GRDC GROWNOTES™

GRDC GRAINS RESEARCH & DEVELOPMENT CORPORATION

BARLEY

SECTION 7

INSECT CONTROL

INTEGRATED PEST MANAGEMENT | APHIDS | ARMYWORM (LEUCANIA CONVECTA) | HELICOVERPA SPP. | MITES | LUCERNE FLEA (SMINTHURUS VIRIDIS) | WEBWORM (HEDNOTA SPP.) | CUTWORM (AGROSTIS SPP.) | PEST SLUGS AND SNAILS | EARWIGS | LOCUSTS AND GRASSHOPPERS | DESIANTHA 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 (*Penthaleus* spp.), redlegged earth mite (*Halotydeus destructor*), Bryobia mites (*Bryobia* spp.), Balaustium mites, cutworms, aphids, earwigs, armyworms, *Helicoverpa* spp., pasture webworm, pasture cockchafers, grass anthelids, 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. [1]

Table 1: *Pests that pose a risk to cereal crops* [2]

High risk	Moderate risk	Low risk
Soil insects, slug and snails		
Some crop rotations increase the likelihood of soil insects: Cereal sown into a long-term pasture phase High stubble loads Above-average rainfall over summer–autumn History of soil insects, slugs and snails Summer volunteers and Brassica weeds will increase slug and snail numbers Cold, wet establishment conditions expose crops to slugs and snails	Information on pest numbers prior to sowing from soil sampling, trapping and/or baiting will inform management Implementing integrated slug management strategy (burning stubble, cultivation, baiting) where there is a history of slugs Increased sowing rate to compensate for seedling loss caused by establishment pests	Slugs and snails are rare on sandy soils
Earth mites		
Cereals adjacent to long-term pastures may get mite movement into crop edges Dry or cool, wet conditions that slow crop growth increase crop susceptibility to damage History of high mite pressure	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

1 DAF Qld (2012) Insect pest management in winter cereals. Department of Agriculture and Fisheries Queensland, http://www.daff.qld.gov.au/plants/field-crops-and-pastures/broadacre-field-crops/integrated-pest-management/ipm-information-by-crop/insect-pest-management-in-winter-cereals

2 DAF Qld (2016) Winter cereals. IPM guidelines. Department of Agriculture and Fisheries Queensland, http://ipmguidelinesforgrains.com.au/crops/winter-cereals

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	Low rainfall areas—lower risk of BYDV infection High beneficial activity (not effective for management of virus transmission)
Armyworms		
Large larvae present when the crop is at late ripening stage	High beneficial insect activity (particularly parasitoids) Rapid crop dry-down	No armyworm present at vegetative and grain-filling stages

Table 2: *Incidence of pests of winter cereals* [3]

	Crop stage			
	Emergence	**Vegetative**	**Flowering**	**Grainfill**
Wireworms	Damaging	Present		
Cutworm	Damaging			
Blackheaded cockchafer	Damaging	Present		
Earth mites	Damaging	Present		
Slugs, snails	Damaging			
Brown wheat mite		Damaging		
Aphids	Present	Damaging	Present	Present
Armyworm		Present–damaging	Present	Damaging
Helicoverpa armigera				Damaging

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.

3 DAF Qld (2016) Winter cereals. IPM guidelines. Department of Agriculture and Fisheries Queensland, http://ipmguidelinesforgrains.com.au/crops/winter-cereals

MORE INFORMATION

[GRDC (2015) Insect pests—resistance, virus vectors and lessons from 2014. GRDC Update Paper.]

[GRDC Ute Guides: Insects]

[cesar: Insect gallery]

[cesar: PestFacts: Grass anthelids]

[NIPI: Insect identification aids]

[PestFacts South Australia]

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]

Damage to crop	Pest
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.	Webworm
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.	Cutworms
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.	Lucerne flea
Leaves shredded or chewed, slimy trails.	Slugs and snails
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.	Earwigs
Minor leaf chewing; presence of dark brown to black caterpillars up to 60 mm long with two yellow spots near posterior end.	Pasture day moth
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.	Redlegged earth mite, blue oat mite, Balaustium mite
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.	Spotted vegetable weevil or Desiantha weevil

4 R McCauley et al. (2016) The world's first Biosecurity Blitz (2015)–Lessons learned about reporting plant pests for the WA grains industry. GRDC Grains Research Update, 29 Feb–01 Mar 2016, http://www.giwa.org.au/2016researchupdates

5 GRDC (2012) I spy. Insects of Southern Australian Broadacre Farming Systems Identification Manual and Education Resource. GRDC, https://grdc.com.au/resources-and-publications/all-publications/bookshop/2012/11/i-spy

Damage to crop	Pest
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* [6]

Pre-season	Pre-sowing	Emergence	Crop establishment
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	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	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	As the crop grows, it becomes less susceptible unless growth is slowed by dry or cool, wet conditions

6 NIPI (2014) Establishment pests—Southern Region. 'Best bet' IPM strategy. NIPI IPM Workshops, http://ipmworkshops.com.au/wp-content/uploads/BestBet_EstablishmentSouth2014.pdf

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 (Note: large numbers of these pests can be found in paddocks without causing crop damage)	Damage to established crops is rare

MORE INFORMATION

NIPI IPM Workshops: Decision making for insect management in grain crops

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]

---

7 K Hertel, K Roberts, P Bowden (2013) Insect and mite control in field crops. NSW DPI Management Guide. NSW Department of Primary Industries, http://www.dpi.nsw.gov.au/__data/assets/pdf_file/0005/284576/Insect-and-mite-control-in-field-crops-2013.pdf

8 GRDC (2009) Integrated Pest Management. GRDC Fact sheet, https://grdc.com.au/resources-and-publications/all-publications/bookshop/2009/12/integrated-pest-management-fact-sheet-national

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. [9]

MORE INFORMATION

DAFWA (2016) Diagnosing cereal aphids.

DAFWA (2016) Aphid feeding damage to cereal crops.

DAFWA (2016) Insecticides for the control of cereal aphids.

GRDC (2015) Crop Aphids Back Pocket Guide.

GRDC: Ute Guides Online.

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. [10] 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.

9 DAFWA (2016) Increasing pressure for Integrated Pest Management. Media Release, 8 March 2016. Department of Agriculture and Food, Western Australia, https://agric.wa.gov.au/n/5402

10 L Price (2010) Aphids in cereals. Goondiwindi Grains Research Update, Northern Grower Alliance, March 2010, http://www.nga.org.au/results-and-publications/download/19/grdc-update-papers-pests/aphids-in-winter-cereals/grdc-adviser-update-paper-goondiwindi-march-2010-.pdf

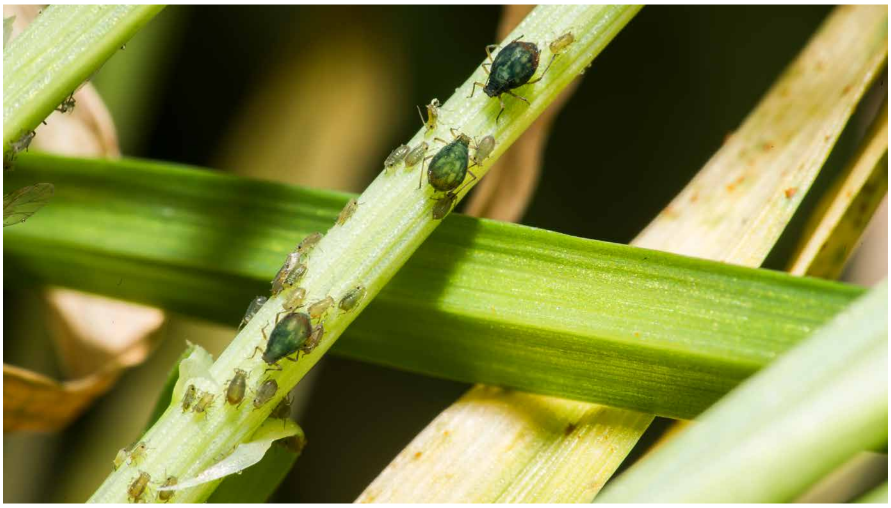

Photo 1: *Heavy infestation of oat aphids (Rhopalosiphum padi).*

Source; Evan Collins

Table 5: *Oat or wheat aphid management summary* [11]

Scientific name	*Rhopalosiphum padi*
Description	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
Distribution	An introduced species found in all states of Australia
Crops attacked	Barley, wheat and oats
Life cycle	Produces many generations through the growing season. Winged and non-winged forms occur
Damage	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
Monitoring and action level	Aphids can affect any crop stage but are unlikely to cause economic damage to cereal crops expected to yield <2 t/ha (for virus damage) and <3 t/ha (for direct feeding). Consider treatment if there are 10–20+ aphids on 50% of the tillers
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

11 DAF Qld (2011) Oat aphid, wheat aphid. Department of Agriculture and Fisheries Queensland, http://www.daff.qld.gov.au/plants/field-crops-and-pastures/broadacre-field-crops/integrated-pest-management/a-z-insect-pest-list/aphid-overview/oat-aphid,-wheat-aphid

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).

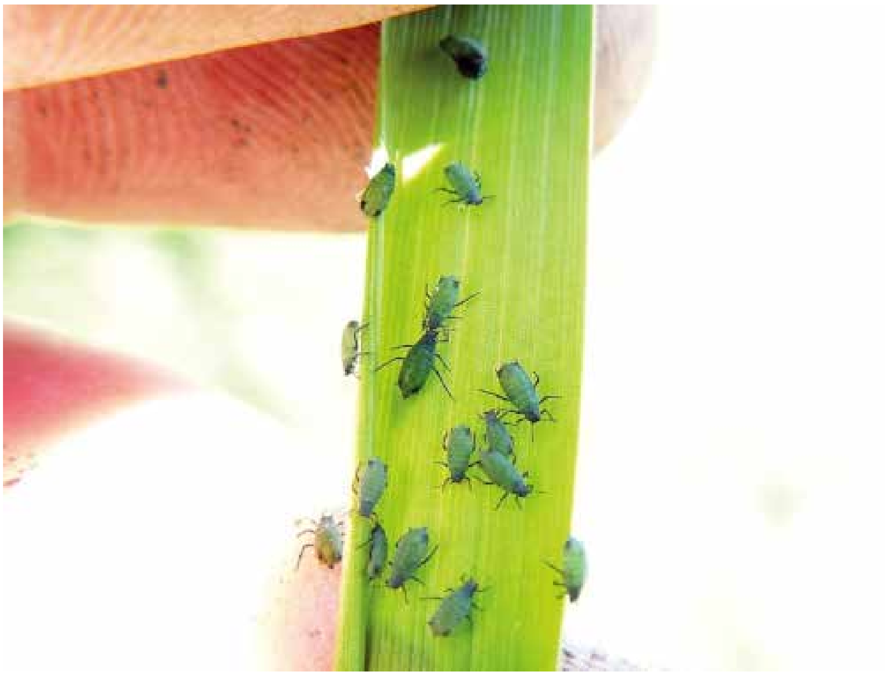

Photo 2: *Corn aphids (Rhopalosiphum maidis).*

Source; Qld DAF

Table 6: *Corn aphid management summary* [12]

Scientific name	*Rhopalosiphum maidis*
Description	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
Similar species	Other species of aphids
Distribution	An introduced species, probably Asiatic in origin, found in all states of Australia
Crops attacked	Sorghum, maize, winter cereals and many grasses Life cycle on cereals: A parthenogenetic species that undergoes many generations through the growing season. Both winged and non-winged forms occur
Damage	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 Risk period: 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
Monitoring	Estimate percentage of plants infested and percentage of leaf area covered by aphids
Action level	Aphids are unlikely to cause economic damage to cereal crops expected to yield <3 t/ha. To avoid damage by direct feeding, consider treatment if there are ≥10–20 aphids on 50% of the tillers
Chemical control	Chemical control is cost-effective. See Pest Genie or APVMA for current control options 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

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.

12 DAF Qld (2010) Corn aphid. Department of Agriculture and Fisheries Queensland, http://www.daff.qld.gov.au/plants/field-crops-and-pastures/broadacre-field-crops/integrated-pest-management/a-z-insect-pest-list/aphid-overview/corn-aphid

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.

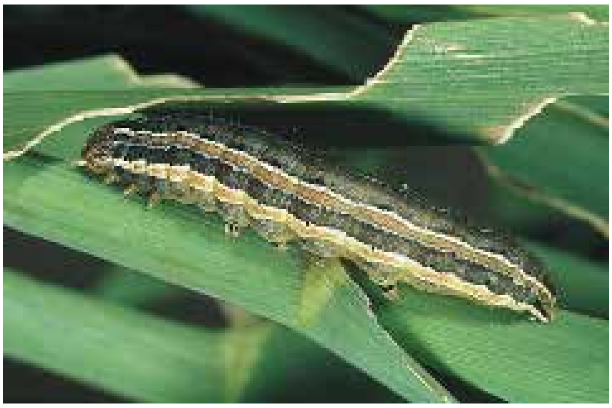

Photo 3: *Common armyworm (Leucania convecta).*

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/m^2 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 m^2 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/m^2. 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/m^2) per day, based on various values for grain and an estimated loss, given 1 larva/m^2, of 70 kg/ha*

Value of grain (A$/t)	Value of yield loss ($) per ha per day	
	1 larva/m^2	2 larvae/m^2
$140	$9.80	$19.60
$160	$11.20	$22.40
$180	$12.60	$25.20
$200	$14.00	$28.00
$220	$15.40	$30.80
$250	$17.50	$35.00
$300	$21.00	$42.00
$350	$24.50	$49.00
$400	$28.00	$56.00

Considering these results, and the relatively low cost of controlling armyworm, populations of >1 large larva/m^2 in ripening crops warrant spraying

Source: DAF Qld

13 DAF Qld (2012) Insect pest management in winter cereals. Department of Agriculture and Fisheries Queensland, http://www.daff.qld.gov.au/plants/field-crops-and-pastures/broadacre-field-crops/integrated-pest-management/ipm-information-by-crop/insect-pest-management-in-winter-cereals

Table 8: *Armyworm management summary* [14]

Scientific name	*Leucania convecta*—common armyworm
Description	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
Similar species	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
Distribution	Common armyworm is a native Australian species, recorded in New South Wales, Queensland, South Australia, Tasmania, Victoria and Western Australia
Crops attacked	Common armyworm damages barley, oats, wheat, native pasture grasses and perennial grass seed crops
Life cycle	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 20.1 days at 20°C and 10.1 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)
Risk period and damage	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

14 DAF Qld (2010) Common, northern and sugarcane armyworms. Department of Agriculture and Fisheries Queensland, http://www.daff.qld.gov.au/plants/field-crops-and-pastures/broadacre-field-crops/integrated-pest-management/a-z-insect-pest-list/armyworm-overview/common,-northern-and-sugarcane-armyworms

Monitoring and action level	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 m^2. 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/m^2 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

MORE INFORMATION

DAFWA (2016) Management of armyworm in cereal crops.

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. [15]

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).

15 GRDC (2012) Approaches to key insect pests of southern and western grains. Southern and Western Regions. Insecticide Management and Invertebrate Pest Identification. GRDC Fact Sheet, http://rawbrown.com.au/pdf/agribusiness/Fact-Sheet-1.pdf

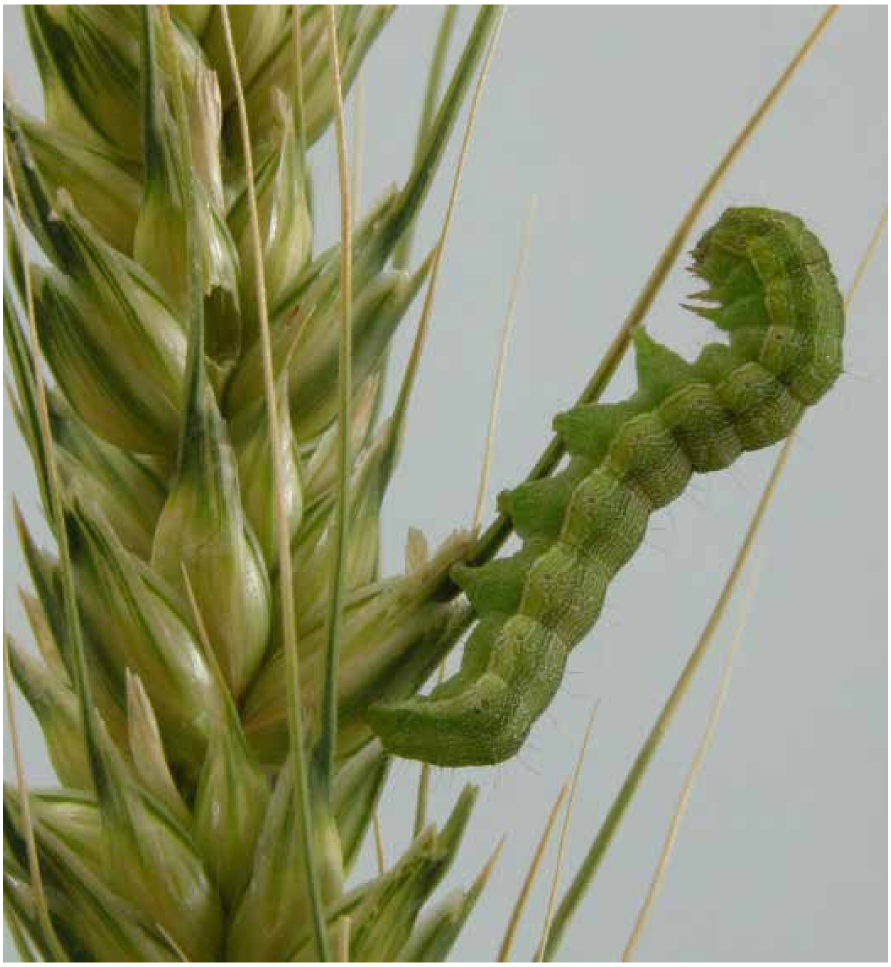

Photo 4: *Helicoverpa armigera.*

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 silvering 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 greyish 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. [16]

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

Source: A Weeks, cesar

16 DAF Qld (2012) Insect pest management in winter cereals. Department of Agriculture and Fisheries Queensland, http://www.daff.qld.gov.au/plants/field-crops-and-pastures/broadacre-field-crops/integrated-pest-management/ipm-information-by-crop/insect-pest-management-in-winter-cereals

Table 9: *Management summary for blue oat mite* [17]

Scientific name	*Penthaleus major, P. falcatus*, *P. tectus*
Description	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
Similar species	Redlegged earth mite Briyobia Mite Balastium mite
Crops attacked	Mainly a pest of cereals and grass pastures, but will feed on pasture legumes and many weeds
Damage	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
Monitor	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
Control	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.
Natural enemies	Thrips and ladybirds

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.

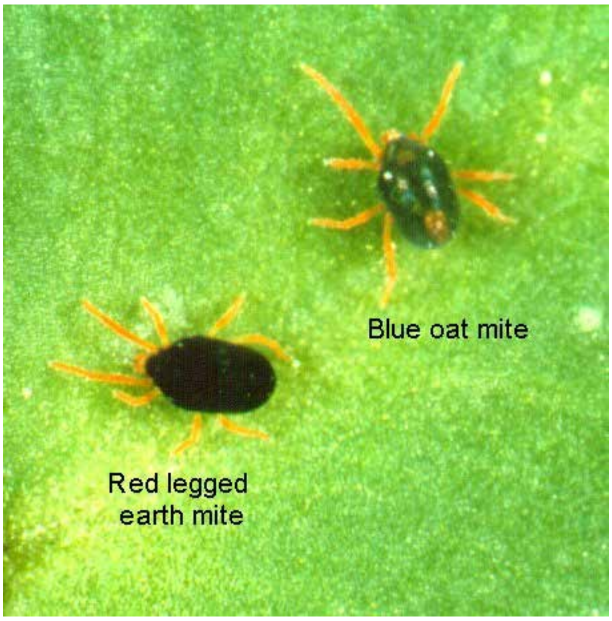

Photo 7: *Redlegged earth mites (Halotydeus destructor) often coexist with blue oat mites (Penthaleus sp.).*

Source: DAFWA

17 DAF Qld (2010) Blue oat mite. Mites in field crops. Department of Agriculture and Fisheries Queensland, http://www.daff.qld.gov.au/plants/field-crops-and-pastures/broadacre-field-crops/integrated-pest-management/a-z-insect-pest-list/mites-overview/blue-oat-mite

MORE INFORMATION

DAFWA (2014) Earth mites – economic considerations for management.

Table 10: *Distinguishing blue oat mite from similar mites*

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

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*

Scientific name	*Halotydeua destructor*
Description	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.
Similar species	Blue oat mite Briyobia mite Balastium mite
Development	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
Damage	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).
Monitor	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
Control	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-leafed 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.

MORE INFORMATION

GRDC (2016) RLEM resistance management strategies. Ground Cover Radio 122.

GRDC (2012) Crop Mites Back Pocket Guide.

DAFWA (2016) Prevent redlegged earth mite resistance.

DAFWA (2015) Diagnosing redlegged earth mite.

DAFWA (2014) Earth mites: economic considerations.

7.5.3 Balaustium mite (*Balaustium medicagoense*)

Balaustium mite (Photo 11) is a sucking pest of crops but usually outgrow damage unless stressed.

Photo 11: *Balaustium mite*

Source: DAFWA

Table 12: *Management summary for Balaustium mite* [18]

Scientific name	*Balaustium medicagoense*
Description	Adults are up to 2 mm and uniformly red-brown with stout hairs covering the body. Very young mites are bright red.
Similar species	Blue oat mite Briyobia mite Redlegged earth mite
Development	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.
Damage	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.
Control	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

18 DAFWA (2015), Diagnosing blue oat mite. Department of Agriculture and Food, Western Australia, https://www.agric.wa.gov.au/mycrop/diagnosing-blue-oat-mite

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. [19]

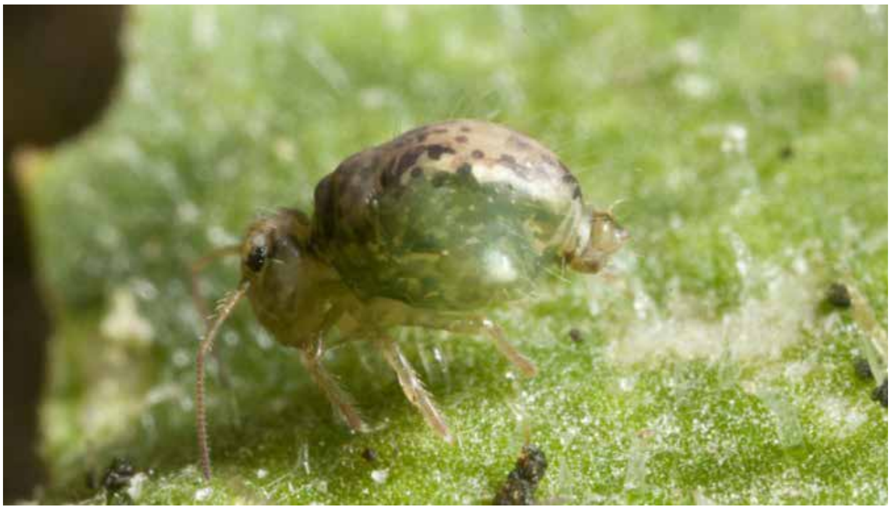

Photo 12: *Adult lucerne flea (Sminthurus viridis).*

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 13: *Management summary for Lucerne flea*

Scientific name	*Sminthurus viridis*
Description	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. [18]
Crops attacked	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.
Damage	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.

19 P Matthews, D McCaffery, L Jenkins (2015) Winter crop variety sowing guide 2015. NSW DPI Management Guide. NSW Department of Primary Industries, http://www.dpi.nsw.gov.au/agriculture/broadacre-crops/guides/winter-crop-variety-sowing-guide

20 CropPro. Lucerne flea. Pests in canola. CropPro, http://www.croppro.com.au/cb_pages/pests_in_canola_-_in_crop.php?category_id=2374

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. [21]

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. [22]

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.

MORE INFORMATION

Agriculture Victoria: Lucerne flea.

NIPI IPM Guidelines: Lucerne flea in winter seedling crops.

NIPI: I Spy Manual. Lucerne flea (section 4, pp. 63–64).

21 CropPro. Lucerne flea. Pests in canola. CropPro, http://www.croppro.com.au/cb_pages/pests_in_canola_-_in_crop.php?category_id=2374

22 cesar (2010) Lucerne flea. PestFacts south-eastern, Issue 3, 21 May 2010. cesar, http://www.cesaraustralia.com/sustainable-agriculture/pestfacts-south-eastern/past-issues/2010/pestfacts-issue-no-3-21st-may-2010/lucerne-flea/

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* [23]

Scientific name	*Hednota* spp.
Description	Insect larvae • Brown caterpillars up to 15 mm long with black heads, which hide in web-lined tunnels during day (Figures 12 and 14). Insect adult • 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. • Larvae tend to be more common on of the edge of patches.
Development	Caterpillars hatch from eggs laid in the grass in autumn and feed throughout the winter. • 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.
Monitor	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.

23 DAFWA (2015) Diagnosing webworm. Department of Agriculture and Food, Western Australia, https://www.agric.wa.gov.au/mycrop/diagnosing-webworm

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).

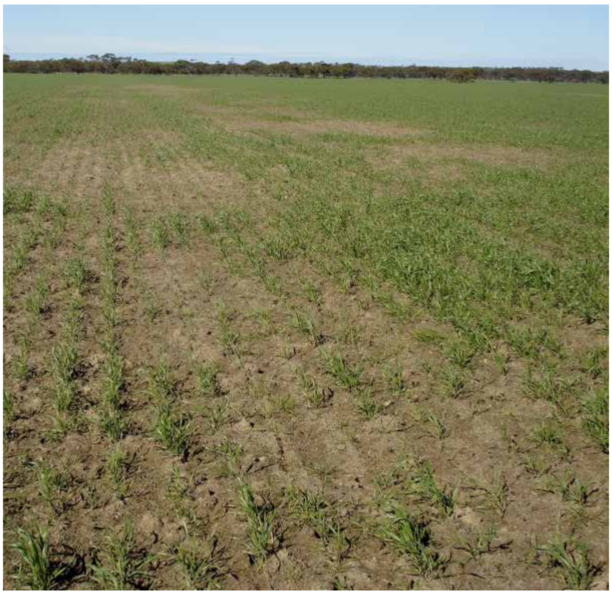

Photo 16: *Cutworm damage.*

Source: DAFWA

Photo 17: *Cutworm.*

Source: DAFWA

Photo 18: *Cutworm larvae can vary in colour.*

Source: DAFWA

Table 15: *Management summary for Cutworm*

Scientific name	*Agrostis* spp.
Description	Cutworm moths can fly large distances and favour bare or lightly vegetated areas for egg laying.
Similar species	Webworm, Armyworm
Monitor	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.

Table 16: *Distinguishing from similar pests* [24]

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

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).

MORE INFORMATION

DAFWA (2016) Cutworm: Pests of crops and pastures.

DAFWA (2014) Cutworm – Economic considerations for management.

24 DAFWA (2014) Diagnosing cutworm in cereal crops. Department of Agriculture and Food, Western Australia, https://www.agric.wa.gov.au/mycrop/diagnosing-cutworm-cereals

25 DAFWA (2015), Identification and control of pest slugs and snails for broadcare crops in Western Australia. Department of Agriculture and Food, Western Australia, https://www.agric.wa.gov.au/grains/identification-and-control-pest-slugs-and-snails-broadacre-crops-western-australia?page=0%2C0

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.*

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.

Photo 22: *Vineyard snail.*

Source: DAFWA

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 m^2). 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 m^2. 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 m^2 so multiplying by 10 will give an estimate of snails per m^2.

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*

Species	Oilseeds	Cereals	Pulses	Pastures
Black keeled slug	1–2 per m^2	1–2 per m^2	1–2 per m^2	5 per m^2
Reticulated slug	1–2 per m^2	5 per m^2	1–2 per m^2	5 per m^2
Small pointed snail	20 per m^2	40 per m^2	5 per seedling	100 per m^2
Vineyard snail	5 per m^2	20 per m^2	5 per m^2	80 per m^2
White Italian snail	5 per m^2	20 per m^2	5 per m^2	80 per m^2

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.

MORE INFORMATION

DAFWA (2015) Identification and control of pest slugs and snails for broadcare crops in Western Australia.

DAFWA (2014) Snail and slug control.

GRDC (2013) Slug identification and management Fact sheet.

GRDC (2010) Snail Bash'em Burn'em Bait'em.

PestNotes: Small Pointed Snail

26 DAFWA (2015), Identification and control of pest slugs and snails for broadcare crops in Western Australia. Department of Agriculture and Food, Western Australia, https://www.agric.wa.gov.au/grains/identification-and-control-pest-slugs-and-snails-broadacre-crops-western-australia?page=0%2C0

- 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

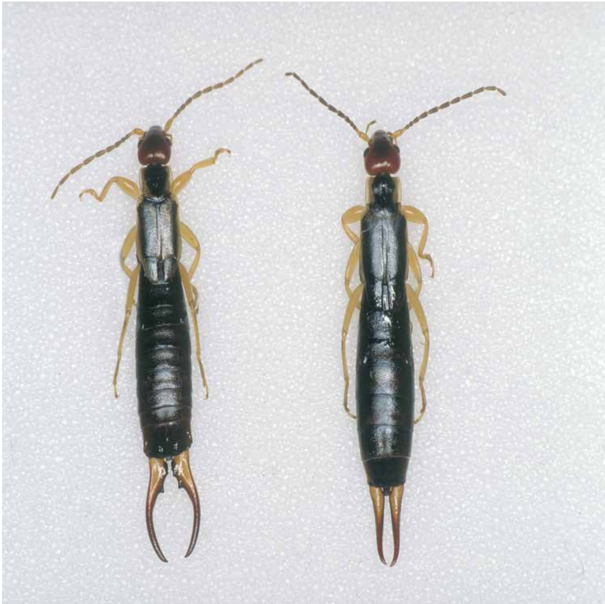

Photo 23: *European earwig: male (left), female (right).*

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.

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

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

Source: DAFWA

MORE INFORMATION

DAFWA (2016) Australian plague locusts: identification field guide.

DAFWA (2015) Monitoring insects and other crop pests.

DAFWA (2014) Locusts and grasshoppers – economic considerations for management.

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* [27]

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

27 DAFWA (2014) Locusts and grasshoppers–economic considerations for management. Department of Agriculture and Food, Western Australia, https://agric.wa.gov.au/n/3495

Photo 26: *Locust adult.*

Source: DAFWA

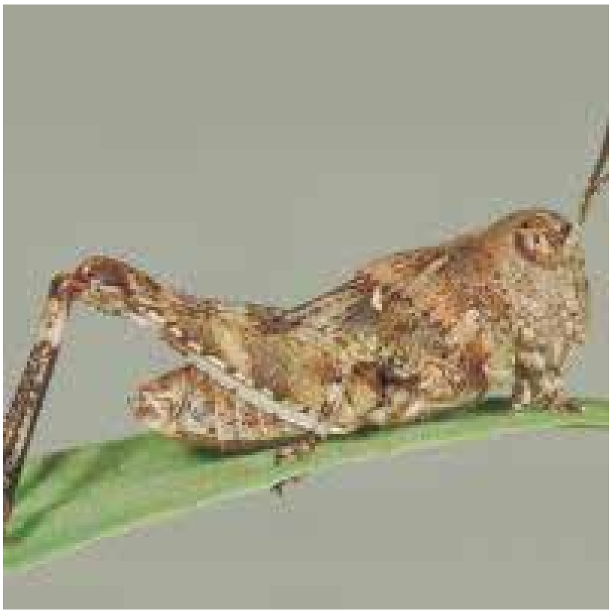

Photo 27: *Locust nymph.*

Source: DAFWA

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).

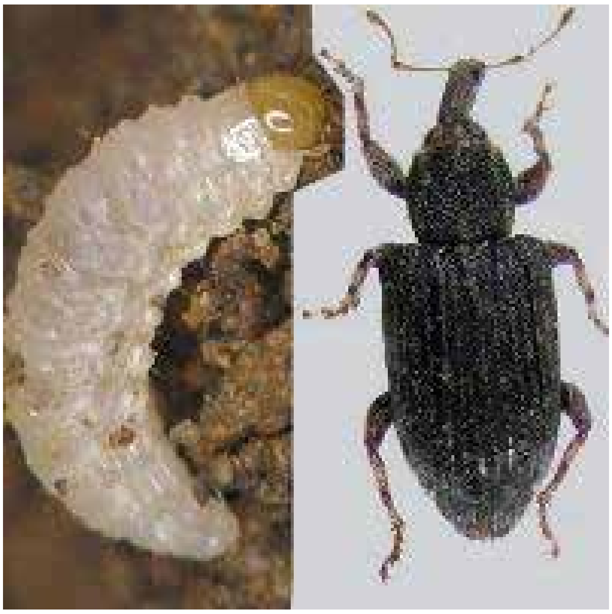

Photo 28: *Desiantha weevil larva (left) and adult (right).*

Source: DAFWA

Table 19: *Management summary for Desiantha or spotted vegetable weevil*

Scientific name	*Steriphus diversipes*
Description	Insect adult 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
Monitor	Check germinating cereal crops, especially along the south coast and in late plantings, for poor emergence and discoloured and stunted plants
Damage	Paddock 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
Control	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

MORE INFORMATION

DAFWA (2014) Desiantha weevil ions management.

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).

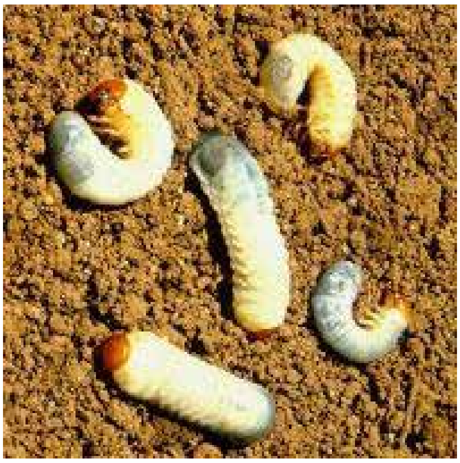

Photo 29: *Scarab larvae.*

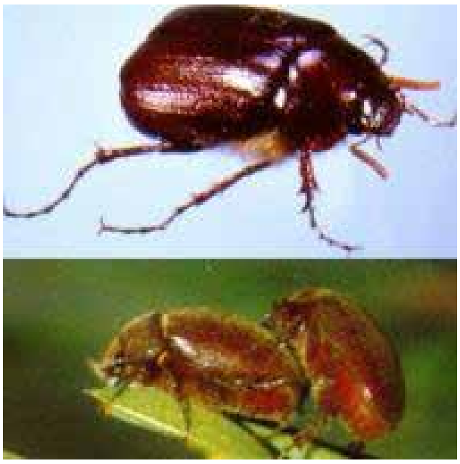

Photo 30: *Top: Scarab adult. Bottom: Scarab adults mating*

Table 20: *Management summary for Cockchafers*

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*

Condition	Similarities	Differences
African black beetle	C-shaped grubs; lead to young plant death from chewed roots and crowns	African black beetle adults continue to chew plants throughout the season, fraying the lower stem and often only affecting individual tillers
Sandgropers	Early plant death from chewed roots and crowns	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

MORE INFORMATION

DAFWA (2015) Cockchafer damage to broadacre crops.

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.

28 Erin Cahill (2016) CSBP Pers comm.

Table 22: *Management summary for Rutherglen bug* [29] [30]

Scientific name	*Nysius vinitor*
Description	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.
Control	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.

29 cesar, Rutherglen bug. PestNotes. http://www.cesaraustralia.com/sustainable-agriculture/pestnotes/insect/Rutherglen-bug

30 GRDC (2014) Rutherglen bug in sunflower. GRDC Fact sheet, http://ipmguidelinesforgrains.com.au/wp-content/uploads/RGB-FS-FINALweb.pdf