au.

Use Table 3 and Table 4 to identify damage caused by key pests, and to assess risk and determine control measures for establishment pests. The MyCrop barley app is also helpful for diagnosis of pest, disease and nutrition.

### Table 3: Crop damage pest identification key—cereals 5

<table>
<thead>
<tr>
<th>Damage to crop</th>
<th>Pest</th>
</tr>
</thead>
<tbody>
<tr>
<td>Leaves or plants cut off and lying on the ground or protruding from small holes next to plants; brown caterpillars (up to 15 mm long) with black heads, present in web-lined tunnels; wheat or barley seeded into grassy pasture paddocks.</td>
<td>Webworm</td>
</tr>
<tr>
<td>Large portions of plants eaten and some leaves or plants cut off. Smooth, fat caterpillars up to 40 mm long usually found just under the soil surface and may curl up when disturbed.</td>
<td>Cutworms</td>
</tr>
<tr>
<td>Green material removed in irregular patches from one surface of the leaf leaving white window-like areas; paddocks may appear white; presence of dumpy, wingless, greenish yellow insects, which spring off plants when disturbed.</td>
<td>Lucerne flea</td>
</tr>
<tr>
<td>Leaves shredded or chewed, slimy trails.</td>
<td>Slugs and snails</td>
</tr>
<tr>
<td>Smooth, shiny brown animals with curved pincers at the end of the body. Damage irregular, often similar to slug damage, mostly in patches, when sown in heavy stubble.</td>
<td>Earwigs</td>
</tr>
<tr>
<td>Minor leaf chewing; presence of dark brown to black caterpillars up to 60 mm long with two yellow spots near posterior end.</td>
<td>Pasture day moth</td>
</tr>
<tr>
<td>Presence of tiny eight-legged (nymphs have six legs) velvety black or brown crawling creatures with orange-red legs, found on plants or on soil surface at the base of plants.</td>
<td>Redlegged earth mite, blue oat mite, Balaustium mite</td>
</tr>
<tr>
<td>Plants stunted and dying at emergence and up to tillering; chewing of seed and stem below ground; white legless larvae up to 7 mm long present near point of attack.</td>
<td>Spotted vegetable weevil or Desiantha weevil</td>
</tr>
</tbody>
</table>

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### Damage to crop

| Plants stunted or dying; roots eaten; slow-moving, soft bodied insects usually in a ‘C’ shape, cream-coloured apart from head and visible gut contents; found near roots. | Cockchafers, African black beetle |
| Plants yellowing and withering; on light soils mostly on coastal plain; stems underground shredded; presence of elongated, cylindrical insects up to 75 mm long, first pair of legs adapted for digging. | Sandgropers |
| Green and straw-coloured insect droppings like miniature square hay bales on ground; cereal heads on ground; some chewing of leaves and seed heads of weeds such as ryegrass. Smooth, fat caterpillars up to 40 mm long, with three stripes on collar behind head; found at base of plants or climbing plants. | Armyworm |
| Seeds chewed but heads not severed; caterpillars up to 40 mm long, sparsely covered with small bumps and bristles, may be various shades of green, yellow, orange or brown; found on seed heads. | Native budworm and related species |
| Presence of many grey-green insects approx. 2 mm long, with or without wings, on upper portions of stem. If heavy infestations, plants stunted; sticky with secretions, possibly black mould growing on secretions. | Aphids |
| Damage in fine pale dots in wriggly or zigzag lines. Yellow to green, 3 mm long wedge-shaped sucking insects that jump sideways when disturbed. | Leafhoppers |

### Table 4: Establishment pests of the southern region—risk assessment and management

#### Pre-season

**Earth mites and lucerne flea**

Assess risk: High risk when:
- history of high mite pressure
- pasture rotating into crop
- susceptible crop being planted (e.g. canola, pasture, lucerne)
- seasonal forecast for dry or cool, wet conditions that slow crop growth

If risk is high:
- ensure accurate identification
- use TIMERITE® (redlegged earth mites only)
- heavily graze pastures in early–mid spring

#### Pre-sowing

If high risk:
- use an insecticide seed dressing on susceptible crops
- plan to monitor more frequently until crop establishment
- use higher sowing rate to compensate for seedling loss
- consider scheduling a post-emergent insecticide treatment

If low risk:
- avoid insecticide seed dressings (especially cereal and pulse crops) and plan to monitor until crop establishment

#### Emergence

Monitor susceptible crops through to establishment using direct visual searches. Be aware of edge effects; mites move in from weeds around paddock edges

If spraying:
- ensure accurate identification of species before deciding on chemical
- consider border sprays (mites) and ‘spot’ sprays (lucerne flea)
- spray prior to winter egg production to suppress populations and reduce risk in the following season

#### Crop establishment

As the crop grows, it becomes less susceptible unless growth is slowed by dry or cool, wet conditions

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## Pre-season Pre-sowing Emergence Crop establishment

### Slugs
Assess risk. High risk when:
- high stubble load
- annual average rainfall >450 mm
- history of slug infestations
- canola being planted
- summer rainfall
- heavy clay soils

If high risk:
- burn stubbles
- cultivate worst areas
- remove weeds in paddocks and along fence lines at least 8 weeks before sowing
- deploy shelter traps before sowing
- sow early to get crop established prior to cold conditions
- use soil compaction at sowing (e.g. press-wheels)
- bait at or after sowing prior to emergence

Assess risk. High risk under cold conditions and with slow plant growth

Use shelter traps or directly search at night when slugs are active to confirm slugs as the cause of seedling loss

If slug pressure is high, successive baiting may be necessary. Monitoring will guide bait use

As the crop grows, it becomes less susceptible unless growth is slowed by cool conditions. Resowing may be required if plant stands are unsatisfactory

### False wireworm and true wireworm
Assess risk. High risk when:
- history of wireworm pressure
- soils high in organic matter
- high stubble and summer—autumn litter cover

Conduct direct visual search for adult beetles over summer and autumn. Search (in soil) for beetle larvae 2 weeks prior to sowing. If high risk:
- reassess crop choice or timing of sowing
- consider an insecticide seed dressing (particularly fipronil) or in-furrow treatment
- use soil compaction at sowing (e.g. press-wheels)
- consider higher sowing rate to compensate for seedling loss

Limited options for control once crop is sown. Consider resowing severely affected areas of crop

Damage to established crops is rare

### Beetles
Assess risk. High risk when:
- sowing crop into pasture, especially with a high clover content
- previous history of scarab damage to crop in that field
- wetter than average seasons
- minimum or no tillage
- Under high pressure:
- spray African black beetle adults in spring
- avoid overgrazing pastures

Dig soil within paddock to determine incidence of scarab larvae.

If high risk:
- cultivate land
- avoid sowing grass pastures
- use soil compaction at sowing (e.g. press-wheels)
- consider higher sowing rate to compensate for seedling loss

Assess risk. High risk when dry conditions slow plant growth

Limited options for control once crop is sown. Larvae of most species do not emerge from the soil

For blackheaded pasture cockchafer, spray around heavy dews or light rainfall, which will trigger larval activity

Resowing may be an option, but some species have a two-year life cycle, so larvae can persist through winter into spring. ID will guide this decision

### Others—e.g. earwigs, slaters, millipedes, weevils
Assess risk. High risk when:
- history of high pest pressure
- minimum/no-tillage
- high stubble load
- heavier soils

Monitor in spring using shelter traps, direct searches and/or pitfall traps

If high risk:
- burn stubbles
- cultivate worst areas
- use cracked wheat baits
- avoid sowing canola

Monitor susceptible crops through to establishment. Directly search at night to confirm pest species as the cause of seedling loss

(Notes: large numbers of these pests can be found in paddocks without causing crop damage)

Damage to established crops is rare
7.1 Integrated pest management

Pests are best managed using integrated pest management (IPM). Careful planning prior to sowing, followed by regular monitoring of crops after sowing, will ensure that potential problems are identified and, if necessary, treated early.

IPM uses a range of management tactics to keep pest numbers below the level where they cause economic damage. It focuses on natural regulation of pests, particularly by encouraging natural enemies, and on using broad-spectrum chemicals as a last resort. IPM relies on having pests and beneficial insects correctly identified, monitoring the crop regularly, and making strategic control decisions according to established damage thresholds. 7

Identification

Accurate identification of beneficial and pest species is fundamental to IPM. For example, there are four easily confused pest mite species commonly found in most grain production regions of Australia. Despite their similarity in appearance, these mites – redlegged earth mite (RLEM), blue oat mite, clover or Bryobia mite and Balaustium mite – differ in their response to commonly used pesticides.

It is important to understand the biology and life cycle of target pests and beneficial species. Knowing when populations are likely to increase or decrease can affect control decisions.

Natural enemies

Beneficial species, sometimes referred to as ‘natural enemies’, help to control invertebrate pests as part of a successful IPM strategy. Many beneficial species occur naturally and populations can be encouraged by reducing pesticide use.

Monitor populations

Populations of pest and beneficial insects need to be monitored prior to seeding, during the growing season, and after control treatments to establish success or the need for re-treatment.

Ideally, each species should be recorded by life stage and detailed records should help identify trends in species’ population growth or decline, over time. Details to be recorded for a paddock should include:

- key pests and beneficial species, ideally by life stage
- insect location within a paddock
- crop health and growth stage
- paddock pesticide history
- weed presence
- weather patterns

Control decisions

Whether beneficial species will effectively control pests depends on the comparative numbers of different life stages present. Small predators cannot control large pests, large predators will devour a large quantity of small pests and some predators attack specific pest types. Small predators can be useful when they attack pests in their early (smaller) life stages or when multiple pests attack larger prey.

It is important to establish if there are enough pests present to warrant control and to relate these figures to an economic threshold. This the point where the balance between pests and beneficial insects is likely to result in economic crop damage greater than the cost of control. 8

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Manage resistance

Emerging pests, like snails and slugs, and rising occurrences of insecticide resistance in RLEM, has heightened the need for better strategies to protect WA crops and pastures.

Climatic conditions, continuous cropping and stubble retention has resulted in a rise in the risk of insecticide resistance with some pests, such as RLEM.

In 2016, 56 properties reported populations of RLEM resistant to synthetic pyrethroids, such as bifenthrin, with three of these properties also resistant to omethoate. A further four properties have been identified with RLEM resistance to omethoate and the first with resistance to chlorophyrifos.

The repeated cumulative exposure of RLEM to the same insecticides was the main factor behind resistance developing. Every time a broad-spectrum insecticide is used to control pests, such as weevils, caterpillars and aphids, RLEM also receive a dose of this insecticide, despite not necessarily being the direct target.

Decreasing the need to spray can be done by reducing the occurrence of pests. This can be achieved by staying on top of the ‘green bridge’ and removing plant material that could provide feed and a habitat to support pests over summer into the growing season.  

7.2 Aphids

Aphids are vectors of Barley yellow dwarf virus (BYDV), a major problem in wet areas in western growing regions.

Seasonal conditions have a major effect on aphid populations, which are ultimately controlled by natural predators. However aphid populations can do considerable damage before other insects or heavy rains reduce or eliminate them. Therefore, growers should consider seed treatment prior to sowing and/or in-crop foliar pesticide spraying to control aphids.

When winged cereal aphids fly into crops from grass weeds, pasture grasses or other cereal crops, colonies start to build within the crop. In Australia, all aphids in a cereal crop are females and are able to give birth to live young without mating. The immature aphid nymphs have several growth stages and moult at each stage into a larger individual. Sometimes the delicate, pale cast skins can be seen near colonies. When host plants become unsuitable or overcrowded, winged aphids, called alataes, develop and migrate to other crops or plants.

Three types of aphid are commonly found in barley crops and they can all carry BYDV. In trials, aphids have been found to attack different parts of the barley plant at different times.

7.2.1 Oat or wheat aphid (*Rhopalosiphum padi*)

Oat or wheat aphids can be found on all cereals and in most years of high infestation they are the most abundant species. A vector of BYDV, the oat aphid colonises the lower portion of the plant with infestations extending from the plant’s base up onto the leaves and stems as the crop starts to elongate (Photo 1, Table 5). Mature adults are about 2 mm long and may have wings that are dark green and rounded or pear-shaped. Juveniles are paler and smaller and both are characterised by a dark reddish patch on the tip of the abdomen.

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Photo 1: Heavy infestation of oat aphids (*Rhopalosiphum padi*).
Source: Evan Collins

Table 5: Oat or wheat aphid management summary  

<table>
<thead>
<tr>
<th>Scientific name</th>
<th><em>Rhopalosiphum padi</em></th>
</tr>
</thead>
<tbody>
<tr>
<td>Description</td>
<td>Adults are 2 mm long, olive-green to black with a red rust patch at the rear end and may have wings. Antennae extend to half the body length. Nymphs are similar but smaller. Very similar to corn aphids</td>
</tr>
<tr>
<td>Distribution</td>
<td>An introduced species found in all states of Australia</td>
</tr>
<tr>
<td>Crops attacked</td>
<td>Barley, wheat and oats</td>
</tr>
<tr>
<td>Life cycle</td>
<td>Produces many generations through the growing season. Winged and non-winged forms occur</td>
</tr>
<tr>
<td>Damage</td>
<td>Aphids feed directly on stems, leaves and heads; in high densities they cause yield losses and plants may appear generally unthrifty. This type of damage is rare throughout the grainbelt. Aphids can spread BYDV in wheat and barley</td>
</tr>
<tr>
<td>Monitoring and action level</td>
<td>Aphids can affect any crop stage but are unlikely to cause economic damage to cereal crops expected to yield &lt;2 t/ha (for virus damage) and &lt;3 t/ha (for direct feeding). Consider treatment if there are 10–20+ aphids on 50% of the tillers</td>
</tr>
</tbody>
</table>
| Control               | Chemical control: Apply a foliar insecticide in late winter or spring to avoid direct damage to tillers and heads. To prevent losses from BYDV in virus-prone areas, control aphids early in the cropping year. Prevent infestation by applying a seed dressing to early-sown wheat crops and a foliar insecticide in high-pressure years if necessary (predator friendly). For current chemical control options, see Pest Genie or APVMA  
Cultural control: Controlling the green bridge (i.e. controlling weeds over the summer fallow) is an effective control measure to prevent aphid survival into the next season |
| Host-plant resistance | In virus-prone areas, use resistant plant varieties to minimise losses due to BYDV |
| Natural enemies       | Predation by hoverflies, lacewings and ladybeetles, and parasitism by wasps can reduce aphid populations, but this does not happen in every season. Heavy rain may reduce aphid populations significantly |

7.2.2 Corn aphid (*Rhopalosiphum maidis*)

Corn aphids are more likely to be found in barley crops, but do also occur in wheat. Corn aphids are more rectangular than oat aphids. Adults are 2 mm long and may have wings. The legs and antennae are typically darker than the green-blue body, which sometimes has a waxy appearance (Photo 2). Colonies generally develop within the furled emerging leaves of tillers, particularly the rolled-up terminal leaf, and they can be difficult to see. Corn aphids can be important vectors of BYDV if they arrive early in crops (Table 6).

![Photo 2: Corn aphids (*Rhopalosiphum maidis*).](image)

Source: Qld DAF
Table 6: Corn aphid management summary

<table>
<thead>
<tr>
<th>Scientific name</th>
<th>Rhopalosiphum maidis</th>
</tr>
</thead>
<tbody>
<tr>
<td>Description</td>
<td>Up to 2 mm long, light to dark olive-green with a purple area at the base of small tube-like projections at the rear of the body. Adults are generally wingless. Antennae extend to about one-third of body length. Nymphs are similar, but smaller</td>
</tr>
<tr>
<td>Similar species</td>
<td>Other species of aphids</td>
</tr>
<tr>
<td>Distribution</td>
<td>An introduced species, probably Asiatic in origin, found in all states of Australia</td>
</tr>
<tr>
<td>Crops attacked</td>
<td>Sorghum, maize, winter cereals and many grasses</td>
</tr>
<tr>
<td>Life cycle on cereals</td>
<td>A parthenogenetic species that undergoes many generations through the growing season. Both winged and non-winged forms occur</td>
</tr>
<tr>
<td>Damage</td>
<td>In cereal: Aphids feed on stems, leaves and heads, and in high densities cause yield losses. However, this type of damage is uncommon in the cereal belt</td>
</tr>
<tr>
<td>Risk period</td>
<td>Most prevalent on cereals in late winter and early spring. High numbers often occur in years with an early break in the season, mild weather in autumn and early winter provides favourable conditions for colonisation and multiplication</td>
</tr>
<tr>
<td>Monitoring</td>
<td>Estimate percentage of plants infested and percentage of leaf area covered by aphids</td>
</tr>
<tr>
<td>Action level</td>
<td>Aphids are unlikely to cause economic damage to cereal crops expected to yield &lt;3 t/ha. To avoid damage by direct feeding, consider treatment if there are ≥10–20 aphids on 50% of the tillers</td>
</tr>
<tr>
<td>Chemical control</td>
<td>Chemical control is cost-effective. See Pest Genie or APVMA for current control options</td>
</tr>
<tr>
<td></td>
<td>Conservation of natural enemies: A range of parasitoids and predators will help reduce aphid populations. Predators of aphids include: ladybird larvae, damsel bugs, big-eyed bugs and the larvae of green lacewings and hoverflies. Wasp parasitoids mummify and kill aphids</td>
</tr>
</tbody>
</table>

7.2.3 Thresholds for control

Inspect for aphids throughout the growing season by monitoring leaves, stems and heads, as well as exposed roots. Choose six, widely spaced positions in the crop and at each position examine five consecutive plants in a row.

Research is under way into damage thresholds and control options for cereal aphids. Some research indicates that aphid infestations can reduce yield by ~10% on average. Current notional thresholds suggest that control is warranted when there are >10–20 aphids on 50% of the tillers.

The decision to control aphids on winter cereals depends on the size of the aphid population and the duration and timing of the infestation. Controlling aphids during early crop development generally results in a recovery of the rate of root and shoot development but there can be a delay. Aphids are more readily controlled in seedling and pre-tillering crops, which are less bulky than post-tillering crops. Corn aphids in the terminal leaf tend to disappear as crops come into head, and other species usually decline in abundance about this time as natural enemy populations build up.

Always determine the level of natural enemy activity when making control decisions about aphids. The thresholds above are for aphid damage—there is no threshold for BYDV transfer.

7.2.4 Russian wheat aphid (*Diuraphis noxia*)

As yet Russian wheat aphid (RWA) has not been detected in WA. However, following the widespread outbreak of RWA in South Australia and Victoria in 2016, WA growers are encouraged to be vigilant in monitoring for RWA and to send photos of any suspect populations to DAFWA.

Russian wheat aphid is potentially a more severe pest than other aphids.

While aphid feeding damage generally results in yield losses of up to 10 per cent, in overseas crops Russian wheat aphid has caused yield losses of more than 80 per cent.

Unlike other aphids, Russian wheat aphids inject a toxin into susceptible crops, like wheat and barley, which can severely retard growth or under heavy infestations, kill the plant.

7.3 Armyworm (*Leucania convecta*)

Armyworms are the caterpillar stage of certain moths (Photo 3), and can occur in large numbers, especially after good rain following a dry period. Larvae shelter in the throats of plants or in the soil and emerge in spring to feed on the leaves of all winter cereals, particularly barley and oats. Leafy cereal plants can tolerate considerable feeding, and control in the vegetative stage is seldom warranted unless large numbers of armyworms are distributed throughout the crop or are moving in a ‘front’, destroying young seedlings or completely stripping older plants of leaves. The most serious damage occurs when larvae feed on the upper flag leaf and stem node as the crop matures, or in barley when the older larvae start feeding on the green stem just below the head as the crop matures.

Photo 3: *Common armyworm (Leucania convecta).*

Source: Qld DAF

Infestations are evident as scalloping on leaf margins from the feeding of older larvae. They target the stem node as the leaves become dry and unpalatable because the stem is often the last part of the plant to dry. One large larva can sever up to seven heads of barley a day and larva/m² can cause a grain loss of 70 kg/ha/day (Table 7). Larvae take ~8–10 days to develop through the final, most damaging instars, with crops susceptible to maximum damage for this period (Table 8).

Check for larvae on the plant and in the soil litter under the plant. The best time to do this is late in the day when armyworms are most active. Alternatively, look around the base of damaged plants where the larvae may be sheltering in the soil during the day. Using a sweep net (or swinging a bucket), check a number of sites throughout the paddock. Sweep sampling is particularly useful early in an infestation when larvae are small and actively feeding in the canopy. One full sweep with a net samples the equivalent of 1 m² of crop.
Early recognition of the problem is vital because cereal crops can be almost destroyed by armyworm in just a few days. Although large larvae do the head lopping, controlling smaller larvae that are still leaf-feeding may be more achievable. Before using chemical intervention, consider how quickly the larvae will reach damaging size, and the development stage of the crops. Small larvae take 8–10 days to reach a size capable of head-lopping, so if small larvae are found in crops nearing full maturity–harvest, spray may not be needed. In contrast, small larvae in late crops that are still green and at early seedfill may reach a damaging size in time to significantly reduce crop yield.

Control is warranted if the armyworm population distributed throughout the crop is likely to cause the loss of 7–15 heads/m². Many chemicals will control armyworms, however their effectiveness often depends on good penetration into the crop in order to contact the caterpillars. Control may be more difficult in high-yielding, thick-canopied crops, particularly when larvae are resting under soil at the base of plants. Larvae are most active at night; therefore, spraying in the afternoon or evening may produce the best results. If applying sprays close to harvest, be aware of relevant withholding periods.

Biological control agents may be important in some years. These include parasitic flies and wasps, predatory beetles and diseases. Helicoverpa NPV is not effective against armyworm. 13

Table 7: Value of yield loss incurred by armyworm larvae (1 or 2/m²) per day, based on various values for grain and an estimated loss, given 1 larva/m², of 70 kg/ha

<table>
<thead>
<tr>
<th>Value of grain (A$/t)</th>
<th>Value of yield loss ($) per ha per day</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1 larva/m²</td>
</tr>
<tr>
<td>$140</td>
<td>$9.80</td>
</tr>
<tr>
<td>$160</td>
<td>$11.20</td>
</tr>
<tr>
<td>$180</td>
<td>$12.60</td>
</tr>
<tr>
<td>$200</td>
<td>$14.00</td>
</tr>
<tr>
<td>$220</td>
<td>$15.40</td>
</tr>
<tr>
<td>$250</td>
<td>$17.50</td>
</tr>
<tr>
<td>$300</td>
<td>$21.00</td>
</tr>
<tr>
<td>$350</td>
<td>$24.50</td>
</tr>
<tr>
<td>$400</td>
<td>$28.00</td>
</tr>
</tbody>
</table>

Considering these results, and the relatively low cost of controlling armyworm, populations of >1 large larva/m² in ripening crops warrant spraying.

Source: DAF Qld

### Table 8: Armyworm management summary

<table>
<thead>
<tr>
<th>Scientific name</th>
<th>Leucania convecta—common armyworm</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Description</strong></td>
<td>Common armyworm: First-instar larvae are about 1 mm long. From the second instar, stripes develop along the top and sides of the larva and become more distinct as the larva grows. The mature larva grows up to 40 mm in length and has three characteristic pale stripes on the head, collar (segment behind the head) and tail segment. They are smooth-bodied with no distinct hairs. The body also has lateral stripes. The forewings of the moth have a wingspan of about 40 mm and are fawn or buff-coloured.</td>
</tr>
<tr>
<td><strong>Similar species</strong></td>
<td>Adults of the common and northern armyworms may be confused. Genitalia dissections by a specialist are required to separate the species. The larval stages likely to be encountered in cereals are similar in appearance.</td>
</tr>
<tr>
<td><strong>Distribution</strong></td>
<td>Common armyworm is a native Australian species, recorded in New South Wales, Queensland, South Australia, Tasmania, Victoria and Western Australia.</td>
</tr>
<tr>
<td><strong>Crops attacked</strong></td>
<td>Common armyworm damages barley, oats, wheat, native pasture grasses and perennial grass seed crops.</td>
</tr>
<tr>
<td><strong>Life cycle</strong></td>
<td>Common armyworms have three generations per year. The winter and spring generations damage cereals. Moths fly into cereal crops and lay their eggs in the folds of dried or drying leaves on grasses or cereals. Females lay up to 1,000 eggs in irregularly shaped masses, cemented in tight folds of foliage. Eggs hatch as little as 3–4 days after laying and young larvae, with the assistance of wind, disperse through the crop on fine silken threads. The larvae feed on leaves and stems. Larvae usually develop through six instars but sometimes seven. Indicative development times at constant temperature are: egg-laying to hatch, 7 days at 20°C and 2.5 days at 30°C; larval stages (including pre-pupal stage) 34.2 days at 20°C and 17.2 days at 30°C. Larvae pupate in the soil. Pupal stage lasts 201 days at 20°C and 101 days at 30°C. Development time from neonate to adult emergence is 61 days at 20°C and 41 days at 30°C (Smith 1984).</td>
</tr>
<tr>
<td><strong>Risk period and damage</strong></td>
<td>Risk period: The greatest risk to cereals is spring. Moth flights occur in September and October, and the later-stage larvae damage cereals often in the weeks prior to harvest. The mature larval stages of the winter generation will sometimes march in cereal crops in late winter and cause serious damage to crops, particularly on the edges of paddocks. Crops directly seeded into standing stubbles are susceptible to severe defoliation during the vegetative stage as the winter generation matures. Damage: There are two distinct periods for economic damage. The first, defoliation during early vegetative development, is less common than the second through ripening. In southern Australia, the cereal head stays green later and armyworms feed along the heads and damage grain rather than excising the whole head.</td>
</tr>
</tbody>
</table>

---

Large numbers of armyworm moths are attracted to farm lights on warm nights in September and October. This provides the first warning of potential problems in cereals. Armyworm larvae are difficult to find in cereals crops because they hide at the base of plants or under clods of soil during the day. Search at the base of plants and under clods of soil to estimate the number of larvae per m². Presence of green–yellow pellet-shaped droppings of the larvae on the ground is usually a reliable sign of larvae. Monitor for larvae at dusk with a sweep net; sweep-netting during the day can be unreliable.

Action level is 2 larvae/m² for barley.

Control

Chemical control: A range of insecticides is registered for armyworm control in cereals. Insecticides should target larvae 10–20 mm long. Larvae >20 mm long can be difficult to kill and may require higher rates of insecticide application. If possible, spray late in the day because larvae are active at night. See Pest Genie or APVMA for current control options.

Cultural control: Windrowed or swathed crops dry out rapidly, rendering them unattractive for the feeding of armyworm larvae. They are also less susceptible to wind damage (head shattering).

Natural enemies

Armyworm larvae are attacked by a number of parasitoids that may be important in reducing the intensity of outbreaks. However, when armyworms are in numbers likely to cause damage, parasitoids are unlikely to give timely control. Predators include green scarab beetles, populations of which increase dramatically in inland Australia in response to abundant noctuid larvae induced by favourable seasons. Other predators include the predatory shield bugs and perhaps common brown earwigs. Fungal diseases are recorded as causing mortality of armyworm.

7.4 Helicoverpa spp.

Helicoverpa spp. are frequently found in winter cereals, usually at levels too low to warrant control, but occasionally numbers may be sufficiently high to cause economic damage. H. punctigera is widespread in southern Australia and common on pulse crops and canola, but rarely found on cereal crops. H. armigera (Photo 4) can occasionally be found grazing wheat and barley heads.

Larvae tend to graze on the exposed tips of a large number of developing grains, rather than totally consuming a low number of whole grains, thus increasing the potential losses. Most (80–90%) of the feeding and crop damage is done by larger larvae (the final two instars).
Photo 4: Helicoverpa armigera.
Source: Qld DAF

Photo 5: Native grubworm
Source: DAFWA
7.5 Mites

7.5.1 Blue oat mite (*Penthaleus* spp.)

Blue oat mites (Photo 6) are important pests of seedling winter cereals. Adults and nymph mites pierce and suck leaves, resulting in silivering of the leaf tips. Feeding causes a fine mottling of the leaves, similar to the effects of drought. Heavily infested crops may have a bronzed appearance, and severe infestations cause leaf tips to wither and can lead to seedling death. Damage is most likely during dry seasons when mites in large numbers heighten moisture stress; control may be warranted in this situation.

Check from planting to early vegetative stage, particularly in dry seasons, monitoring several sites throughout the field (Table 9). Blue oat mites are most easily seen in the cooler part of the day or in cloudy conditions as they shelter on the soil surface when conditions are warm and sunny. If pale-green or greysish irregular patches appear in the crop, check for blue oat mite at the leaf base.

Where warranted, foliar application of registered insecticide may be cost-effective. Check the most recent research to determine the likely susceptibility of blue oat mite to the available registered products. Cultural control methods can contribute to reducing the size of the autumn mite population (e.g. cultivation, burning, controlling weed hosts in fallow, grazing and maintenance of predator populations).

Eggs laid in the soil hibernate throughout winter; therefore, populations of the mite can build up over a number of years and cause severe damage if crop rotation is not practised. Using control tactics solely in spring will not prevent the carryover of eggs into the following autumn.

Predators of blue oat mites include spiders, ants, predatory beetles and the predatory *Anystis* mite and snout mite. Blue oat mites are also susceptible to infection by a fungal pathogen (*Neozygites acaracida*), particularly in wet seasons.  

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**Photo 6: Blue oat mite (*Penthaleus* sp.).**

Source: A Weeks, cezar
Table 9: Management summary for blue oat mite

<table>
<thead>
<tr>
<th>Scientific name</th>
<th>Penthaeleus major, P. falcatus, P. tectus</th>
</tr>
</thead>
<tbody>
<tr>
<td>Description</td>
<td>Adults are 1 mm long and have eight legs. Adults and nymphs have a purplish-blue, rounded body with red legs. They move quickly when disturbed. The small red area on the back distinguishes it from the redlegged earth mite</td>
</tr>
<tr>
<td>Similar species</td>
<td>Redlegged earth mite</td>
</tr>
<tr>
<td></td>
<td>Bryobia Mite</td>
</tr>
<tr>
<td></td>
<td>Balastium mite</td>
</tr>
<tr>
<td>Crops attacked</td>
<td>Mainly a pest of cereals and grass pastures, but will feed on pasture legumes and many weeds</td>
</tr>
<tr>
<td>Damage</td>
<td>Adults and nymphs pierce and suck on leaves resulting in silvering of the leaf tips in cereals. When heavy infestations occur, the leaf tip withers and the seedling can die</td>
</tr>
<tr>
<td>Monitor</td>
<td>Check from planting to early vegetative stage, particularly in dry seasons. Most easily seen in the late afternoon when they begin feeding on the leaves</td>
</tr>
<tr>
<td>Control</td>
<td>Foliar applications of insecticides may be cost-effective if applied within 2 to 3 weeks of emergence in autumn. Using control tactics solely in spring will not prevent the carryover of eggs into the following autumn. For current chemical control options see Pest Genie or APVMA. Blue oat mites have higher natural tolerance to a range of pesticides.</td>
</tr>
<tr>
<td>Natural enemies</td>
<td>Thrips and ladybirds</td>
</tr>
</tbody>
</table>

Blue oat mite often co-exists with redlegged earth mites (Photo 7). Refer to Table 10 for how to distinguish it from other mites that may be found with it.

Photo 7: Redlegged earth mites (Halotydeus destructor) often coexist with blue oat mites (Penthaeleus sp.).

Source: DAFWA
Table 10: Distinguishing blue oat mite from similar mites

<table>
<thead>
<tr>
<th>Condition</th>
<th>Similarities</th>
<th>Differences</th>
</tr>
</thead>
<tbody>
<tr>
<td>Redlegged earth mite</td>
<td>Size, body colour and plant damage</td>
<td>The redlegged earth mite has no red dot on its back</td>
</tr>
<tr>
<td>Balaustium mite</td>
<td>Immature balaustium mites are the same size as blue oat mites and cause similar plant damage</td>
<td>Adult balaustium mites are twice the size of adult blue oat mites</td>
</tr>
<tr>
<td>Bryobia mite</td>
<td>Plant damage and leg colouration</td>
<td>The front legs of the bryobia mite are much larger and it causes whitish trails on the leaf surface</td>
</tr>
</tbody>
</table>

Source: DAFWA

7.5.2 Redlegged earth mite (*Halotydeua destructor*)

Redlegged earth mites (RLEM) are a common sap-sucking pest of crops and pastures (Photo 8, Photo 9 and Photo 10) with canola and peas are particularly susceptible. They often co-exist with blue oat mites (Table 16).

Photo 8: An emerging lupin plant being attacked.
Source: DAFWA
Photo 9: Young barley plant showing typical symptoms of cuticle stripping and tip withering.
Source: DAFWA

Photo 10: A young canola plant being attacked.
Source: DAFWA
### Table 11: Management summary for redlegged earth mite

<table>
<thead>
<tr>
<th>Scientific name</th>
<th>Halotydeua destructor</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Description</strong></td>
<td>Adults are 1 mm long with a black body and eight red-orange legs. Newly hatched mites are 0.2 mm long with a pinkish-orange body and six legs.</td>
</tr>
<tr>
<td><strong>Similar species</strong></td>
<td>Blue oat mite, Briyobia mite, Balastium mite</td>
</tr>
<tr>
<td><strong>Development</strong></td>
<td>RLEM originate in South Africa, and usually have three generations per season, with the last generation producing thick-walled over-summering eggs in spring. Over-summering eggs hatch in autumn, stimulated by adequate moisture and at least seven days of temperatures below 20°C. Mite damage tends to be worse after pastures than after cereal crops</td>
</tr>
<tr>
<td><strong>Damage</strong></td>
<td>Feeding causes a silver or white discolouration of leaves and distortion. If damage is severe the plants shrivel and die. Damage is more severe when seedlings are stressed (e.g. cold waterlogged or under very dry conditions).</td>
</tr>
<tr>
<td><strong>Monitor</strong></td>
<td>Check paddock for mites in the spring and again before seeding. Check for mites on the ground and on leaves and for plant damage from emergence to early vegetative stage, particularly in late-sown crops</td>
</tr>
<tr>
<td><strong>Control</strong></td>
<td>Spray only if required. RLEM have been detected that have resistance to synthetic pyrethroids. Rotate chemical groups in and between seasons, as this will help to reduce resistance. Use insecticide seed treatments for crops and new pastures with moderate pest pressure rather than spraying whole paddocks. This allows for smaller quantities of pesticide to be used that will directly target plant-feeding pests. Control weeds before seeding, particularly in crops sown in late autumn or winter when RLEM are likely to hatch before seeding. At least one week of bare soil can ‘starve out’ most of the mite population before crops are sown. Control weeds in the crop and along fence lines that provide habitat for mites. A weed-free crop will have few mites and over-summering eggs to carry through to the following season. Controlled grazing of pasture paddocks that will be cropped the next year will reduce mite numbers to levels that are almost as effective as chemical sprays. Sustained grazing of pastures throughout spring should maintain them at levels below 2 t/ha. Feed On Offer (dry weight) will restrict mite numbers to low levels. Apply insecticides to paddocks that are to be cropped during spring to prevent RLEM populations producing over-summering eggs. This will minimise the pest population for the following autumn. TIMERITE® is a free package that provides a date in spring for a spray application to stop female RLEM from producing over-summering eggs. Look at cropping rotations to decrease reliance on pesticides. The risk is generally highest if paddocks have been in long-term pasture (with high levels of broad-leaved plants) where mite populations have been uncontrolled. Lower risk Paddocks that generally do not require mite control are often those that follow a weed-free cereal or chickpea crop.</td>
</tr>
</tbody>
</table>
7.5.3 Balaustium mite (*Balaustium medicagoense*)

Balaustium mite (Photo 1) is a sucking pest of crops but usually outgrow damage unless stressed.

![Photo 1: Balaustium mite](source: DAFWA)

**Table 12: Management summary for Balaustium mite**

<table>
<thead>
<tr>
<th>Scientific name</th>
<th><em>Balaustium medicagoense</em></th>
</tr>
</thead>
<tbody>
<tr>
<td>Description</td>
<td>Adults are up to 2 mm and uniformly red-brown with stout hairs covering the body. Very young mites are bright red.</td>
</tr>
<tr>
<td>Similar species</td>
<td>Blue oat mite</td>
</tr>
<tr>
<td></td>
<td>Briyobia mite</td>
</tr>
<tr>
<td></td>
<td>Redlegged earth mite</td>
</tr>
<tr>
<td>Development</td>
<td>Balaustium mites originate in South Africa, usually have two generations per season and do not require cold temperatures to stimulate egg hatching. Eggs hatch when there is sufficient moisture. Mite damage is common in early-sown crops in years with summer rain and green bridge.</td>
</tr>
<tr>
<td>Damage</td>
<td>Balaustium mites typically attack leaf edges and leaf tips of plants and affected barley plants look moisture stressed. They are most common in early break seasons where green material was left on the paddock prior to sowing. Damage is characterised by distorted cupped cotyledons that may appear leathery.</td>
</tr>
<tr>
<td>Control</td>
<td>Early control of summer and autumn weeds, especially capeweed and grasses, will help to control populations. Applications of SP at the highest registered rate provides control. Organophosphates are not effective against this pest</td>
</tr>
</tbody>
</table>

7.6 Lucerne flea (*Sminthurus viridis*)

Lucerne flea is an important pest of establishing crops. It is identified by its behaviour of jumping between plants rather than flying. Early-sown crops are more at risk of attack. Frequent crop inspection from the time of emergence and early control measures are important because of the impact of seedling vigour on crop performance. Ensure there is sufficient monitoring to detect localised patches or ‘hot spots’. Seek advice on management and spray strategies.

![Photo 12: Adult lucerne flea (*Sminthurus viridis*).](source: cesar)

7.6.1 Seasonal development and symptoms

Lucerne fleas hatch following periods of good, soaking autumn–winter rainfall and can cause significant damage to emerging crops and pastures at this time of year. They can also cause considerable damage to older crops if numbers build up under favourable conditions throughout the season.

<table>
<thead>
<tr>
<th>Scientific name</th>
<th><em>Sminthurus viridis</em></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Description</strong></td>
<td>Adult lucerne fleas are globular, wingless insects, 2–3 mm long with green, brown and yellow markings (Figure 11). They appear yellow-green to the naked eye, although their globular abdomens are often a mottled pattern of darker pigments. They make jumping movements when disturbed. Nymphs resemble the adults except in size.</td>
</tr>
<tr>
<td><strong>Crops attacked</strong></td>
<td>Lucerne fleas have a wide host range. They will attack most broadacre crops, including canola, lucerne, pastures, cereals and some pulses. Feeding results in distinctive transparent ‘windows’. They are generally a problem in regions with heavier soil types.</td>
</tr>
<tr>
<td><strong>Damage</strong></td>
<td>The cells of the upper surface of leaves and cotyledons are eaten, resulting in small ‘windows’ in the leaves. Severe infestations cause skeletonised leaves, with only the more fibrous veins remaining. This damage is quite distinctive and can be used to help identify lucerne flea as the key pest.</td>
</tr>
</tbody>
</table>


Monitor  
Crops should be inspected frequently. Crops are most susceptible to damage—at and immediately following—emergence. Paddocks are most likely to have problems when they follow a weed-infested crop or a pasture in which the lucerne flea has not been controlled.

Control  
Several options are available to growers for controlling the lucerne flea. Foliar insecticides can be applied around 3 weeks after lucerne fleas have been observed in a newly emerged crop. This will allow for further hatching of over-summering eggs but will be before lucerne fleas reach the adult stage and begin to lay winter eggs. If spraying is required, do not use synthetic pyrethroids.

They tend to target heavier soil types first. In paddocks where damage is likely, a border spray may be sufficient to prevent movement of lucerne fleas into the crop from neighbouring paddocks. Lucerne fleas are often distributed patchily within crops; therefore, spot-spraying is generally all that is required. Do not blanket-spray unless the infestation warrants it.

For current chemical control options see Pest Genie or APVMA.

7.6.2 Management

Only when infestations are severe should lucerne flea be sprayed. In some instances, spot spraying with registered chemicals may be adequate. Several natural enemies such as mites, beetles and spiders prey on lucerne fleas, and blanket spraying is harmful to these natural control agents. Seed dressing can also be a useful technique to prevent damage by lucerne flea. 

Snout mites, which have orange bodies and legs, are effective predators of lucerne fleas, particularly in pastures, and can prevent pest outbreaks. The complex of beneficial species (including snout mites) should be assessed before deciding on control options.

Several options are available to growers for controlling the lucerne flea. Foliar insecticides can be applied around 3 weeks after lucerne fleas have been observed in a newly emerged crop. This will allow for further hatching of over-summering eggs but will be before lucerne fleas reach the adult stage and begin to lay winter eggs. If spraying is required, do not use synthetic pyrethroids.

They tend to target heavier soil types first. In paddocks where damage is likely, a border spray may be sufficient to prevent movement of lucerne fleas into the crop from neighbouring paddocks. Lucerne fleas are often distributed patchily within crops; therefore, spot-spraying is generally all that is required. Do not blanket-spray unless the infestation warrants it.

7.7 Webworm (Hednota spp.)

Webworm larvae are leaf-chewing pests of seedling wheat and barley (Photo 13, Photo 14 and Photo 15). They can be distinguished from cutworm as demonstrated in Table 13.

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Photo 13: Webworm larva.
Source: DAFWA

Photo 14: Webworm adult.
Source: DAFWA
Photo 15: Webworm larva on seedling.
Source: DAFWA

Table 14: Management summary for Webworms

<table>
<thead>
<tr>
<th>Scientific name</th>
<th>Hednota spp.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Description</td>
<td>Insect larvae</td>
</tr>
<tr>
<td>• Brown caterpillars up to 15 mm long with black heads, which hide in web-lined tunnels during day (Figures 12 and 14). Insect adult</td>
<td></td>
</tr>
<tr>
<td>• Small tan-coloured moths with wings that fold closely around the body in a nearly vertical position (Figure 13), enabling the moth to blend with its surroundings.</td>
<td></td>
</tr>
<tr>
<td>• Larvae tend to be more common on the edge of patches.</td>
<td></td>
</tr>
<tr>
<td>Development</td>
<td>Caterpillars hatch from eggs laid in the grass in autumn and feed throughout the winter.</td>
</tr>
<tr>
<td>• Spring and summer are passed in the tunnels as resting-stage caterpillars. After this, they pupate and emerge as adult moths, which are about 10 mm long and may be seen flying in large numbers on autumn nights.</td>
<td></td>
</tr>
<tr>
<td>Monitor</td>
<td>Check emerging crops seeded into areas where fine, dry grasses were prevalent during autumn for signs of damage. Careful digging at the base of recently damaged plants may reveal web-lined tubes containing caterpillars, or a search at night may reveal feeding activity.</td>
</tr>
</tbody>
</table>

Damage Paddock

- Bare patches in emerging crops.

Plant

- Oldest leaves have been removed or are severed at ground level.
- Leaves are scattered on the ground or pulled into web-lined holes near the plants.

Control Spraying insecticide

- If 25% of plants are being seriously damaged at or just after emergence, spraying should not be delayed, as continued feeding will kill many plants and result in bare ground or thin areas.
- Webworm eggs will not be laid in large numbers or survive well in a bare paddock or in stubble.
- Three-week fallow at the break of the season will starve any caterpillars present.

7.8 Cutworm (*Agrostis* spp.)

Cutworm caterpillars feed on leaves and stems near ground level, with stems often chewed through and ‘cut’ to ground level (Photo 16).

Photo 16: Cutworm damage.

Source: DAFWA
Photo 17: Cutworm.
Source: DAFWA

Photo 18: Cutworm larvae can vary in colour.
Source: DAFWA
Table 15: Management summary for Cutworm

<table>
<thead>
<tr>
<th>Scientific name</th>
<th>Description</th>
<th>Similar species</th>
<th>Monitor</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>Agrostis</em> spp.</td>
<td>Cutworm moths can fly large distances and favour bare or lightly vegetated areas for egg laying.</td>
<td>Webworm, Armyworm</td>
<td>Cutworm caterpillars are usually easily controlled with registered rates of SP chemicals (refer to currently registered products). Early and complete control of green bridge two weeks before planting will minimise survival of cutworm larvae. Check crops from emergence through to establishment. Larvae are usually just below the soil surface during the day and emerge to feed at night. Check the base of healthy or recently damaged plants adjoining damaged, bare or thin areas. Two large caterpillars per 0.5 m row of cereals can cause extensive damage.</td>
</tr>
</tbody>
</table>

Table 16: Distinguishing from similar pests

<table>
<thead>
<tr>
<th>Condition</th>
<th>Similarities</th>
<th>Differences</th>
</tr>
</thead>
<tbody>
<tr>
<td>Webworm</td>
<td>Chewed seedlings leaving bare patches</td>
<td>Webworms are small brown caterpillars that pull leaves into web-lined burrows</td>
</tr>
<tr>
<td>Armyworm</td>
<td>Lop seedling stems at ground level</td>
<td>Armyworm has three prominent stripes behind the head</td>
</tr>
</tbody>
</table>

7.9 Pest slugs and snails

Slug and snail pests damage plant seeds (mainly legumes), recently germinated seeds, seedlings and leaves, and can be a contaminant of grain at harvest. 25

7.9.1 Distribution of slugs and snails

Slugs are pests of crops, especially higher rainfall regions of WA.

Snails are found on all soil types. White Italian and vineyard snails prefer alkaline sandy soils; the small pointed snail is able to survive on all soil types, even acidic soils. Liming areas where there are snails will aid their survival.

The small pointed snails are only known to cause economic crop damage in high rainfall areas, whereas the vineyard and white Italian snails are known to cause crop damage in the Greenough Flats (the region between Dongara to Geraldton) and the Geraldton region.

7.9.2 Identification and habits of pest slugs and snails

Slugs

*Black keeled slug* (*Milax gagates*)

Black keeled slugs are 40–60 mm long, black to brown, with a ridge down their back (Photo 19).
This species burrows to a depth of 20 cm or more, surviving the heat of summer under the ground. Black keeled slugs re-emerge when conditions improve, such as after reasonable rainfall and when soil temperature decreases.

Photo 19: Black keeled slug (bottom) and reticulated slug (top).
Source: DAFWA

Snails

Small pointed (conical) snail (Prietocella barbara)

The small pointed snail has a conical shell with brown bands of varying width. It is usually less than 10 mm in length or diameter.

Small pointed snails are not restricted to alkaline soils. These snails survive the summer in many habitats—under leaf litter, under the soil surface (up to 50 mm), under stumps or stones—and they climb posts and vegetation. This behaviour of climbing up on vegetation makes it a contamination risk at harvest (Photo 20).

Photo 20: Small conical snails on underside of a canola leaf.
White Italian snail (*Theba pisana*)

White Italian snails are predominantly white, often with fine, brown, concentric lines of varying intensity (Photo 21). The body of the snail is creamy-white and the shell is 10–20 mm in diameter. The umbilicus (the hole about which the shell spirals) is partly obscured.

This species thrives in areas of alkaline sandy soils with high calcium content, mainly near the coast. Be aware of snails before liming paddocks, as lime aids survival. It survives during summer off the ground on vegetation and posts, and is commonly found on green weeds. This over-summering behaviour of sealing itself on vegetation off the ground makes it a contamination risk of harvested grain.

![Photo 21: Different shell colours of white Italian snail.](image)

Source: DAFWA

Vineyard or common white snail (*Cernuella virgata*)

The vineyard snail resembles the white Italian snail in size and colouring (Photo 22). However, the umbilicus (the hole about which the shell spirals) of the vineyard snail is entire and not partly obscured as with the white Italian snail.

Like the Italian snail, this species thrives in areas of alkaline sandy soils with a high calcium content, mainly near the coast. It survives during summer off the ground on vegetation and posts. If lime is applied to paddocks where this snail is present, it will aid the survival of the population.
7.9.3 Damage

Snails are not known to damage seeds, but may damage germinated seeds close to the soil surface. However, slugs are not known to feed on ungerminated canola or cereal seeds.

Irregular pieces chewed from leaves and shredded leaf edges are typical of snail and slug presence.

Cereal crops are likely to survive damage by slugs and snails, while canola and lupins cannot compensate for the damage or loss of cotyledons. If cereals are deep sown into a fine, firm seedbed, the slugs and snails are not able to feed on the growing point and emerging crops may recover from damage after treatment.

Different species of slugs cause differing amounts of damage. Cereals are less likely to sustain damage from reticulated slugs than from black keeled slugs.

7.9.4 Snail and slug control

Control methods

The most effective control of pests involves combining cultural control measures alongside chemical and biological measures. Set a long-term goal to reduce slug and snail pests, rather than relying on a ‘knee-jerk’ reaction to an immediate problem.

Cultural control

Snails and slugs live in areas where abundant ground cover and vegetation provide ideal moisture levels and shelter. This is why they can be a problem on the edge of a crop with a weedy fence line. Good hygiene, weed control and removal of refuges can reduce the problem over time. Pest problems may increase in the short term after this process, as the pests will no longer have the weeds for food or shelter.

Cultivation of the ground not only kills pests directly, but provides a sterile habitat from which survivors flee. A short fallow period can improve this effect. Good hygiene will improve the value of other methods, especially baiting.

Control measures applied individually are unlikely to provide optimum control. An integrated approach needs to be considered to protect crops from damage by slugs and/or snails.
Monitoring

The key to effective control is monitoring. Monitoring regularly means pests can be detected early, ideally before seeding, as there are more control options available at this time. Once the crop has been seeded and germination is commencing, control options are limited to baiting. At this time crops should be examined at night for slug and snail activity.

It is best to look for slugs and snails on moist, warm and still nights. Fresh trails of white and clear slime (mucus) visible in the morning also indicate the presence of slugs or snails.

How to find slugs

An alternative method in a paddock is to place wet carpet squares, hessian sacks or tiles on the soil surface. They should be at least 32 cm by 32 cm (10% of a m²). Place pellets under them. After a few days, count the number of slugs under and around each square. Multiplying by 10 will give an estimate of slugs per m². Table 17 gives an indication of thresholds.

A useful method to detect areas infested with slugs, prior to seeding or crop emergence, is to lay lines of slug pellets with a rabbit baiter. In infested areas, slugs are attracted to the freshly turned soil and pellets placed in the furrow. Very large numbers can be found dead or dying in the furrows or nearby. On sloping ground, furrows should be run along contours to reduce the risk of soil erosion in heavy rain.

How to find snails

Snails are usually found on stumps, fence lines and under stubbles. A good way to determine snail numbers on open ground is to use a 32 cm by 32 cm square quadrant and count all of the live snails in it. This is an area of 10% of a m² so multiplying by 10 will give an estimate of snails per m².

Consider control options if slug and snail numbers are above thresholds. 26

Table 17: Suggested thresholds for control of slugs and snails in broadacre crops

<table>
<thead>
<tr>
<th>Species</th>
<th>Oilseeds</th>
<th>Cereals</th>
<th>Pulses</th>
<th>Pastures</th>
</tr>
</thead>
<tbody>
<tr>
<td>Black keeled slug</td>
<td>1–2 per m²</td>
<td>1–2 per m²</td>
<td>1–2 per m²</td>
<td>5 per m²</td>
</tr>
<tr>
<td>Reticulated slug</td>
<td>1–2 per m²</td>
<td>5 per m²</td>
<td>1–2 per m²</td>
<td>5 per m²</td>
</tr>
<tr>
<td>Small pointed snail</td>
<td>20 per m²</td>
<td>40 per m²</td>
<td>5 per seedling</td>
<td>100 per m²</td>
</tr>
<tr>
<td>Vineyard snail</td>
<td>5 per m²</td>
<td>20 per m²</td>
<td>5 per m²</td>
<td>80 per m²</td>
</tr>
<tr>
<td>White Italian snail</td>
<td>5 per m²</td>
<td>20 per m²</td>
<td>5 per m²</td>
<td>80 per m²</td>
</tr>
</tbody>
</table>

Please note: The above thresholds are from limited data. It is essential to carefully monitor crops as distributions of snails and slugs are patchy.

Source: DAFWA

7.10 Earwigs

7.10.1 European earwig (*Forficula auricularia*)

The European earwig (*Forficula auricularia*) (Photo 23) were first recorded in WA around 1990 and now can be found over much of the south-west of WA and in Perth.

Although the adults have wings, they seldom fly and are mainly spread by human activity. In recent years these earwigs have caused significant damage to broadacre and horticultural crops, as well as contaminating grain.

This section details the biology and management options for this pest.
- Adults range from 12 to 24 mm long
- They have uniform brown bodies that are smooth and shiny with light brown or yellow legs, pincers (also called forceps) and ‘shoulders’
- These earwigs have a flattened, elongated body with a reddish-brown head and slender, beaded antennae
- Pincers of male earwigs are long and curved, whereas those of females are almost straight
- Young earwigs, also called nymphs, look similar to adults but are smaller, paler and do not have wings

**Photo 23:** *European earwig: male (left), female (right).*  
Source: DAFWA

### 7.10.2 Native earwigs

Native earwigs are widespread and feed mainly on leaf litter and other organic material and are not known to damage crops (Photo 24).

They are often solitary and will not be seen in the high numbers usually associated with pest populations of European earwigs.
There are two native species commonly confused with European earwigs. *Carcinophora occidentalis* (no common name) has reddish-brown foreparts and legs, with a darker abdomen and pincers. *Labidura truncata* (common brown earwig) has similar colouring to the European earwig but can be distinguished from the European earwig by the orange triangle behind the head on the wing case (Photo 25).

**Photo 24:** Native earwig: male (left), female (right). Note: the male has curved pincers.

**Photo 25:** Common brown earwig (*Labidura truncata*).

Source: DAFWA
7.11 Locusts and grasshoppers

Locusts and grasshoppers are chewing pests that can cause complete defoliation if populations are high enough. In WA there are regular locust outbreaks in seasons following wet summers (every 4–5 years). Experience has shown damage to barley crops is usually minimal. In most cases barley crops have matured by the time the locusts are at their most damaging. Late maturing barley crops could be vulnerable to head loss due to locusts feeding on the stem below the head as this is the last part of the plant to ripen.

Table 18: Management summary for locusts and grasshoppers

| Description | Adult locusts are up to 40 mm long with a black spot on the tip of a clear hindwing, X-shaped mark behind the head and red shanks of the hind legs (Figure 35). |
| Insect larvae | Nymph locusts resemble adults but have dark shanks and lack wings |
| Development | Plague locusts are native insects that have two generations, in spring and autumn, and require green feed. |
| | Nymphs have five growth stages (instars). |
| | Over-summering eggs are laid in spring for the autumn generation, often in heavy soils. |
| | Green bridge feed is required for the autumn generation to lay sufficient eggs to pose a risk for crops in spring. |
| | Adults form swarms that can fly long distances and cause significant damage. |
| Damage | Leaves and stems have chewed pieces missing, with complete defoliation of plants in extreme cases. |
| | Established green crops tend to be avoided by hoppers, although the edges of crops can be damaged. Crops beginning to dry off when locusts begin to fly are susceptible to damage; locusts cause little if any damage to crops that have dried off. |
| Control | To achieve effective control, the best time to apply an insecticide is when locusts are hoppers. Treating small areas of dense masses of hoppers immediately after hatching can also be worthwhile, but will only control a relatively small proportion of the total number within a paddock and may involve several sprays as hatching times are staggered. |
| | If locust swarms do form, they should be controlled when they first fly into an area where their feeding will cause damage. It is important to be aware of the likelihood of locusts flying onto your property and to stay vigilant. |
| | Sprays must be applied directly onto the locusts and the vegetation on which they are feeding. |
| | Barrier spraying to keep locusts out of an area is not effective. |

7.12 Desiantha or spotted vegetable weevil (*Steriphus diversipes*)

The larvae of Desiantha weevil attack cereal crops, especially along the south coast and in late plantings. Larvae feed underground on germinating seeds or stems and often kill plants or cause abnormal or stunted growth. They favour sand over gravel and sandy duplex soils.

Desiantha weevil larvae are white, legless, with orange-brown heads and are up to 6 mm long (Photo 28). Larvae remain under the soil and are difficult to locate, although some painstaking digging may reveal larvae close to plants. Adults are mottled grey-black weevils about 5 mm long with the typical weevil snout (Photo 28).
Photo 28: Desiantha weevil larva (left) and adult (right).
Source: DAFWA

Table 19: Management summary for Desiantha or spotted vegetable weevil

<table>
<thead>
<tr>
<th>Scientific name</th>
<th>Steriphus diversipes</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Description</strong></td>
<td></td>
</tr>
<tr>
<td>Insect adult</td>
<td>Flightless weevils are about 5 mm long, dark grey to black, and often have a mottled or spotted appearance. Adults live on the soil surface but do not damage cereals. Insect larvae. White, legless grubs with yellow or orange-brown heads and up to 6 mm long.</td>
</tr>
<tr>
<td><strong>Monitor</strong></td>
<td>Check germinating cereal crops, especially along the south coast and in late plantings, for poor emergence and discoloured and stunted plants.</td>
</tr>
<tr>
<td><strong>Damage</strong></td>
<td>Paddock</td>
</tr>
<tr>
<td>Patches of dead, weak or dying plants that are mainly found on sandy surfaced soils. Symptom severity patterns can vary with practices that may alter weevil egg-laying preference, plant density, or plant nutrition. Plant. Larvae chew the swollen seed, bore into the underground stem of seedlings or tillers causing them to wither and die.</td>
<td></td>
</tr>
<tr>
<td><strong>Control</strong></td>
<td>Effective control of grass weeds in previous season and of green bridge following summer rain will minimise the risk of crop losses from desiantha. The only in-crop treatment is to reseed with insecticide-coated seed.</td>
</tr>
</tbody>
</table>
7.13 Cockchafers (*Sericesthis* spp.)

Cockchafer (scarab) larvae feed underground on organic material and some species are also serious pests of cereals. A number of species are found in WA, however, only a few actually cause crop damage. Cockchafer larvae can be found in high numbers and not cause crop damage (Photo 29).

![Photo 29: Scarab larvae.](image)

Cockchafer adults are also a major pest, causing damage to cereal crops. Adult cockchafers can be found in high numbers and not cause crop damage. (Photo 30).

![Photo 30: Top: Scarab adult. Bottom: Scarab adults mating](image)
### Scientific name
Sericesthis spp.

### Description
Larvae are found only in soil and are up to 12 mm long, creamy-white with a darker head and curled into a ‘C’ shape.

### Development
Cockchafers are native insects that occasionally reach damaging levels when conditions favour egg laying. The complete life cycle may take one or two years. Some species have a long larval stage that extends over 12–18 months. In most species the larva is active during late autumn and winter, then pupates in spring, with adults emerging in early summer. Feeding, mating and egg laying may occur throughout summer.

### Monitor
Check newly emerged crops for underground damage and larvae in the soil.

### Damage
Larvae feed on underground plant parts, causing them to wither and die, potentially leading to large bare areas. Crops after pasture are more likely to be damaged, with damage worse near tree belts.

### Control
Cockchafers cannot be successfully controlled with insecticides post-crop emergence as they stay underground. Insecticides can be mixed with seed or a higher seeding rate can be used if paddocks are known to have high populations of cockchafers.

### Table 21: Distinguishing from other causes of damage

<table>
<thead>
<tr>
<th>Condition</th>
<th>Similarities</th>
<th>Differences</th>
</tr>
</thead>
<tbody>
<tr>
<td>African black beetle</td>
<td>C-shaped grubs; lead to young plant death from chewed roots and crowns</td>
<td>African black beetle adults continue to chew plants throughout the season, fraying the lower stem and often only affecting individual tillers.</td>
</tr>
<tr>
<td>Sandgropers</td>
<td>Early plant death from chewed roots and crowns</td>
<td>Sandgropers are large cricket-type insects that cause damage in the West Midlands; they continue to chew plants throughout the season and fray the lower stem.</td>
</tr>
</tbody>
</table>

#### 7.13.1 Rutherglen bug (Nysius vinitor)

The Rutherglen bug has traditionally only been a problem in emerging canola in WA, but in the last few years with wet summer/autumn there has been significant damage to young cereal crops growing post canola (or where there was high mintweed numbers over summer) and when an insecticide knockdown wasn’t included with the weed knockdown. 28

The Rutherglen bug is a native species that breeds on a range of native and weed hosts and is a pest of numerous crops across Australia. It is a small, fast moving bug that can build up to high numbers during the warmer months when suitable hosts are available. The pest occurs most commonly in late canola pod set and at windrowing.

### Table 22: Management summary for Rutherglen bug ²⁹ ³⁰

<table>
<thead>
<tr>
<th>Scientific name</th>
<th>Nysius vinitor</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Description</strong></td>
<td>The adult RGB (Nysius vinitor) is a sapsucking insect; 4–6 mm long; mottled grey, brown and black in colour; with clear, silvery-grey wings folded flat over its back. It is often mistaken for grey cluster bug (Nysius clevelandensis), which is a close relative, but is a minor pest compared to RGB. The RGB nymph is wingless with a reddish-brown, pear-shaped body. It is more mobile than similar-looking aphids. Adult bugs breed on weeds and non-crop plants in inland Australia and need a green bridge to survive. During wetter winter–spring seasons, weeds in cropping regions can also be key breeding hosts. It is hard to predict which plants will drive RGB invasions in any one season. Adults generally stop breeding in late February as temperatures drop and days grow shorter.</td>
</tr>
<tr>
<td><strong>Control</strong></td>
<td>Damage of Rutherglen bugs can be reduced by parasitoids, controlling weeds and ploughing a deep furrow around emerging summer crops. There are several organophosphates and synthetic pyrethroids registered against Rutherglen bugs but these are disruptive to natural enemies. Insecticide applications will not guarantee a clean crop as Rutherglen bugs can readily reinvade a sprayed area. Broad-spectrum insecticides are the only effective management tool for reducing RGB damage. Certain insecticides from the carbamate, organophosphate and synthetic pyrethroid groups are suitable for controlling RGB. However, they are highly disruptive to natural insect enemies of RGB and applying repeatedly may increase the potential for resistance to those insecticides in other pests.</td>
</tr>
</tbody>
</table>
