WESTERN

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GRDC GROWNOTES™

GRDC GRAINS RESEARCH & DEVELOPMENT CORPORATION

DURUM

SECTION 7

PESTS AND INSECTS

MORE INFORMATION

DPIRD 'MyPestGuide': https://mypestguide.agric.wa.gov.au/#/

DPIRD 'Aphid Feeding Damage to Cereal Crops': https://www.agric.wa.gov.au/barley/aphid-feeding-damage-cereal-crops

DPIRD 'Pest Insects': https://www.agric.wa.gov.au/pests-weeds-diseases/pests/pest-insects

DPIRD 'Mites and Spiders': https://www.agric.wa.gov.au/pests-weeds-diseases/pests/mites-spiders

Pests and Insects

7.1 Overview

Insects are not typically a major problem in Western Australia's winter cereal crops. But several pests can cause serious damage to wheat, potentially including durum wheat, in some seasons, locations and farming systems.

The types of pests affecting WA's crops have changed in recent years as a result of:

- Increased use of broad spectrum insecticides
- Widespread adoption of stubble retention and minimum tillage
- Increased plantings of vulnerable crops (such as canola)
- Drier conditions exacerbated by climate change.

Incidence of pest resistance to insecticides is also increasing on the back of widespread use of prophylactic, or 'insurance', insecticide applications.

Parasitic wasps (*Hymenoptera*), ladybeetles (*Coccinella*), lacewings (*Chrysopidae*) and hoverflies (*Syrphidae*) can provide useful biological control of some crop pests. Monitoring of both pest and beneficial insect populations can reduce the need to apply insecticides.

The Department of Primary Industries and Regional Development (DPIRD) MyPestGuide application (app) has comprehensive information about pest identification and management in WA cropping systems and is available at https://mypestguide.agric.wa.gov.au/#/. It covers more than 200 crop and grain storage pests, beneficial and biological control agents and biosecurity pest threat alerts specific to WA.

A key feature of the app is that it enables users to send pest reports and photographs direct to entomologists at DPIRD for diagnosis.

7.2 Integrated pest management

Prophylactic, or 'insurance', insecticide applications can be an unnecessary cost and speed the development of insect resistance.

It is advisable to closely analyse the need for insecticides, as there may be beneficial insects that can help control pests if crops are left untreated.

Integrated pest management (IPM) plans can include monitoring, identification, cultural, chemical, genetic and biological tactics to prevent crop pests from reaching damaging levels.

It is recommended to only apply insecticides after monitoring and correctly identifying pest species.

If insecticides are used, minimising chemical impact on beneficial insects can be helped by selective spraying and limiting the number of applications.

When using insecticides, it is best practice to:

- Rotate products
- Use different modes of action (MOA)
- Use recommended label rates
- Ensure good coverage
- Consider economic thresholds for pest control.

7.3 Insect and pest monitoring in cereal crops

- Monitoring insect incidence and numbers is key to IPM
- Correctly identify immature and adult stages
- Monitor and identify both pest and beneficial insects
- Use good sampling and recording techniques.

Knowledge of the pests and beneficial insects likely to be present during the year, their lifecycles and typical location on crop plants are essential when conducting monitoring as part of an IPM plan.

Monitoring frequency and pest focus should be targeted at crop stages likely to incur economic damage, such as at seedling emergence and flowering/grain formation.

Using appropriate sampling technique is important to ensure that a representative portion of the crop has been monitored — as pest activity is often patchy.

Defining sampling parameters (such as number of samples per paddock and number of leaves per sample) helps achieve sampling consistency.

Actual sampling technique, including sample size and number, will depend on crop type, age and paddock size and is often a compromise between the ideal number and location of samples and what is practical, considering time constraints and distance covered.

It is recommended random sampling be balanced with sampling in areas of obvious damage.

Random sampling aims to give an overall picture of what is happening in the paddock, but any obvious 'hot spots' of insect activity should also be investigated.

7.3.1 Monitoring — keeping good records

Accurately recording the results of insect and pest sampling is key to good decision making and being able to review the success of control measures.

It is advised monitoring record sheets should show:

- » Numbers and types of insects found
- » Details of adults and immature stages
- » Size of insects (particularly important for larvae)
- » Date and time
- » Crop stage and any other relevant information — such as row spacings, weather conditions.

It can be useful to collate insect monitoring data into a visual form that enables analysis of trends in pest numbers and plant conditions over time.

Being able to track whether an insect population is increasing, static or decreasing can be useful in deciding whether an insecticide treatment may be required and/or if a treatment has been effective.

Records of insecticide use can include:

- » Date and time of day
- » Conditions (wind speed, wind direction, temperature, presence of dew and humidity)
- » Product(s) used (including any additives)
- » Amount of product(s) and volume applied per hectare of application
- » Nozzle types and spray pressure.

7.3.2 Monitoring — optimal times to inspect for insect and pests

It is advised to check cereal crops for signs of pest and beneficial insects or eggs every week during the vegetative stage.

Caterpillar pests are typically not mobile in the canopy and some, such as cutworm (*Agrotis* ssp.), reside below the ground during the day. It is advised to check for these with a torch at night in wheat crops — at the emergence to seedling stage.

Pod-sucking bugs, particularly green vegetable bugs, often bask on the top of the canopy during the early morning and are more easily seen at this time.

Most thresholds for insect control are expressed as pests per square metre (pests/m^2).

It is recommended to separate leaflets or flowers when looking for eggs or small larvae and to dig below the soil surface to assess soil insect activity.

Visual checking of plants in a crop is also important for estimating how the crop is progressing in terms of average growth stage, pod retention and other agronomic factors.

Sweep net sampling can be used for flighty insects and is also useful if the field is wet. This works well for smaller pests found in the tops of smaller crops, but is less efficient against larger pests, such as pod-sucking bugs, and tends not to be practical in tall crops with a dense canopy.

It is recommended by DPIRD researchers that at least 20 sweeps are taken along a single 20 metre row.

Monitoring with traps (such as pheromone, volatile and light traps) can provide general evidence about pest activity and the timing of peak egg-laying events for some species. But this is considered a poor substitute to in-paddock monitoring of actual pests and beneficial insect numbers.

FEEDBACK

MORE INFORMATION

DPIRD MyCrop Diagnostic Tool 'Aphids'': https://agric.wa.gov.au/n/2157

GRDC Ute Guide 'Crop Insects': https://grdc.com.au/Resources/Ute-Guides/Insects

GRDC Tips and Tactics 'Reducing Aphid and Virus Risk': https://grdc.com.au/Resources/Factsheets/2015/02/Reducing-aphid-and-virus-risk

GRDC Back Pocket Guide 'Crop Aphids': https://grdc.com.au/Resources/Bookshop/2015/02/Crop-Aphids-Back-Pocket-Guide

DPIRD 'Russian Wheat Aphid': www.agric.wa.gov.au/rwa2016

7.4 Aphids (*Aphidoidea*)

Figure 1: *Aphids can significantly damage wheat crops.*

(SOURCE: GRDC)

- Occasional pests of wheat crops
- Affect wheat during tillering and from flowering to maturity
- Adults and nymphs suck sap
- Big populations can limit grain yield and size
- Especially damaging with winter and spring infestations.

Cereal aphid numbers can build up on volunteer cereals and grass weeds (the 'green bridge') before sowing and then migrate to infest new season crops.

Damaging populations can typically develop in three out of five years and there are no obvious signs or symptoms of cereal aphid damage in wheat.

The two main cereal aphid species affecting wheat crops in WA are corn aphid (*Rhopalosiphum maidis*) and oat aphid (*R. padi*).

A potential future risk is the Russian wheat aphid, or RWA (*Diuraphis noxia*), which was identified for the first time in Australia in May 2016 and quickly became widespread across Victorian and South Australian cereal-growing areas. It has since been detected in southern New South Wales and the WA grains industry is monitoring crops closely for any incursions.

As part of an integrated approach to future RWA management, GRDC is making investments into:

- » Determining aphid biotype
- » Chemical control options (seed treatment and foliar)
- » Plant resistance activities (screening, germplasm access)
- » Importance of natural enemies
- » Biology and population dynamics
- » Yield loss and thresholds for control
- » Communication and extension activities — including the 'Find, identify, threshold approach, enact (FITE)' strategy.

7.4.1 Control of aphids

It is advised to check crops from late tillering onwards for feeding damage by corn aphids in the furled growing tips and for oat aphids on stems, ears and the backs of leaves. Infestations of both aphid species simultaneously can cause more damage than either species in isolation.

Cereal aphids also spread Barley yellow dwarf virus (BYDV), which reduces cereal yield.

The spread of BYDV by aphids is typically economically damaging if aphids transmit the virus early, in the first eight to 12 weeks after crop emergence.[1]

Such early BYDV infection tends to occur mainly in high rainfall areas, especially where early season grass and cereal weeds have been present.

Insecticide treatment for aphid feeding damage is considered worthwhile if about 50 percent of tillers have at least 15 aphids and crops are expected to yield 3 tonnes per hectare or more.[2]

Registered insecticides for aphids in WA wheat crops include (but are not restricted to) products containing:

- Dimethoate
- Esfenvalerate
- Gamma-cyhalothrin
- Lambda-cyhalothrin
- Pirimicarb
- Sulfoxaflor.

Registered seed treatments for aphids in WA wheat crops include products containing:

- Imidacloprid
- Thiamethoxam + lambda-cyhalothrin.

Crops treated with insecticides for aphid control before stem elongation (Zadoks Growth Scale stage GS30) may need re-treating between booting and heading (GS50 or later) if aphid numbers build up again.

It is recommended to wait until threshold aphid levels are reached before applying insecticide because, in many years, aphid numbers will not reach damaging levels. But it is important to pay close attention to weather forecasts, as very hot or very cold conditions can decimate aphid numbers. Aphids will thrive in mild weather.

Parasitic wasps, ladybeetles, lacewings and hoverflies can provide useful biological control of this pest, mainly by preventing secondary outbreaks.

1 DAFWA MyCrop Diagnostic Tool, 'Aphids', 2017', https://agric.wa.gov.au/n/2157

2 Coutts, B and Micic, S (2016) Aphid Feeding Damage to Cereal Crops, DAFWA, https://agric.wa.gov.au/n/113

FEEDBACK

MORE INFORMATION

DPIRD MyCrop 'RLEM': https://agric.wa.gov.au/n/2177

TimeRite®: www.timerite.com.au

GRDC 'Back Pocket Guide — Crop Mites': www.grdc.com.au/BPG-CropMites

cesar 'Redlegged Earth Mite': http://www.cesaraustralia.com/sustainable-agriculture/pestnotes/insect/Redlegged-earth-mite

DPIRD 'Diagnosing Redlegged Earth Mite': https://www.agric.wa.gov.au/mycrop/diagnosing-redlegged-earth-mite

GRDC Fact Sheet 'RLEM Resistance Management Strategy — Western': https://grdc.com.au/FS-RLEM-Resistance-strategy-West

GRDC 'Management of Insecticide Resistance in RLEM and Screening New MOA Chemistry': http://projects.grdc.com.au/projects.php?action=view_project&project_id=2020

7.5 Redlegged earth mite (*Halotydeus destructor*)

Figure 2: *Similarly to lupin crops (pictured), RLEM can damage wheat at seedling stage.*

(SOURCE: GRDC)

- Affects wheat growth at seedling stage
- Sap-sucking
- Feeds on all stages of plants
- Typically damage is not severe
- Big numbers commonly found in annual pastures at break of the season.

Redlegged earth mite, or RLEM, is particularly damaging to wheat seedlings during autumn and in years when the season break and sowing is late. In this situation, mite numbers can be well established by the time crop seedlings emerge.

Adult RLEM are about the size of a pinhead (up to 1 mm), have velvety black bodies and eight bright orange-red coloured legs. The mites are often gregarious and can be found clumped together in large numbers.

Mites hatch from over-summering eggs in autumn when there is adequate moisture and low temperatures. Eggs produced through the season are thin-walled and hatch immediately. Several generations can develop during winter and spring.

As pastures begin to senesce, the mites produce thick-walled eggs, which resist drying out over summer and carry the mite through to the next season.

Wheat crops sown after a pasture phase are most at risk of RLEM damage.

Mites rupture cells on the surface of leaves and feed on exuding sap. Affected leaves look 'silvered', but do not have holes (as with lucerne flea attack).

RLEM damage to wheat seedlings is more severe if plant growth is slowed by cold temperatures, waterlogging or low seedling density. Severe damage can kill seedlings.

7.5.1 Control of RLEM

Applying insecticide for RLEM control in cereal crops should only be considered if absolutely necessary, as RLEM populations with resistance to synthetic pyrethroids, or SPs (Group 3A) and tolerance of omethoate (Group 1B) have been recorded in WA.

Registered insecticides for control of RLEM in WA wheat crops include (but are not restricted to) products that contain the actives:

- Alpha-cypermethrin
- Beta-cypermethrin
- Bifenthrin
- Chlorpyrifos
- Cypermethrin
- Dimethoate
- Esfenvalerate
- Gamma-cyhalothrin
- Lambda-cyhalothrin
- Methidathion
- Omethoate
- Phosmet.

Using insecticide seed treatments for crops and new pastures with moderate pest pressure directly targets plant-feeding pests and enables smaller amounts of insecticide to be used.

Seed treatments registered for suppression of RLEM in WA wheat crops include those containing thiamethoxam/lambda-cyhalothrin.

Methidathion (Group 1B) at a rate of 200 ml/ha is registered for bare earth control of RLEM and lucerne flea. Bifenthrin (Group 3A) is also registered as a bare earth treatment for RLEM.

The efficacy of a bare earth insecticide is influenced by the application method.

Best results are typically obtained by application in an unbroken layer over the soil surface just before crop emergence.

To prolong the efficacy of all insecticide groups and minimise resistance risks, it is vital to rotate insecticide products and MOAs within and between seasons and limit 'insurance' or prophylactic spraying.

RLEM often occur in combination with other mites, such as blue oat mites (*Penthaleus major*), bryobia mites (*Bryobia praetiosa*) and balaustium mites (*Balaustium medicagoense*).

It is important to correctly identify the pest, as each of the mite species responds differently to registered insecticides and chemical rates.

The wrong treatment will cost money and act to increase selection pressure for further resistance development.

Maintaining pasture dry matter levels below 2 t/ha has been found to help restrict RLEM numbers to low levels in many parts of WA.[3]

An important biological control agent against RLEM and lucerne flea is the pasture snout mite (*Bdellodes lapidaria*).

Insecticide resistance in RLEM is increasing across WA cropping regions.

3 Micic, S (2016) MyCrop: Diagnosing Redlegged Earth Mite, DPIRD, https://agric.wa.gov.au/n/2177

A population of RLEM on the south coast was confirmed to be tolerant to the widely-used insecticide omethoate in late 2014. This population was also resistant to the SP group of chemicals.[4]

It is recommended RLEM be sprayed only if absolutely necessary. The nominal threshold for control is 50 mites/m^2.[5]

Difficulty in controlling RLEM could indicate resistance to SPs, including bifenthrin and alpha-cypermethrin, and mites surviving any insecticide application should be tested for resistance.

To discuss testing and any suspected resistance issues and to facilitate collection of samples for testing, contact Svetlana Micic at DPIRD at svetlana.micic@agric.wa.gov.au

7.5.2 RLEM and spring pastures

Untreated and under-grazed pastures favour RLEM during spring.

Sustained grazing of pastures at this time to maintain livestock feed on offer (FOO) levels below 2 t/ha dry matter — and ideally about 1.4 t/ha dry matter — tends to restrict mite numbers to low levels.[6] These paddocks will often not require spraying for RLEM.

Applying insecticides to some paddocks — including pastures with FOO of more than 3 t/ha — or legume break crops — during spring to prevent RLEM populations producing diapause (over-summering) eggs will also typically reduce the pest population the following autumn.[7]

But routine spraying of all pasture paddocks in spring will not be sustainable and it is advised to base a decision to treat RLEM during spring based on FOO levels, future grazing management options, seed production requirements and intended paddock use next season.

Timerite® is a free package that provides a predicted date in spring, specific to a locality, for spraying to stop RLEM from producing over-summering eggs. Information can be found at https://www.wool.com/woolgrower-tools/timerite/

CSIRO studies have shown spraying on the optimum Timerite® date, or two weeks earlier, can provide effective RLEM control. Waiting for two weeks after that date can significantly increase the carry-over RLEM population.[8]

4 Micic, S (2015) Update on Redlegged Earth Mite Resistance in WA, DAFWA, http://www.giwa.org.au/pdfs/CR_2015/REVIEWED.20.02.2015/Micic,%20Svetlana_Update%20on%20redlegged%20earth%20mite%20resistance%20in%20WA_FINAL_.pdf

5 Umina, P (2012) GRDC Back Pocket Guide — Crop Mites, GRDC, **cesar**, www.grdc.com.au/BPG-CropMites

6 Micic, S (2016) MyCrop: Diagnosing Redlegged Earth Mite, DPIRD, https://agric.wa.gov.au/n/2177

7 Micic, S (2016) MyCrop: Diagnosing Redlegged Earth Mite, DPIRD, https://agric.wa.gov.au/n/2177

8 Australian Wool Innovation Ltd (2016) Timerite®, AWI, http://www.wool.com/woolgrower-tools/timerite/

MORE INFORMATION

DPIRD MyCrop 'Balaustium Mite': https://agric.wa.gov.au/n/2175

Herbiguide 'Balaustium mite': http://www.herbiguide.com.au/Descriptions/hg_Balaustium_Mite.htm

7.6 Balaustium mite (*Balaustium medicagoense*)

- Affects wheat at seedling stage
- Similar in appearance to RLEM
- Greyish-red body and red legs
- Under magnification, short stout hairs can be seen on body
- Adults almost double the size of RLEM
- Require rainfall before over-summering eggs hatch
- Newly hatched nymphs are orange and have six legs
- Development from egg to adult takes about five to six weeks
- Several generations can occur each year
- No registered insecticides for control in wheat crops in WA.

Balaustium mites are the main species of mites affecting wheat crops and feed on plant leaves by probing into the surface cells with their mouth parts and sucking out sap.

Crops sown into paddocks that were previously in a pasture phase and/or had high burdens of broadleaf weeds (especially capeweed, *Arctotheca calendula L.*) tend to be most at risk from damage.

In most situations in WA conditions, wheat crops will not require insecticide treatment as the mites tend to cause little or no damage.

Early control of summer weeds in paddocks that are to be sown to cereals can help to prevent build-up of mite populations.

MORE INFORMATION

DPIRD MyCrop 'Bryobia Mite': https://agric.wa.gov.au/n/2702

7.7 Bryobia mite (*Bryobia praetiosa*)

- Affects wheat at seedling stage
- Easily confused with RLEM
- Difficult to identify without the use of a hand lens
- Common in early autumn
- Cold temperature requirement before hatching.

Bryobia mites, or clover mites, mainly tend to affect canola and lupin crops. But these pests can cause seedling damage in wheat.

Rates of insecticides commonly used to control RLEM and lucerne flea are not typically effective against bryobia mites.

Registered insecticides for control of bryobia mites in WA wheat crops include (but are not restricted to) products with the actives:

- Bifenthrin
- Chlorpyrifos + bifenthrin.

MORE INFORMATION

DPIRD MyCrop 'Blue Oat Mite': https://agric.wa.gov.au/n/2174

7.8 Blue oat mite (*Penthaleus major*)

Blue oat mites typically affect wheat crop growth at the seedling stage and are frequently found with RLEM.

These pests have a purplish-blue body, with red-orange legs and a red dot on their back.

They tend to be found if the cold temperature requirement for hatching has been met and can cause extensive leaf bleaching.

Registered insecticides for control of this mite in WA wheat crops include (but are not restricted to):

- Alpha-cypermethrin
- Beta-cypermethrin
- Bifenthrin
- Chlorpyrifos
- Cypermethrin
- Dimethoate
- Esfenvalerate
- Methidathion
- Omethoate.

MORE INFORMATION

DPIRD MyCrop 'Webworm': https://agric.wa.gov.au/n/2173

7.9 Pasture webworm (*Hednota* spp.)

- Affects wheat before seeding and at seedling stage
- Caterpillars rarely seen above ground
- Caterpillars live in web-lined tunnels (spring/summer)
- Caterpillars hatch from eggs in autumn and feed through winter
- There is a pupal stage followed by emergence as adult moths
- Moths about 10 mm long
- Moths often seen flying in big numbers at night (autumn)
- Moths hide in dry grass in day time (autumn).

Webworm caterpillars sever leaves and whole plants. Big areas of emerging wheat or barley crops can be destroyed by the continual chewing damage of a heavy webworm infestation.

Severed leaves are pulled into the pest's tunnels.

Eggs are not typically laid in big numbers and do not survive well in bare paddocks or stubble. Grassy weeds and pastures favour survival.

Cultivation that results in weed-free paddocks for three weeks after sowing can reduce survival of larval stages. Reduced tillage tends to favour higher pest survival.

It is recommended to treat wheat crops with insecticide for webworm if about 25 percent of plants are seriously damaged at — or just after — emergence.[9]

Registered insecticide treatments for control of pasture webworm in WA wheat crops include (but are not restricted to) the actives:

- Alpha-cypermethrin
- Bifenthrin
- Chlorpyrifos
- Cypermethrin
- Esfenvalerate
- Gamma-cyhalothrin
- Lambda-cyhalothrin
- Permethrin.

9 Micic, S (2016) MyCrop: Diagnosing Webworm, DPIRD, https://agric.wa.gov.au/n/2173

MORE INFORMATION

DPIRD MyCrop 'Lucerne Flea': https://agric.wa.gov.au/n/2164

IPM 'Guidelines for Lucerne Flea': http://ipmguidelinesforgrains.com.au/pests/lucerne-flea-in-winter-seedling-crops/

cesar Australia 'Lucerne Flea': http://www.cesaraustralia.com/sustainable-agriculture/pestnotes/insect/Lucerne-flea

7.10 Lucerne flea (*Sminthurus viridis*)

- Affect wheat at seedling stage
- Appear early in the season
- Chew young wheat leaves
- Particularly problematic on heavier-textured soils
- Can cause seedling death when in big numbers.

Lucerne fleas are small jumping bugs also commonly known as springtails.

These pests eat leaf tissue and leave the leaf surface covered in a whitish film.

From a distance, severely affected crop and pasture areas appear bleached.

Heavy soils and moisture favour the lucerne flea and it cannot live in very sandy situations.

Systemic or contact insecticides can control lucerne flea in crops and pastures, but SP treatments tend to be ineffective against the pest.

The pasture snout mite is a predator of lucerne fleas and can be found across most WA grainbelt areas where lucerne flea is found. This exerts a useful level of control.

Registered insecticides for control of lucerne flea in WA wheat crops include (but are not restricted to) products containing the actives:

- Chlorpyrifos
- Dimethoate
- Methidathion
- Omethoate.

Seed treatment for suppression of lucerne flea in WA wheat crops contains the actives thiamethoxam/lambda-cyhalothrin.

MORE INFORMATION

DPIRD MyCrop 'Cutworm': https://agric.wa.gov.au/n/2161

DPIRD hub 'Cutworm: Pests of Crops and Pastures': https://www.agric.wa.gov.au/pest-insects/cutworm-pests-crops-and-pastures

IPM guidelines 'Cutworms': http://ipmguidelinesforgrains.com.au/pests/soil-insects/cutworms/

cesar 'Cutworms': http://www.cesaraustralia.com/sustainable-agriculture/pestfacts-south-eastern/past-issues/2014/pestfacts-issue-no-4-5th-june-2014/cutworms/

7.11 Cutworms (*Agrotis munda, A. infusa, A. Rictonis* and *A. Omphaletis*)

- Affect wheat at seedling stage
- Not a regular pest in wheat crops
- Chew through leaves or stems
- Most damage occurs in autumn
- Larvae hide in the soil during the day
- Two large caterpillars per 0.5 m of cereal row can cause extensive damage.

Several species of cutworms can be problematic in WA wheat crops, particularly those sown after a pasture phase.

Weather and food supply are the most important factors in determining populations.

Occasionally, autumn attack by armyworm (*Leucania convecta*) in cereals resembles damage from cutworms. This is significant, because armyworm tends to be more difficult to control with insecticides than cutworms — making correct pest identification vital.

Biological control of cutworms by fungal diseases can be successful and wasp and fly parasites can also actively prevent more frequent and serious outbreaks.

Cutworms can be controlled in WA wheat crops with registered rates of insecticides including (but not restricted to) the actives:

- Alpha-cypermethrin
- Beta-cypermethrin
- Chlorpyrifos
- Cypermethrin
- Esfenvalerate

- Gamma-cyhalothrin
- Lambda-cyhalothrin
- Permethrin.

7.12 Armyworm (*Leucania convecta*)

MORE INFORMATION

DPIRD MyCrop 'Armyworm': https://agric.wa.gov.au/n/2159

- Affects wheat at harvest
- Caterpillars are plump and smooth (hairless)
- Characterised by three parallel white stripes on the collar behind a big head
- Check for green to straw-coloured droppings
- Droppings are the size of a match head
- Droppings found between cereal rows
- Damage to weeds can indicate presence
- Wheat crops less frequently attacked than barley
- Wheat tends to suffer only minor damage.

Assessing the number of armyworms in a cereal crop can be difficult, as the location of this pest tends to vary according to weather conditions and feeding preference.

Sometimes armyworms are found sheltering on the ground and under leaf litter. At other times the pest can be seen high up on plants and easily picked up using sweep nets.

Armyworm caterpillars are most damaging to wheat crops close to harvest, when grubs chew through grain head stems and cause the heads to fall to the ground. The economic trigger for spraying in wheat is typically 10 grubs/m^2.[10]

Registered insecticides for control of armyworm in WA wheat crops include (but are not restricted to) the actives:

- Alpha-cypermethrin
- Beta-cypermethrin
- Chlorpyrifos
- Cypermethrin
- Methidathion
- Methomyl
- Permethrin
- Esfenvalerate (suppression only).

7.13 Spotted vegetable weevil, or Desiantha weevil (*Steriphus diversipes*)

MORE INFORMATION

DPIRD 'Desiantha Weevil in Cereals': https://agric.wa.gov.au/n/2162

- Affects wheat at seedling stage
- Sporadic pest of cereal seedlings
- Mostly found on the south coast
- Late sown crops most at risk
- Favours sand over gravel and sandy duplex soils
- No registered insecticide for control in wheat in WA.

The larval stage of the Spotted vegetable weevil, or Desiantha weevil, can destroy big tracts of young crops when heavily infested.

Larvae chew the swollen seed or bore into the underground stem of seedlings, causing these to be stunted, wither or die. The pest can also bore into tillers at tillering, causing these to die.

Desiantha weevil larvae are white and legless, with orange-brown heads and grow up to 6 mm in length. Larvae remain under the soil and are difficult to find.

10 Micic, S (2016) MyCrop: Diagnosing Armyworm, DPIRD, https://agric.wa.gov.au/n/2159

MORE INFORMATION

DPIRD MyCrop 'African Black Beetle': https://agric.wa.gov.au/n/2156

7.14 African black beetle (*Heteronychus arator*)

- Affects wheat at seedling stage
- Can cause economic damage to cereals (autumn/winter)
- South coast particularly affected
- Crops susceptible close to/following kikuyu pastures
- Adults are shiny black (brown when newly emerged)
- Adults grow to 12 mm long
- Soil-dwelling larval stage mostly in late spring/summer/early autumn
- Larvae are C-shaped and up to 25 mm long
- No registered insecticides for use in WA wheat crops.

If present in crops, African black beetles are likely to be seen walking on the soil surface at night.

A density of 2-6 beetles/m^2 can cause problems, especially in some pastures.[11]

There are no insecticide actives specifically registered for control of African black beetle in pasture or cereal crops in WA.

But pasture seed treated with imidacloprid for RLEM has shown some efficacy against this pest.

Increasing crop seeding rate and avoiding the use of drill rows can help manage African black beetle in wheat.

MORE INFORMATION

DPIRD MyCrop 'Snails': https://agric.wa.gov.au/n/2172

GRDC Fact Sheet 'Snail Management': https://grdc.com.au/Resources/Factsheets/2012/09/Snail-Management

GRDC Hot Topic 'New Insights to Give Snails and Slugs the Slip': https://grdc.com.au/Media-Centre/Hot-Topics/New-insights-to-give-snails-and-slugs-the-slip

7.15 Snails and slugs

Figure 3: *Snails are not a significant pest of wheat crops across much of the WA grainbelt, but can cause damage in some areas and seasons.*

(SOURCE: GRDC)

- Affect wheat at seedling stage and harvest
- Snail damage to WA crops is increasing in some areas, but is not a widespread issue across the grainbelt
- Slugs are particularly problematic in higher rainfall areas
- Registered molluscicides for WA wheat are metaldehyde and methiocarb.

11 DAFWA MyCrop Diagnostic Tool, 'African Black Beetle', 2017, https://agric.wa.gov.au/n/2156

WA wheat crops can be affected in some areas (mostly in the southern and south eastern grainbelt) by three main species of snails and two main species of slugs, as outlined below.

The small pointed snail (*Prietocella barbara*)

- Has a conical shell with brown bands of varying width
- Typically less than 10 mm in length and diameter
- Occurs on all soil types in the high rainfall area.

The white Italian snail (*Theba pisana*)

- Grows up to 30 mm in diameter
- White with broken brown bands
- Prefers alkaline sandy soils.

The vineyard snail (*Cernuella virgate*)

- Grows up to 20 mm in diameter
- Has almost continuous brown bands
- Prefer alkaline sandy soils.

The black-keeled slug (*Milax gagates*) and reticulated slug (*Deroceras reticulatum*)

- Typically found on WA's heavy clay soils
- Prefer wet areas
- Common in high rainfall zones.

Conservation farming practices have resulted in significant increases in slug and snail populations in some WA cropping regions in recent years.

Snail species can impact on wheat grower returns on the back of yield losses and grain contamination at harvest.

It is recommended to monitor snail numbers during and after harvest to determine whether control pre-sowing is necessary.

A combination of measures is required for effective control of snails and slugs, including stubble management, summer weed control and baiting.

While all bait formulations can kill snails and slugs, experience indicates none will result in 100 percent mortality.

7.15.1 Snail damage and cost

Snails are primarily limited to the south coast region, from Albany to Esperance. Some are found (along with slugs) in the wetter parts of the western great southern area and in pockets along the coastal strip near Geraldton.

Small pointed snails can cause economic crop damage in high rainfall areas. The vineyard and white Italian snails commonly cause crop damage in the Geraldton region and on the Greenough flats — the area between Dongara and Geraldton.

Economic losses result from reduced crop yields and/or grain contamination.

Some growers first discover snails are a problem in their crops when their grain is rejected from grain handlers.

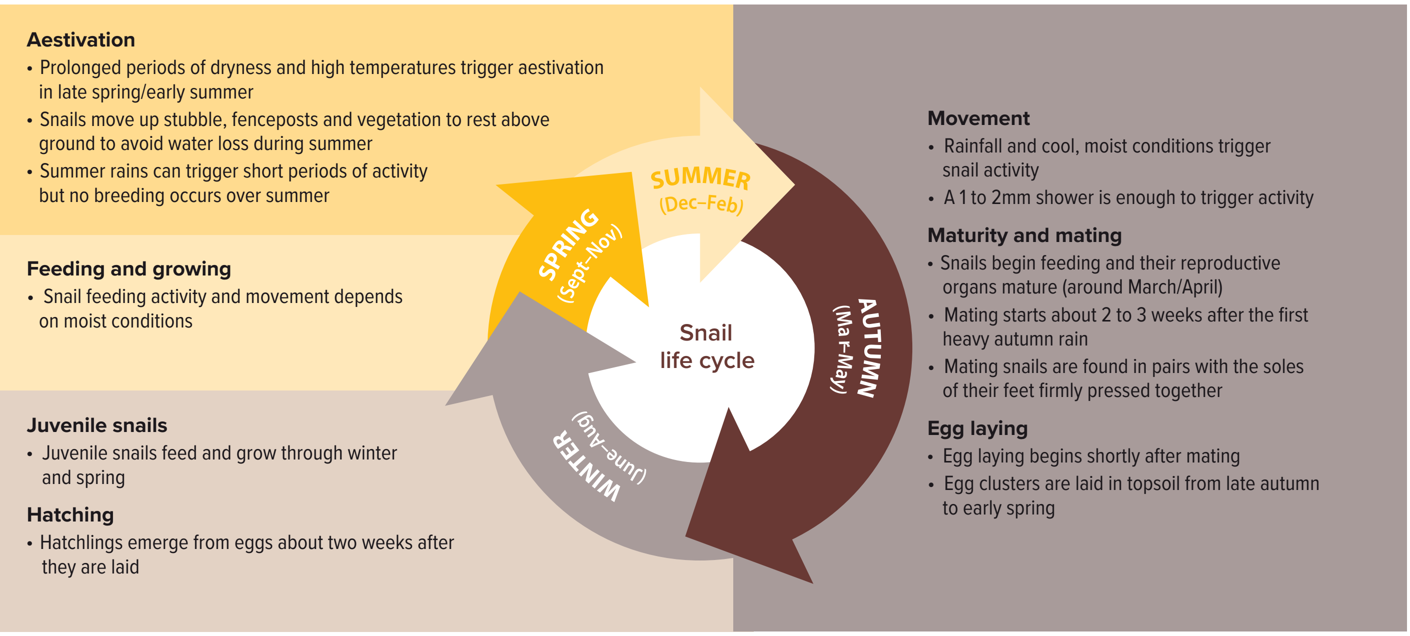
Rejection occurs if more than half of a dead — or one live — snail is found in a 0.5 L wheat grain sample (but standards should always be confirmed with the grain buyer).

Identifying the snail species and sizes in a paddock underpins management options.

During summer, snails are dormant (aestivation). Egg laying starts after snails are activated by autumn rain and continues while soil is moist.

The most effective control program will be an integrated program that uses the most appropriate option for each of the seven stages of the snail life cycle, as shown in Figure 4.

Figure 4: *The snail life cycle.*[12]



12 GRDC Fact Sheet 'Snail Management': https://grdc.com.au/Resources/Factsheets/2012/09/Snail-Management

MORE INFORMATION

GRDC Back Paddock Guide 'Snail Identification and Control': www.grdc.com.au/Resources/Publications/2011/03/Snail-Identification-and-Control-The-Back-Pocket-Guide

DPIRD 'Identification and Control of Pest Slugs and Snails for Broadacre Crops in WA': www.agric.wa.gov.au/grains/identification-and-control-pest-slugs-and-snails-broadacre-crops-western-australia

MORE INFORMATION

IPM Guidelines 'Slugs and Snails': http://ipmguidelinesforgrains.com.au/pests/slugs-and-snails/

SARDI 'Bash'em, Burn'em, Bait'em': https://grdc.com.au/resources-and-publications/all-publications/factsheets/2012/09/grdc-fs-snailmanagement

7.15.2 Monitor and manage snails

It is advised to monitor snails regularly to establish numbers, types, activity and success of control measures.

It is best to check for snails in the early morning, or evening, when conditions are cooler and snails are more active.

It is recommended to look closely in the crowns of last year's stubble, as snails can be easily missed on a casual inspection.

Thresholds for control of snails in various crops and pastures are outlined in Table 1.

Table 1: Thresholds for snail control.[13]

	Crops			
Snail species	**Cereals (wheat)**	**Oilseeds (canola)**	**Pulses (lupins)**	**Pastures**
Small pointed snail	40/m^2	20/m^2	5/seedling	100/m^2
White Italian snail	20/m^2	5/m^2	5/m^2	80/m^2

When estimating snail numbers, it is advised to sample 10 cm by 10 cm quadrants at 50 locations across a suspect paddock and around the paddock boundary.

Simple sieve boxes can be used to separate snails by size and it is advised that snails larger than 7 mm are more likely to take bait.[14]

Effective snail control requires a targeted and integrated approach across the whole year.

Pre-sowing options for snails include a combination of effective summer weed control and stubble management tactics, such as bashing, burning or grazing.

Baiting is the only control option after crops have been sown. Research and experience indicates mortality rates from baiting are typically between 60 to 90 percent for mature round snails and 50 to 70 percent for mature pointed snails.[15]

Baiting is an effective control measure when snails are mobile and actively seeking food. It is advised to lay pellets along fence lines and paddock boundaries, as well as in the paddock.

Whole paddock, border and fenceline baiting is most effective when rain or moisture triggers snail activity in autumn and before significant egg laying starts (during early autumn). This can reduce potential population build up for that season.

Bait degrades in UV light and degradation rates are reduced as day length shortens. In trials, the concentration of metaldehyde fell from 15 to 4.9 percent in four weeks when bait was spread in February, but to 7.5 percent when spread a month later.[16]

It is advised to target mature snails — round snails larger than 7 mm in diameter and conical snails larger than 7 mm in length — as baits are largely ineffective against juvenile snails.

The best time to apply snail pellets is early in the season when morning temperatures are low and dew forms and after the first germinating rains when snails start to emerge and look for food.

13 GRDC Back Paddock Guide 'Snail Identification and Control': www.grdc.com.au/Resources/Publications/2011/03/Snail-Identification-and-Control-The-Back-Pocket-Guide

14 GRDC Back Paddock Guide 'Snail Identification and Control': www.grdc.com.au/Resources/Publications/2011/03/Snail-Identification-and-Control-The-Back-Pocket-Guide

15 GRDC (2012) Fact Sheet — Snail Management, Southern and Western Regions, GRDC, www.grdc.com.au/GRDC-FS-SnailManagement

16 GRDC (2012) Fact Sheet — Snail Management, Southern and Western Regions, GRDC, www.grdc.com.au/GRDC-FS-SnailManagement

Recent trials in WA found growers can spend between $15 and $85/ha on baits, but may not be applying them effectively.[17] Spreaders not calibrated correctly can result in an uneven distribution of baits.

The more even the bait distribution, the more likely that snails will come into contact with the bait, resulting in better control.

Stubble burning is still the most effective pre-sowing method for controlling snails in WA — if an even burn is achieved and taking into account erosion risks.

It is advised to only burn stubbles in paddocks with the highest number of snails to reduce negative impacts on soil properties and the risk of erosion.

A complete, even, burn can achieve a 100 percent kill, while a patchy burn results in a 50 to 80 percent kill.[18]

MORE INFORMATION

GRDC Fact Sheet 'Mouse Management': www.grdc.com.au/GRDC-FS-MouseManagement2012/

Invasive Animals CRC 'MouseAlert': http://www.feralscan.org.au/mousealert/

GRDC Hot Topic 'Mice': http://grdc.com.au/Media-Centre/Hot-Topics/Mice

PestSmart 'Connect Toolkit': www.pestsmart.org.au.

7.16 Mice

Figure 5: *Mice can cause significant crop losses in some seasons and in some regions.*

(SOURCE: GRDC)

- Frequency of plagues in WA have increased in past 20 years
- All crop types, crop stages and cropping regions affected
- Damage at sowing can devastate emerging wheat crops
- Critical periods are autumn and spring.

Strategies to control and reduce mouse populations in WA include:

  - Limiting available food sources
  - Monitoring incidence throughout the year
  - Bait as necessary
  - Registered bait active is zinc phosphide
  - Bait cannot be applied to bare ground
  - Manage at flowering and seed set to protect grain yields
  - Manage grain and weed seed residues all year.

17 GRDC (2012) Fact Sheet — Snail Management, Southern and Western Regions, GRDC, www.grdc.com.au/GRDC-FS-SnailManagement

18 GRDC (2012) Fact Sheet — Snail Management, Southern and Western Regions, GRDC, www.grdc.com.au/GRDC-FS-SnailManagement

Intensive cropping rotations, minimum tillage and stubble retention, more diverse crops, higher grain yields and fewer livestock are all contributing factors to higher mouse impact on wheat crops in WA.

These conditions provide mice with abundant food and cover, as well as a favourable habitat for breeding.

Hygiene in and around paddocks, grain storage facilities and fodder storage facilities — combined with tactical baiting programs — remain the key control options. It is recommended to clean-up grain spills in the paddock and around yards at sowing and harvest and remove rubbish and nesting material from sheds.

Mouse numbers increase and decline rapidly depending on seasonal conditions and feed availability. Mice can move up to 300 m each day, so it is advised to regularly monitor activity on a paddock-by-paddock basis, rather than a single site on the farm.

Mice typically damage cereal crops at sowing by digging into the soil and eating the seed, or just after emergence when they feed on the seedling.

Wheat is most vulnerable during the first two to three weeks following crop emergence (when every seed removed is equal to one less plant to provide yield).

Although there is generally less crop damage during the vegetative stages, mice can chew crops to supplement their diet.

In the worst cases, this pest can reduce yields by 50 percent during flowering.[19] After grain fill, the risk of damage slows as the mice can obtain more nutrients from less feed.

Trapping with 'snap traps' throughout the year can indicate mouse population levels and breeding status.

A trapping rate of 10 percent indicates an emerging issue. A trapping rate of 20 percent or more in an early maturing crop indicates a problem.[20]

Recommendations for laying traps include to set out a straight line of 20 to 25 traps, spaced 10 m between each trap, for three consecutive nights.

Baiting is the only option available for in-crop control for mice.

Registration details for baits tend to change frequently and not all products are registered for use in-crop.

Check with your agronomist, adviser, retailer or the Australian Pesticides and Veterinary Medicines Authority (APVMA) for current control options.

Tips for effective baiting include:

- Application by Chemcert registered landholders or commercial operators
- Consult the label for use instructions
- Wherever possible, apply within 24 hours of sowing
- Lay during late afternoon and early evening (after birds have fed)
- Maintain a buffer of more than 50 m from areas of remnant native vegetation
- Advise any beekeepers with hives near the paddock well in advance of baiting
- Always wear personal protection equipment (PPE) when handling baits
- Wear gloves
- Check paddocks and surrounding areas for non-target animal mortalities
- Only use registered baits
- Continue to monitor mouse activity after baiting.[21]

19 GRDC (2012) Fact Sheet, Mouse Management, Western Region, GRDC, www.grdc.com.au/GRDC-FS-MouseManagement2012

20 GRDC (2012) Fact Sheet, Mouse Management, Western Region, GRDC, www.grdc.com.au/GRDC-FS-MouseManagement2012

21 GRDC (2012) Fact Sheet, Mouse Management, Western Region, GRDC, www.grdc.com.au/GRDC-FS-MouseManagement2012