SOUTHERN
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GRDC GROWNOTES™

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GRAINS RESEARCH & DEVELOPMENT CORPORATION

# FIELD PEA

## SECTION 8

## PEST MANAGEMENT

KEY POINTS | INTEGRATED PEST MANAGEMENT (IPM) | IPM PROCESS | KEY PESTS OF FIELD PEA | HELICOVERPA SPECIES: NATIVE BUDWORM AND CORN EARWORM | PEA WEEVIL | APHIDS AND VIRUSES | SNAILS | SLUGS | REDLEGGED EARTH MITE | BLUE OAT MITE | LUCERNE FLEA | AUSTRALIAN PLAGUE LOCUST | ETIELLA OR LUCERNE SEED WEB MOTH | OCCASIONAL PESTS OF FIELD PEA | EXOTIC FIELD PEA INSECTS | BENEFICIAL SPECIES | COMMONLY USED REGISTERED PESTICIDES

# Pest management

## Key points

- **The key pests of field pea across southern Australia are native budworm (*Helicoverpa punctigera*), pea weevil (*Bruchus pisorum*), snail, slugs, aphids, mites, lucerne flea and lucerne seed web moth (*Etiella behrii*).**
- **Integrated pest management (IPM) is an ecological approach aimed at significantly reducing use of pesticides while managing pest populations at an acceptable level.**
- **IPM involves planning, monitoring and recording, identification, assessing options, controlling/managing and reassessing.**
- **Monitoring for beneficial species is important.**
- **Exotic bruchids and leaf miners pose a biosecurity threat.**

MORE INFORMATION

GRDC Fact Sheet Integrated pest management: https://grdc.com.au/resources-and-publications/all-publications/bookshop/2009/12/integrated-pest-management-fact-sheet-national

IPM Guidelines, http://www.ipmguidelinesforgrains.com.au

## 8.1 Integrated pest management (IPM)

Integrated pest management (IPM) is an integrated approach of crop management to reduce chemical inputs and solve ecological problems. Although originally developed for agricultural insect pest management, IPM programs are now developed to encompass diseases, weeds and other pests that interfere with the management objectives of sites.

IPM is performed in three stages: prevention, observation and intervention. It is an ecological approach aimed at significantly reducing the use of pesticides while managing pest populations at an acceptable level. IPM therefore uses an array of complementary methods including mechanical and physical devices, as well as genetic, biological, cultural and chemical management. The reduction in cost, contamination, residues and resistance to the pesticide are all benefits.

An IPM system is designed around five basic components:

### 1. Acceptable pest levels

Emphasis is on control, not eradication. Wiping out an entire pest population is often impossible, and can be economically expensive and environmentally unsafe. IPM programs work to establish acceptable pest levels (action thresholds) and then apply controls if those thresholds are exceeded. Thresholds are pest and site specific. What is acceptable at one site may not be acceptable at another site or crop.

### 2. Preventive cultural practices

Using varieties best suited to local growing conditions, and maintaining healthy crops, is the first line of defense, together with plant hygiene and crop sanitation (e.g. removal of diseased plants to prevent spread of infection). Should an insect pest reach an unacceptable level, mechanical methods may be possible. For example, burning, rolling or cabling for snail control. Note that mechanical controls only work out of season as pests are unlikely to reach an unacceptable level when there is no crop.

### 3. Monitoring

Regular observation is the key to IPM. Observation is broken into inspection and identification. Visual inspection, insect traps and other measuring tools are used to monitor insect pest levels. Accurate pest identification is critical to a successful IPM program.

For insects, monitoring for beneficial organisms and predators is important too. These are important to assist in controlling the pest. Record-keeping is essential, as is a thorough knowledge of the behaviour and reproductive cycles of target pests.

Insects are cold-blooded and their physical development is dependent on temperatures in their environment.

Many insects have had their development cycles modelled in terms of degree days (e.g. etiella, pea weevil). Monitor the degree days of an environment to determine the optimal time for a specific insect outbreak.

### 4. Biological controls

Biological processes and materials can provide control, with minimal environmental impact, and often at low cost. The main focus is on promoting beneficial insects that eat target pests. In broadacre crops the best strategy is currently to preserve those that are naturally occurring. Biological insecticides, derived from naturally occurring microorganisms, also fit this category (e.g. *Bt* (*Bacillus thuringiensis*). Unlike broad-spectrum chemical pesticides, *Bt* toxins are selective and negative environmental impact is very limited. *Bt* has been highly efficacious in pest management of corn and cotton, drastically reducing the amount of broad-spectrum chemical insecticides used while being safe for consumers and non-target organisms. *Bt* entomopathogenic fungi and entomopathogenic nematodes).

### 5. Responsible pesticide use

Synthetic pesticides are generally only used as required and often only at specific times in a pest's life cycle. Many newer pesticide groups are derived from plants or naturally occurring substances. Examples are nicotine, pyrethrum and insect juvenile hormone analogues. The active component may be altered to provide increased biological activity or stability. Further 'biology-based' or 'ecological' techniques are under evaluation.[1]

## 8.1.1 Problems with pesticides

IPM does not mean abandoning pesticides – they are still the basis for pest control – but the impact on natural enemies must be considered when selecting a pesticide. Regular monitoring is needed to observe pest and beneficial species dynamics. Beneficial species can provide control of most pests if they are present. By reducing the use of non-selective pesticides, the aim is to foster predators and parasites to stabilise pest populations and reduce the need to spray.

Overuse of pesticides can hasten pesticide resistance developing. It can also lead to a resurgence of pests, create new pests, potentially increase pesticide residues in grain and lead to off-target contamination, including of wildlife reserves and waterways.[2]

MORE INFORMATION

GRDC Fact Sheet Pest-suppressive landscapes: pest management using native vegetation: https://grdc.com.au/GRDC-FS-PestSuppressiveLandscapes

## 8.1.2 IPM, organics and biological control

IPM is not the same as organic pest management, although many organic options are compatible with IPM. IPM is sometimes confused with classic biological control. While they are not the same, IPM plays an important role in maximising the success of biological control by reducing the use of non-selective sprays, boosting the survival of biological control agents.[3]

Native remnant vegetation can support beneficial predatory insects. Pest-suppressive landscapes are those that have the right mix of habitats that support beneficial insects and allow them to move into crop fields, while discouraging the build-up of pest insect species.[4]

## 8.1.3 Soft *v.* hard pesticides

The terms 'soft' and 'selective' are terms used to describe pesticides that kill target pests but have minimal impact on parasites and predators attacking these pests. Parasites and predators are often called 'beneficials'.

Pesticides that impact on beneficial species are termed 'hard', 'non-selective' or broad-spectrum'.

In practice, there are varying degrees of softness, and many products may be hard on one group of beneficial species but relatively soft on another.

(See Section 8.16 Beneficial species.)

Insecticides that are less toxic to beneficial insects should be used where possible; for example, using pirimicarb for aphid control may mean fewer repeat applications compared with the use of synthetic pyrethroids because beneficial insects are preserved.[5]

1 Pulse Australia (2016) Southern Faba & Broad Bean – Best Management Practices Training Course, module 7-2016

2 H Brier (2008) Break crop IPM short course manual. Southern Region IPM Workshop Training Manual: Soybeans and Winter Pulses, 11 March 2008, Griffith and Coleambally, NSW, 82pp

3 H Brier (2008) Break crop IPM short course manual. Southern Region IPM Workshop Training Manual: Soybeans and Winter Pulses, 11 March 2008, Griffith and Coleambally, NSW, 82pp

4 GRDC (2014) Pest-suppressive landscapes: pest management using native vegetation. Fact Sheet, Grains Research and Development Corporation, www.grdc.com.au/GRDC-FS-PestSuppressiveLandscapes

5 H Brier (2008) Break crop IPM short course manual. Southern Region IPM Workshop Training Manual: Soybeans and Winter Pulses, 11 March 2008, Griffith and Coleambally, NSW, 82pp

## 8.2 IPM process

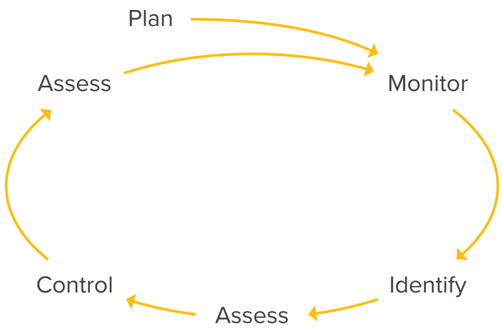



**Figure 1:** *A summary of the pest management process.*

Source: Pulse Australia (2016) Faba & Broad Bean – Best Management Practices Training Course, module 7-2016. Pulse Australia Limited

### Planning

Be aware of which pests are likely to attack the crops in your region and become familiar with when to monitor for particular pests, what the pests look like and damage symptoms. Assess sampling protocols and plan how you will cope with the logistics of sampling. Discuss this with your consultant/clients, and their attitude towards management. Be aware of the latest management options, pesticide permits and registrations in field pea, and any use and withholding period restrictions.

### Monitoring

Scout crops thoroughly and regularly during 'at risk' periods using the most appropriate sampling method. Record insect counts and other relevant information using a consistent method to allow comparisons over time. Also monitor any nearby crops that may be harbouring pests, e.g. aphids, that could rapidly build up and then take flight into a neighbouring pea crop. For more information see Section 8.2.1 Pest monitoring methods.

### Identification

It is important to be able to identify the various insects present in your crop, whether they are pests or beneficial species, and their growth stages. It is important to be able to identify the different larval instars of *Helicoverpa* (very small, small, small–medium, medium–large, large). Other minor pests of field pea include: aphids, pea weevil, cutworms, thrips, loopers, lucerne fleas and mites. For more information see Section 8.2.2 Identify pests.

### Assess options

Use the information gathered from monitoring to decide what sort of control action (if any) is required. Make spray decisions based on a combination of any available economic threshold information and your experience. Other factors such as insecticide resistance and area-wide management strategies may impact on spray recommendations.

### Control

If a control operation is required, ensure application occurs at the appropriate time of day. Record all spray details including rates, spray volume, pressure, nozzles, meteorological data (relative humidity, temperature, wind speed and direction, inversions and thermals) and time of day.

### Re-assess and document results

Assess crops after spraying and record data for future reference. Post-spray inspections are important in assessing whether the spray has been effective.[6]

6 Pulse Australia (2016) Faba & Broad Bean – Best Management Practices Training Course, module 7-2016. Pulse Australia Limited

## 8.2.1 Pest monitoring methods

Knowing when field pea crops are susceptible to pest attack is the first step in good pest management. For example, *Helicoverpa* do most damage during pod-set through to maturity. Seedling insect pests, such as cutworm, can attack field pea early. Regular monitoring of the crop for the presence of insects pests and/or damage is necessary in order to make timely decisions on control, especially when it is important to be targeting small larvae.

See individual pest species descriptions for best monitoring methods.

### Pest monitoring will save money

Routine spraying without checking pest levels or spray effectiveness is a hit-and-miss process that may or may not be effective, and is likely to result in increased levels of resistance. It is also likely to take more time and money than necessary and give poor results.

Effective pest management depends on identifying changes in pest and beneficial insect activity in and around the crop in time to keep damage levels low.

Setting up a suitable monitoring program is probably the most complex and time-intensive component of an IPM program, but it is an essential risk-management tool for protecting all other investments made in the business.

A monitoring program will cut crop losses and unnecessary chemical costs and identify hidden weaknesses in the pest control program. Crop monitoring is absolutely essential if you want to also incorporate beneficial insects into your pest control program.

### Record the results from monitoring

Successive records of crop inspections will show you whether pest numbers are increasing or decreasing, and help in deciding whether a spray is necessary.

As well as recording pest insect numbers, there are other key details that are important to both observe and record.

Insect checking records should include, as a minimum:

- date and time of day;
- crop growth stage and susceptibility;
- change in the number of insects present (pest and beneficial) and their stage of development over time;
- type of checking method used and number of samples taken per paddock;
- control recommendation if any; and
- post-spray counts.

### When to monitor

All field pea crops should be scouted for insects at regular intervals, usually once per week prior to pod-set and 2–3 times a week from pod-set onwards.

### Sweep net monitoring

The easiest and quickest way to determine the number of grubs in a crop is to 'sweep' the crop with an insect sweep net. It is impossible to accurately determine numbers by simply looking in the crop.

A standard sized net (380 mm in diameter) can be purchased from most chemical suppliers.

Follow these steps:

- Take 10 sweeps of the net through the crop canopy while walking slowly through the paddock. A standard sweep of the net needs to be about 2 m in length.

- Empty the contents into a tray or bucket and count the caterpillars of various sizes. It is important to look very carefully for small caterpillars as these have the most potential to cause damage.
- Repeat this process in at least 12 places throughout the paddock to obtain an average insect density.

### Crop inspection

Sampling flowers and leaves in the crop can tell you much more than a sticky trap including:

- presence or absence and levels of non-flying juvenile stages (eggs, larvae, pupae);
- presence/absence and levels of non-flying adult insects (mites, snails etc); and
- early stages and extent of pest damage.

This information is much more powerful for assessing pest levels, accurately predicting trends and checking the effectiveness of control measures. It is essential for making decisions and following up on the results. It will also reveal a lot about the behaviour of pests and beneficial insects that will help you to manage problem pests. Depending on the pest, where it feeds, hides and breeds, you will need to check flowers, leaves, fruit etc. The pattern, frequency and level of sampling depend on the crop, pests of concern and beneficial insects of interest and the time of year.

Weeds near to your farm/crop will build up large numbers of pests in spring. Inspecting the weeds can keep you in touch with how the local pest pressure is building up. Better still, remove the weeds before the pests build up on them.

### Yellow sticky traps or cards

Sticky traps are useful as a way of monitoring flying pests like thrips, whitefly and aphids. They attract these insects because of their colour. Yellow traps attract thrips, whitefly and aphids. They are also a useful way of sending samples away for identification of thrips species. However, they do not give a complete picture of pest dynamics in the crop. Adult insects may settle into the crop after flying in and juvenile non-flying stages may survive spray applications but will not show up on the traps.

Sticky traps should be changed or checked at least weekly. They need to be placed just above the growing tips of the plants to catch insects hovering above them and to avoid getting stuck and lost in the crop.

### Quadrats

Use quadrats to sample snails. See Section 8.7.4 Monitoring snails.

### Tiles, hessian bags and slug traps

Use either a tile, hessian bag or slug trap left in the paddock over night to count snail or slug numbers.[7]

7 Pulse Australia (2016) Faba & Broad Bean – Best Management Practices Training Course, module 7-2016. Pulse Australia Limited

### 8.2.2 Identify pests

It is important to be able to identify the various insect present in your crop, whether they are pest or beneficial species, and their growth stages.

#### Sending insect samples for diagnostics

SARDI Entomology Unit provides free insect diagnostic services for subscribers of PestFacts South Australia and western Victoria newsletter.

CESAR (University of Melbourne), SARDI and NSW DPI will identify insects for a fee. For more information: contact CESAR (03 9349 4723 or www.cesaraustralia.com/sustainable-agriculture/identify-an-insect/insect-identification-service/) or SARDI (www.pir.sa.gov.au/research/services/crop_diagnostics/insect_diagnostic_service) (prices available on application).

Agriculture Victoria does not offer a routine insect identification service.[8]

### 8.2.3 Insect ID: The Ute Guide

While many resources are available, the primary insect-identification resource for grain growers is 'Insect ID: The Ute Guide', a digital guide (App) for smartphones and tablets that is progressively updated as new information becomes available.


**Figure 2:** *Insect ID: The Ute Guide App.*

Source: GRDC

Insect ID: The Ute Guide is a comprehensive reference guide for insect pests commonly affecting broadacre crops and growers across Australia, and includes the beneficial insects that may help to control them.

Photos have been provided for multiple life-cycle stages, and each insect is described in detail, with information on the crops it attacks, how it can be monitored and other pests that it may be confused with.

Not all insects found in field crops are listed in this App, so further advice may be required before making management decisions.

8 Pulse Australia (2016) Agronomy. Southern Faba Bean Best Management Practices Training Course Manual 2016, Pulse Australia Limited.

FEEDBACK

## MORE INFORMATION

Field peas: The Ute Guide, https://grdc.com.au/resources-and-publications/all-publications/publications/2009/04/field-peas-the-ute-guide

PestFacts, https://grdc.com.au/resources-and-publications/apps

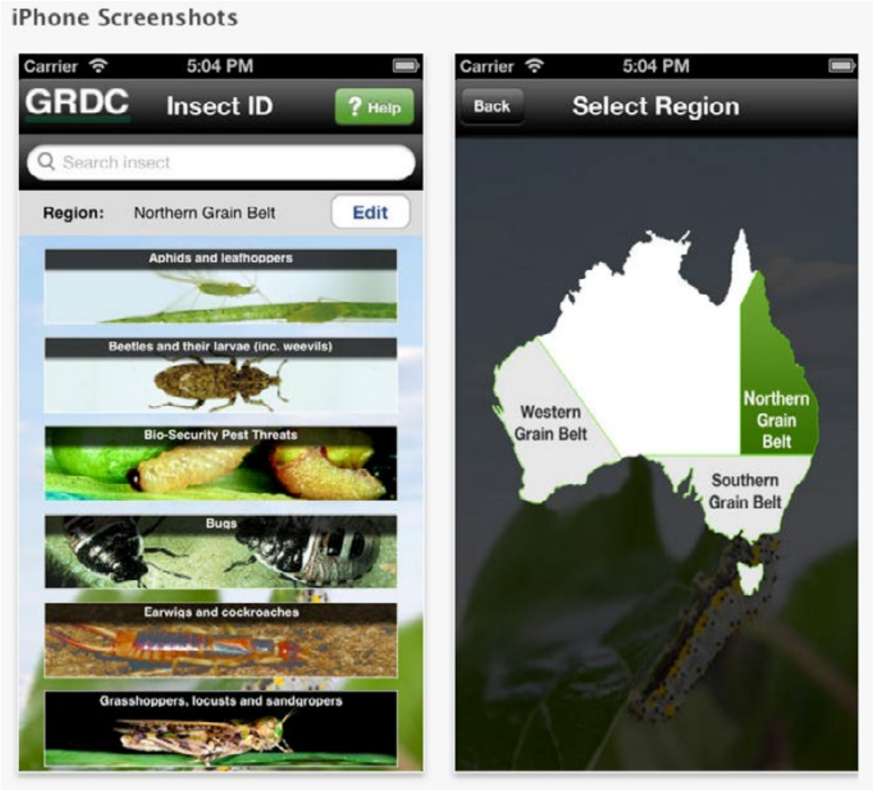



**Photo 1:** *Screen shots from the iOS edition of Insect ID: The Ute Guide App.*

Source: iTunes store, https://itunes.apple.com/au/app/insect-id-the-ute-guide/id667842983

### 8.2.4 GrowNotes™ Alerts

GrowNotes™ Alerts is a free, early-warning system that notifies growers of any emerging disease, pest and weed threats, specific to the user's chosen area. It provides real-time information from experts across Australia.

A GrowNotes™ Alert can be delivered via App, SMS, voice, email, social media or web portal (or a combination of preferred methods). The urgency with which the alerts are delivered can help reduce the impact of weed, pest and disease costs. GrowNotes™ Alerts improves the relevance, reliability, speed and coverage of notifications on the incidence, prevalence and distribution of weed, pest and diseases. To subscribe go to: https://grdc.com.au/grownotesalert

## 8.3 Key pests of field pea

The key pests of field pea in southern Australia are: native budworm (*Helicoverpa punctigera*), pea weevil (*Bruchus pisorum*), snail, slugs, aphids, mites, lucerne flea and lucerne seed web moth (*Etiella behrii*). Table 1 shows the timing of damaging effects of the key and other pests in field pea crops.

**Table 1:** Incidence of insect pests in field pea.

| Pest | Crop stage | | | | |
|---|---|---|---|---|---|
| | Emergence/ seedling | Vegetative | Flowering | Podding | Grain-fill |
| Earth mites | Damaging | Present | Present | | |
| Lucerne flea | Damaging | Present | | | |
| Cutworms | Damaging | | | | |
| Slugs and snails* | Damaging | Damaging | | | |
| Aphids | Damaging | Damaging | Present | Present | |
| Thrips | | Present | Present | | |
| Pea weevil | | Present | Damaging | Damaging | Damaging |
| Helicoverpa | | Present | Damaging | Damaging | Damaging |
| Etiella | | Present | Present | Damaging | Damaging |

Source: NIPI & field pea IPM: http://ipmguidelinesforgrains.com.au/crops/winter-pulses/field-peas/

MORE INFORMATION

Insect ID: The Ute Guide

https://grdc.com.au/resources-and-publications/apps/insect-id-the-ute-guide

## 8.4 *Helicoverpa* species: native budworm and corn earworm (*Helicoverpa punctigera* and *H. armigera*)

The main insect pest of field pea late in the season in southern and western Australia is the larvae of native budworm (*Helicoverpa*), sometimes known as Heliothis.

*Helicoverpa punctigera* is not the species *H. armigera*, which is commonly known as corn earworm or cotton bollworm.

### 8.4.1 Distribution of *Helicoverpa* spp.

Most *Helicoverpa* across southern Australia from September to early November will be *H. punctigera*.[9] *H. punctigera* (native budworm) breeds over winter in the arid inland regions of Queensland, South Australia, Western Australia and New South Wales on desert plants before migrating into southern agricultural areas in late winter or spring. They can migrate as far south as Tasmania.[10]

*H. armigera* may become more problematic in summer crop irrigation areas. It rarely occurs in significant numbers in Victorian crops.[11] It is a major pest of chickpea and other pulses in northern Australia.[12]

While significant numbers of *H. armigera* are rare in Victoria, it is still an important pest when it does occur in large numbers as it may be resistant to many of the commonly used insecticides.[13]

9 Pulse Australia (2016) Southern/western field pea best management practices training course, module 7-2016, Draft. Pulse Australia Limited

10 G McDonald (2015) Native budworm. Pest Notes Southern. CESAR and South Australian Research and Development Institute, http://www.pir.sa.gov.au/__data/assets/pdf_file/0005/274181/Native_Budworm.pdf

11 G McDonald (1995) Native budworm. Agnote Ag0417. Agriculture Victoria, June 1995, http://agriculture.vic.gov.au/agriculture/pests-diseases-and-weeds/pest-insects-and-mites/native-budworm

12 Pulse Australia (2016) Faba & Broad Bean – Best Management Practices Training Course, module 7-2016. Pulse Australia Limited

13 G McDonald (1995) Native budworm. Agnote Ag0417. Agriculture Victoria, June 1995, http://agriculture.vic.gov.au/agriculture/pests-diseases-and-weeds/pest-insects-and-mites/native-budworm

### 8.4.2 Identification of *Helicoverpa* spp. moths

Adult moths are nocturnal, so are rarely seen during the day. They vary in colour from grey-green to pale cream and have a wingspan of 3–4.5 cm (Photo 2).

**Photo 2:** *Helicoverpa moths, showing male (right) and female (left). Note the buff colouring.*

Photo: Photo from northern field pea GrowNote, chapter 7, Figure 1

For native budworm (*H. punctigera*), the forewings are buff-olive to red-brown with numerous dark spots and blotches. The hind wings are pale grey with dark veins and a dark band along the lower edge. The hind wings have a dark, broad band on the outer margin (Figure 3).

*H. armigera* has a small light or pale patch in the dark section of the hindwing while the dark section is uniform in *H. punctigera* (Figure 3).[14]

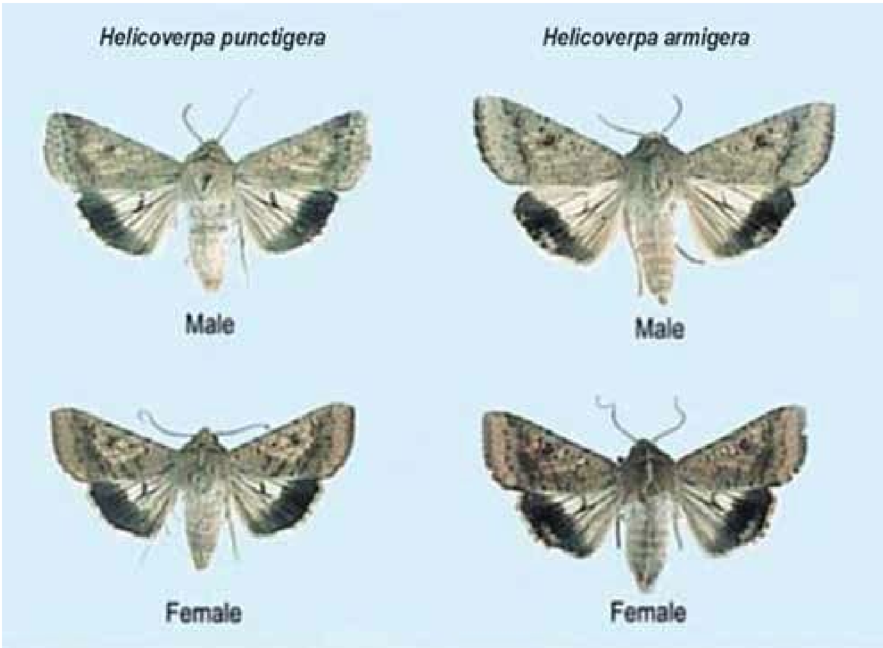



**Figure 3:** *Helicoverpa punctigera and H. armigera moths are distinguished by the presence of a pale patch in the margin of the hindwing of H. armigera.*

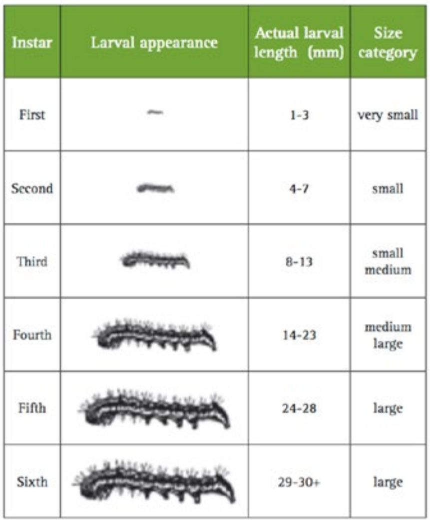
Photo: GRDC Resources Ute-Guide, https://grdc.com.au/Resources/Ute-Guides/Insects/Butterflies-moths-larvae/North/Heliothis

14 GRDC (2013) Insect ID: The Ute Guide, iOS app, Version 1.1, 14 October 2013

### 8.4.3 Identification of *Helicoverpa* spp. eggs and larvae

Determining which species of *Helicoverpa* are present in the crop is essential, because of the differing susceptibility of the two species to synthetic pyrethroids and carbamates. *H. armigera* is resistant to some insecticide groups, whereas *H. punctigera* is susceptible to all products.

As the larvae of *Helicoverpa* are the main insect pest of field pea, it is important to be able to identify the different larval instars (very small, small, medium, large) of *Helicoverpa* spp. (Figure 4).



| Instar | Larval appearance | Actual larval length (mm) | Size category |
|---|---|---|---|
| First | | 1-3 | very small |
| Second | | 4-7 | small |
| Third | | 8-13 | small medium |
| Fourth | | 14-23 | medium large |
| Fifth | | 24-28 | large |
| Sixth | | 29-30+ | large |

**Figure 4:** *Guide to Helicoverpa spp. larval instars and size categories.*

Source: QDPI&F, Understanding *Helicoverpa* ecology & biology in southern Queensland: Know the enemy to manage it better, https://www.daf.qld.gov.au/__data/assets/pdf_file/0005/72689/Insects-Helicoverpa-ecology-biology.pdf

The adult moths lay round eggs (0.5 mm in diameter), singly on the growing tips and buds of host plants. They are white when first laid but change colour from yellow through to brown just before hatching (Photo 3).

**Photo 3:** *(From left) black larval head in nearly hatching egg, brown ring and fresh laid white eggs of Helicoverpa spp.*

Photo: GRDC https://grdc.com.au/Resources/Ute-Guides/Insects/Butterflies-moths-larvae/North/Heliothis

Newly hatched caterpillars (larvae) are very small (approximately 1.5 mm), light in colour with dark brown heads and can easily be missed when inspecting a crop. They will pass through six or seven growth stages or instars until they are up to 40 mm long (Photo 4).

When fully grown, they can have considerable colour variation, from green, buff yellow, red or brown to almost black, with a broad yellow-white stripe down each side of the body and a dark stripe down the centre of the back (Photo 5).

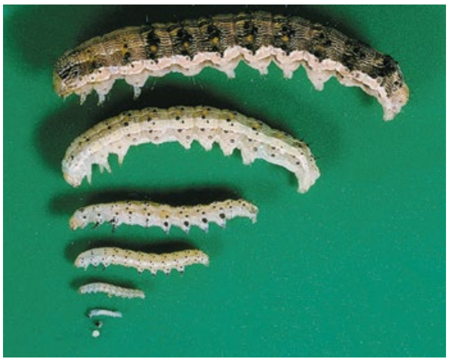


**Photo 4:** *Developmental stages of Helicoverpa spp. eggs and larvae. Newly laid egg (white and mature egg (black) with six larval instars.*

Photo: Gabriella Caon, SARDI, GRDC Resources Ute-Guide, https://grdc.com.au/Resources/Ute-Guides/Insects/Butterflies-moths-larvae/North/Heliothis

**Photo 5:** *Large Helicoverpa larvae showing colour variation.*

Photo: D. Ironside, Queensland DAF, GRDC Resources Ute-Guide, https://grdc.com.au/Resources/Ute-Guides/Insects/Butterflies-moths-larvae/North/Heliothis

The two species of *Helicoverpa* look similar and it is important to identify them and develop an understanding of the likely presence and population mix of the two species, particularly when making control choices as *H. armigera* has developed resistance to the commonly used pyrethroid chemical group (e.g. Decis Options®, Karate®) and to the carbamate group (e.g. Lannate L®). Separate pheromone traps can be deployed to trap both species and is an indicator of their presence and the likely mix other than identifying the moths or larvae that are present.

While both species of *Helicoverpa* have four pairs of abdominal prolegs (grasping appendages) in addition to a pair of anal prolegs, *H armigera* caterpillars have a saddle on the fourth abdominal segment (Photo 6) at the 3rd instar stage (approximately 1 cm long), and white hairs on the segment directly behind the head (Photo 8) at the 5th instar stage (approximately 2 cm long) and dark legs compared to black hairs on native budworm *H. punctigera*, which has no saddle and light-coloured legs (Photo 7 and Photo 8).[15]

15 Pulse Australia (2016) Managing native budworm in pulses. Australian Pulse Bulletin, http://www.pulseaus.com.au/growing-pulses/publications/native-budworm

**Photo 6:** *Medium larvae of Helicoverpa armigera with saddle on fourth segment.*

Photo: IPM guidelines for grains, http://ipmguidelinesforgrains.com.au/pests/helicoverpa/

**Photo 7:** *Medium larvae of Helicoverpa punctigera (no saddle).*

Photo: IPM guidelines for grains, http://ipmguidelinesforgrains.com.au/pests/helicoverpa/

In larger larvae (5th and 6th instar), hair colour on the segment immediately behind the head is a good species indicator. These hairs are white on *H. armigera* and black on *H. punctigera* (Photo 8).

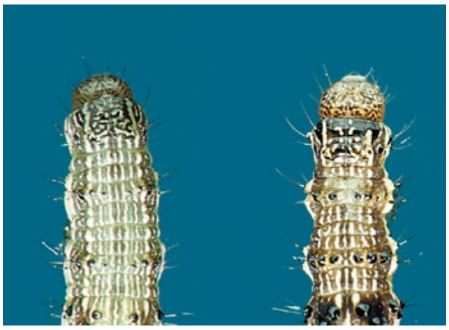


**Photo 8:** *Large larvae of H. punctigera (left) with black hair behind head and H. armigera (right) with white hair behind head.*

Photo: GRDC

*Helicoverpa punctigera* larvae can be identified, despite the colour variations, by a broad yellow stripe along the body. The young larvae (<10 mm) prefer to feed on foliage. Older larvae prefer to feed on pods. Insecticides are more effective on smaller larvae.

Other larvae, which look like native budworm, may be found in a pulse crop, e.g. southern armyworm and pink cutworm. These are primarily grass feeders and rarely do any damage to pulses.[16]

16 Pulse Australia (2016) Faba & Broad Bean – Best Management Practices Training Course, module 7-2016. Pulse Australia Limited

### 8.4.4 Life cycle of *Helicoverpa* spp.

In southern Australia, native budworm may produce up to five generations a year. The spring generation causes the most damage, especially to grain legume crops. The late summer generation usually attacks lucerne seed crops.

During winter, native budworm enters a resting period as a pupa in the soil. Adult moths emerge from these overwintering pupae in August and September and live for about 2–4 weeks. The moths are capable of laying up to 1,000 eggs each.

The eggs hatch 1–2 weeks after laying in spring and the larvae feed in crops for 4–6 weeks. The mature larvae leave the host plant to pupate in the soil. During spring, summer and early autumn the pupae develop quickly and a new generation of moths emerges after about 2 weeks. Native budworm eggs and holes on soursob (oxalis) petals are signs of native budworm activity in the area.[17]

#### Diapause in *Helicoverpa* spp.

Both species of *Helicoverpa* survive winter as pupae in the soil, when host plants and thus food sources are scarce. *H. punctigera* are capable of overwintering in southern cropping regions, but only a few are ever found. By contrast, substantial numbers of overwintering *H. armigera* pupae can be found under late summer crops, particularly when *Helicoverpa* activity has been high late into March.

Not all pupae that form in late summer go into diapause; a proportion continue to develop, perhaps emerging during winter, or early in spring.

Overwintering pupae can be killed without the use of chemicals. Pupae in the soil are susceptible to soil disturbance and disruption of the emergence tunnel. Cultivation is enough to create this disturbance.[18]

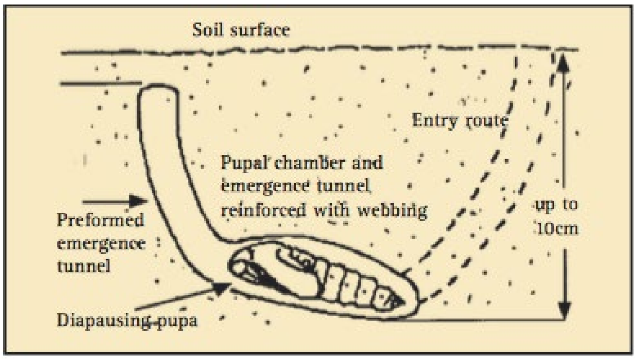



**Figure 5:** *Helicoverpa pupa in pupal chamber showing the entry and exit tunnels formed before the larvae pupated.*

Source: DPI & F, QLD, Insects understanding Helicoverpa ecology & biology in southern Queensland: Know the enemy to manage it better, https://www.daf.qld.gov.au/__data/assets/pdf_file/0005/72689/Insects-Helicoverpa-ecology-biology.pdf

17 Pulse Australia (2016) Faba & Broad Bean – Best Management Practices Training Course, module 7-2016. Pulse Australia Limited

18 Queensland DAF. Insects understanding: Helicoverpa ecology & biology in southern Queensland: know the enemy to manage it better. https://www.daf.qld.gov.au/__data/assets/pdf_file/0005/72689/Insects-Helicoverpa-ecology-biology.pdf

### 8.4.5 Damage by *Helicoverpa* spp.

Field pea is very susceptible to all sizes of caterpillars (larvae) during the formation and development of pods. Tiny larvae enter emerging pods and damage developing seed or devour the entire contents of the pod (Photo 9). Some growers have had unexpected losses from native budworm damage in semi-leafless field peas like Kaspa⁽ᵇ⁾ as these are more difficult to sample with their intertwined tendrils.[19]

**Photo 9:** *Field pea pod with entire contents eaten by native budworm.*

Photo: DAWFA, https://agric.wa.gov.au/n/2685

**Photo 10:** *Mature field pea with large budworm.*

Photo: T. Bray, formerly Pulse Australia

The larvae bore into the pods and usually destroy the seeds in each pod. One larva may attack four to five pods before reaching maturity. The amount of damage to each seed varies considerably, but the damaged area has jagged edges (Photo 11). This contrasts with damage from pea weevil (in field pea), which leave a cylindrical, smooth, circular exit-hole.[20]

Direct losses are usually associated with yield through grain being wholly or partially consumed by the caterpillar. However, indirect losses from quality issues can result in downgrading or even rejection from high levels of damaged grain, weathering or fungal infections from holes in pods, discolouration or odour.[21]

19 P Mangano, S Micic (2016) Management and economic thresholds for native budworm control. Department of Agriculture and Food, Western Australia, www.agric.wa.gov.au/grains/management-and-economic-thresholds-native-budworm

20 Pulse Australia (2016) Southern/western field pea best management practices training course, module 7- 2016, Draft. Pulse Australia Limited

21 Pulse Australia (2016) Managing native budworm in pulses. Australian Pulse Bulletin, Pulse Australia, http://www.pulseaus.com.au/growing-pulses/publications/native-budworm

**Photo 11:** *Native budworm larvae leave holes in field pea pods.*

Photo: Pulse Australia (2016) Managing native budworm in pulses. Pulse Australia, http://www.pulseaus.com.au/growing-pulses/publications/native-budworm

### 8.4.6 Monitoring

The use of pheromone traps (which attract male moths) provides an early warning of moth arrival and abundance, following their migration from inland regions. These should be set up in late winter or early spring. Observing the activity of moths in the crop and the presence of eggs may also be indicative of future larval activity. However, egg and early larval mortality of native budworm through natural courses can be very high. In Queensland chickpea, this has been estimated to be up to 70%. Eggs and very small larvae can be dislodged and will die after heavy rain or wind.[22]

All crops should be scouted weekly during flowering for moth activity and eggs, then at least twice a week during pod-fill for eggs and larvae. The main egg-laying period is often around the flowering period when moths can be quite abundant. Eggs can often be found on the vegetative or floral growing points, new leaves, stems, flowers, flower buds and young pods. They may not be obvious to the untrained eye unless there is a heavy egg lay or until small larvae can be found.

Crop types can vary in attractiveness to moths for egg laying and as a general rule lentil is the most attractive crop, followed by field pea, vetch, faba bean, chickpea and lupin. Crop health, density and growth stages (flowering and podding) will generally affect the number of eggs laid, with moths mostly preferring the more advanced dense and succulent areas.

Feeding behaviour of caterpillars also changes according to the pulse type, with field pea, chickpea, lentil and faba bean crops being more susceptible to all sizes of caterpillars during pod formation and development. While tiny caterpillars will usually foliage feed, there are times, such as in hot, dry conditions, that they will burrow into emerging pods as they become more palatable than the wilting foliage.[23]

22 G McDonald (2015) Native budworm. Pest Notes Southern. CESAR and South Australian Research and Development Institute, http://www.pir.sa.gov.au/__data/assets/pdf_file/0005/274181/Native_Budworm.pdf

23 Pulse Australia (2016) Managing native budworm in pulses. Australian Pulse Bulletin, Pulse Australia, http://www.pulseaus.com.au/growing-pulses/publications/native-budworm

### 8.4.7 Sampling methods

Either a sweep net (for e.g. field pea, lentil) or beat sheet (for e.g. chickpea, lupin, bean) should be used to monitor larval activity in crops. For field pea, monitor larval activity from budding and flowering development through to maturity.[24]

**VIDEO**

See video How to use a sweep net to sample for insect pests. https://youtu.be/DGggRMwpnY8


#### Sweep net sampling

The quickest and easiest way to sample most crops is with a standard sweep net (380 mm diameter) and taking 2-metre-long sweeping arcs in multiples of 10 sweeps in several parts of the crop, keeping the lower edge of the sweep net slightly forward to catch any dislodged grubs.

This roughly equates to a sampled area of one square metre. This method works well in short and thin crops such as field pea, lentil and vetch, but may be less efficient in tall dense crops such as faba bean, lupin and chickpea.

Trials conducted in WA have found that semi-leafless field peas (e.g. Kaspa(PBR)) with intertwined tendrils make the netting efficiency only half that of the conventional trailing types (e.g. Parafield, Sturt) and 10 sweeps is usually sufficient to provide estimates that only equate to numbers present over 0.5 $m^2$.[25]

To monitor for native budworm larvae in field pea:

- Semi-leafless field pea crops – use grub counts based on 20 sweeps of a sweep net.
- Trailing type field pea crops – use counts based on 10 sweeps of a sweep net.[26]

**VIDEO**

Watch video Using a beatsheet to sample *Helicoverpa* in chickpeas https://youtu.be/_Z457Cc1fig

#### Beat sheet sampling

A beat sheet is a good alternative monitoring technique for taller or more rigid crops, especially wide row chickpea and faba bean (Photo 12). A standard beat sheet (plastic or canvas) is about 1.3 metres wide and 1.5 m long, with a heavy dowel to weigh it down. One edge should be placed at the base of a row and the sheet spread out across the inter-row space. If rows are narrow then it can be draped over the adjacent row. Using a 1-metre-long rod, vigorously shake the row 10 times over the sheet to dislodge and catch larvae.[27]

An alternative approach is to gently cut plants from an area such as 0.25 $m^2$ (0.5 x 0.5 m) and shake larvae into a large basin or onto a white sheet or poly bag. This is very simple and more accurate, with less plant and flower material than the sweep net, but it is more time consuming as at least five separate sites need to be sampled within a crop and the numbers averaged.

Misleading conclusions can result from inadequate sampling as grub numbers can vary greatly within a crop and sampling needs to be conducted at five or more randomly spaced locations and then averaged.[28]

24 G McDonald (2015) Native budworm. Pest Notes Southern. CESAR and South Australian Research and Development Institute, http://www.pir.sa.gov.au/__data/assets/pdf_file/0005/274181/Native_Budworm.pdf

25 Pulse Australia (2016) Managing native budworm in pulses. Australian Pulse Bulletin, Pulse Australia, http://www.pulseaus.com.au/growing-pulses/publications/native-budworm

26 P Mangano, S Micic (2016) Management and economic thresholds for native budworm control. Department of Agriculture and Food, Western Australia, www.agric.wa.gov.au/grains/management-and-economic-thresholds-native-budworm

27 G McDonald (2015) Native budworm. Pest Notes Southern. CESAR and South Australian Research and Development Institute, http://www.pir.sa.gov.au/__data/assets/pdf_file/0005/274181/Native_Budworm.pdf

28 Pulse Australia (2016) Managing native budworm in pulses. Australian Pulse Bulletin, Pulse Australia, http://www.pulseaus.com.au/growing-pulses/publications/native-budworm

Photo 12: *A beat sheet used in sampling a wide row chickpea crop.*

Photo: Pulse Australia (2016) Managing native budworm in pulses. Australian Pulse Bulletin, Pulse Australia website, http://www.pulseaus.com.au/growing-pulses/publications/native-budworm

MORE INFORMATION

Integrated pest management: combating serial pests, https://grdc.com.au/resources-and-publications/all-publications/bookshop/2009/12/integrated-pest-management-fact-sheet-national

### 8.4.8 Control thresholds for *Helicoverpa* spp.

An economic threshold is the number of caterpillars that will cause more financial loss than the cost of spraying. The thresholds used are based on yield loss rather than quality.

The control thresholds used in the southern region are those developed for Western Australia in DPIRD trials. This threshold is the only one used in Australia that is derived from research. It assumes 50 kg/ha yield loss per larva in 10 sweeps from conventional field pea types and 100 kg/ha yield loss per larva in 10 sweeps from semi-leafless types (Table 2).

**Table 2:** Economic thresholds (ET) for native budworm (*Helicoverpa*) on various crops in WA.

| Crop | P Grain price per tonne | C Control costs including chemical + application | K Loss for each grub in 10 sweeps (kg/ha/grub) | ET Grubs in 10 sweeps | ET Grubs in 5 lots of 10 sweeps | ET Grubs (>15 mm) per m$^2$ |
|---|---|---|---|---|---|---|
| Field pea - trailing type e.g. Helena, Dundale | 200 | 10 | 50 | 1.0 | 5 | - |
| Field pea - semi-leafless e.g. Kaspa⫯ | 200 | 10 | 100 | 0.5 | 2.5 | - |
| Chickpea | 420 | 10 | 30 | 0.8 | 4 | - |
| Faba bean | 280 | 10 | 90 | 0.4 | 2 | - |
| Lentil | 420 | 10 | 60 | 0.4 | 2 | - |
| Canola | 270 | 10 | 6 | 6.2 | 31 | - |
| Lupin | 175 | 10 | 7 | - | - | 8.2 |

Source: P Mangano, S Micic (2016) Management and economic thresholds for native budworm control. Department of Agriculture and Food, Western Australia, www.agric.wa.gov.au/grains/management-and-economic-thresholds-native-budworm

To use the table, you need to substitute:

- control costs with your own actual costs; and
- expected grain price per hectare based.

This will calculate the economic threshold or the number of caterpillars that will cause more financial loss than the cost of spraying.[29]

## IN FOCUS

**Example**

This is an example of how to calculate the economic threshold (ET) or the number of caterpillars that will cause more financial loss than the cost of spraying.

The on-farm value of field pea is $185 per tonne (t).

The cost of control is $12 per hectare (ha).

ET = C ÷ (K x P)

Where:

ET = economic threshold (number of grubs in 10 sweeps)

C = control cost (includes price of chemical + application) ($ per ha)

K = kilograms per hectare (ha) eaten for every one caterpillar netted in 10 sweeps or per square metre (see Table 2)

P = price of grain per kg (price per tonne ÷ 1000)

Therefore, economic threshold for field pea = 12 ÷ (50 x (185 ÷ 1000)) = 1.3 grubs per 10 sweeps

Note that the Western Australian thresholds are only a guide for the southern region.

## 8.4.9 Management options

### Biological

A key component to any IPM strategy is to maximise the number of beneficial organisms and incorporate management strategies that reduce the need for pesticides. Correct identification and monitoring is the key when checking for build-up or decline of beneficials. There are many natural enemies that attack native budworm. The egg stage is susceptible to the parasite *Trichogramma ivalae*, a minute wasp that has been recorded in up to 60% of eggs, along with egg predators such as ladybird beetles, lacewings and spiders. Beneficials attacking larvae include shield bugs, damsel bugs, assassin bugs, tachinid flies (their larvae prey on caterpillars), orange caterpillar parasite, two-toned caterpillar parasite, orchid dupe, lacewings and spiders. Naturally occurring fungal diseases and viruses also play an important role in some seasons.

### Cultural

Desiccating pulse crops such as field pea may be an option to advance the drying of crops when small–medium size larvae are present near crop maturity.

29 P Mangano, S Micic (2016) Management and economic thresholds for native budworm control. Department of Agriculture and Food, Western Australia, www.agric.wa.gov.au/grains/management-and-economic-thresholds-native-budworm

FEEDBACK

MORE INFORMATION

Native budworm Pest Notes Southern, CESAR: http://cesaraustralia.com/sustainable-agriculture/pestnotes/insect/native-budworm

### Chemical

There are several insecticides registered for the control of native budworm. Timing and coverage are both critical to achieving good control. Try to target small larvae (up to 7 mm in length) and apply insecticides before larvae move into flowering pods. IPM options include the use of *Bt* (*Bacillus thuringiensis*) and nuclear polyhedrosis virus (NPV) based biological insecticides. Small larvae are generally easier to control because they are more susceptible to insecticides, and leaf feeding makes them susceptible to ingestion of active residues on the plant surface. Larvae entrenched in buds and pods will be more difficult to control and chemical residual will be important in contacting them.

The crop should be re-inspected 2–4 days after spraying to ensure enough caterpillars have been killed to prevent future damage and economic loss. In years of very high moth activity and extended egg lays, a second spray may be required.

In choosing a registered product, be aware of the withholding period for harvest or windrowing/swathing, which is the same as harvest. Residue testing is routinely conducted on grain destined for export and domestic stock-feed markets.[30]

## 8.5 Pea weevil (*Bruchus pisorum*)

The pea weevil (*Bruchus pisorum*) is actually a beetle as opposed to a weevil and should really be called the pea beetle, however industry refer to *B. pisorum* as 'pea weevil'. The Australia pea weevil is one of the most damaging pests of the field pea industry. Not only does this beetle reduce yields but it can also reduce germination rates of seed and affect grain quality to the point that it is not saleable for human consumption.

### 8.5.1 Identification of pea weevil

The pea weevil is a chunky, 5–6 mm long, brownish beetle, flecked with white, grey and black patches (Photo 13). The white tip of the abdomen is marked with two black, oval spots.

**Photo 13:** *Adult pea weevil.*

Photo: DPIRD (2016) https://agric.wa.gov.au/n/2815

30 G McDonald (2015) Native budworm. Pest Notes Southern. CESAR and South Australian Research and Development Institute. http://www.pir.sa.gov.au/__data/assets/pdf_file/0005/274181/Native_Budworm.pdf

Eggs are bright yellow, cigar-shaped and about 1.5 mm long, and attach individually to the developing pods (Photo 14). The larva is C-shaped, up to 6 mm long, legless, brown-headed and cream coloured (Photo 15). Larvae burrow directly into pods to feed on cotyledons and remain protected in the seed until the adult emerges. Once eggs are laid it is too late for field control.

**Photo 14:** *A bright yellow, cigar-shaped pea weevil egg, about 1.5 mm long, attached individually to a developing pod.*

Photo: W Smith (2014) https://agric.wa.gov.au/n/4477

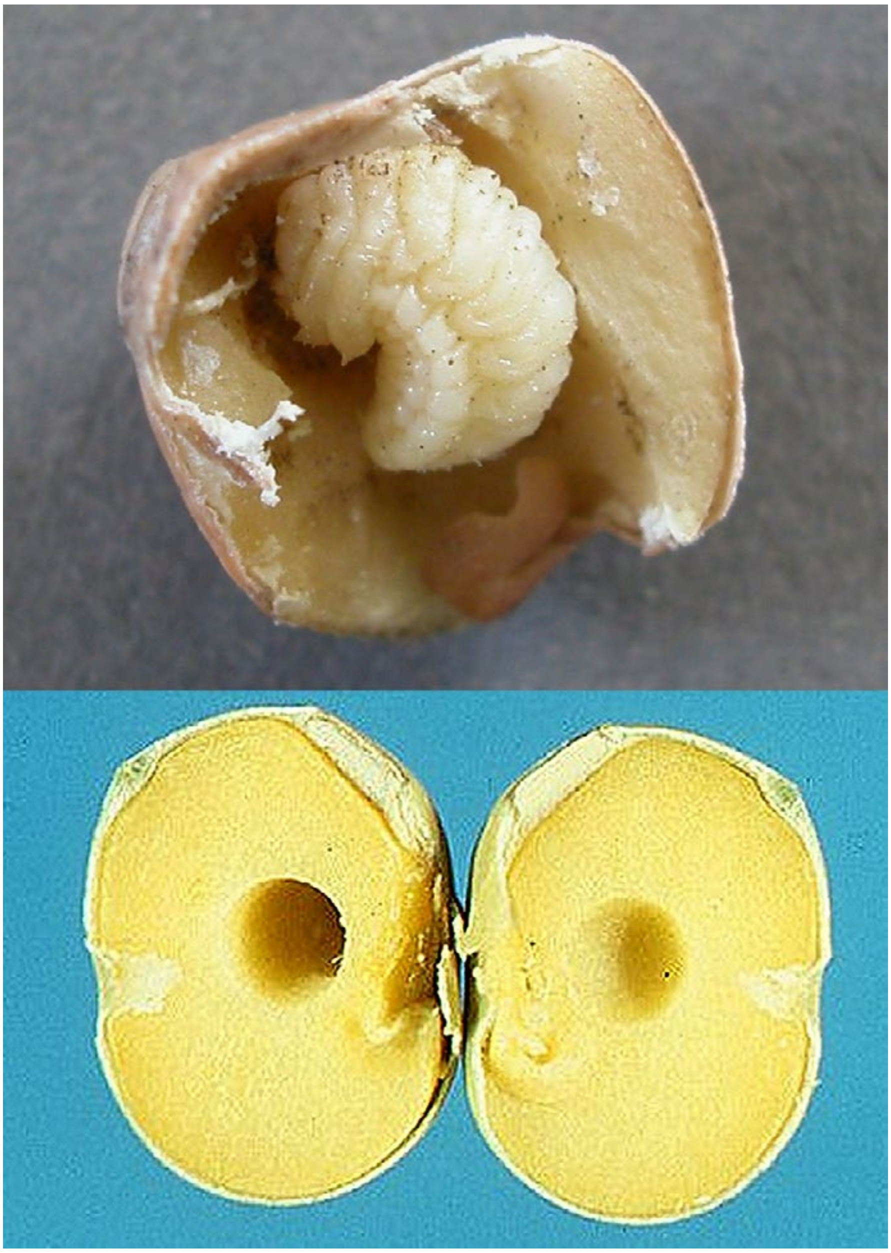


**Photo 15:** *Developing pea weevil larva (top) and split infested seed at early harvest (below).*

Photo: DPIRD (2014) https://agric.wa.gov.au/n/4477

## 8.5.2 Life cycle of pea weevil

Adult beetles hibernate during summer, autumn and winter in sheltered positions, e.g. under the bark of trees or in cracks and crevices of fence posts.

When spring temperatures reach about 20°C, the beetles become active and are attracted to crops. Even though pea weevil can travel up to 5 km, infestations usually occur from infested seed from the previous season.

The female beetles are sexually immature when they leave hibernation and first arrive in the pea crop. They require a feed of pollen and further time for ovarian development to take place.

Approximately 2 weeks after arrival in the pea crop the females lay eggs on the developing pods. Female beetles lay eggs individually on the surface of pods.

Small larvae hatch from the eggs in about 6–13 days. The larvae bore through the wall of the pod and into the soft, developing seed.

After about 40 days of feeding inside the pea seed the larva prepares a 2–3 mm exit hole by chewing partially through the seed coat. The larva then pupates and after about 14 days is ready to emerge as an adult beetle.

By this time the seed has generally been harvested and some beetles will emerge from the seeds to find suitable hibernation sites, others can remain concealed in grain for many months or when the grain is next sown.

The pea weevil will not reproduce in stored grain.[31]

### 8.5.3 Damage by pea weevil

Pea weevil reduce yield by:

- consuming seed – as much as 30% of individual seed weight is lost from larval feeding;
- feeding damage – which also increases the amount of seeds that split during sowing, harvesting and seed cleaning.

Many food consumption markets have a nil tolerance for live or dead adult pea weevil contamination or peas damaged by larval feeding.

The stockfeed market has nil tolerance for live pea weevil.

Pea-weevil-infested seed should be fumigated prior to sowing to prevent this pest spreading to new growing areas and to reduce the impact of this species on the pea crop later in the season.

Peas heavily damaged by pea weevil should not be sown without a germination test as the seed may not be viable or produce weak seedlings.[32]

**Photo 16:** *Holes created in pea seed by mature pea weevil adults (3 mm).*

Photo: QDAF, The Beatsheet, http://thebeatsheet.com.au/wp-content/uploads/2014/11/C-maculatus-field-peas-IMG_2994.jpg

31 D Hardie, S Micic (2015) Management of pea weevil. Department of Agriculture and Food, Western Australia, https://agric.wa.gov.au/n/2815

32 D Hardie, S Micic (2015) Management of pea weevil. Department of Agriculture and Food, Western Australia, https://agric.wa.gov.au/n/2815

### 8.5.4 Monitoring

#### Where

Pea weevil movement in early spring within a flowering crop is generally restricted to the crop's edge, especially if adjacent to over-wintering sites such as trees and sheds.

#### When

Monitor the crop edges every 3–4 days from the start of flowering. Monitor when average temperatures are above 20°C as this is when pea weevil are active.

If sprays are applied, monitor crops about 10 days after spraying.

#### How

To monitor crops use a sweep net. It should be dragged across the tops of the plants in a horizontal, 160° arc with a one-metre stride between each sweep.

Take 25 sweeps within 1–5 m of crop edge. Repeat this at 6 or more sites.

**Photo 17:** *Sampling pea crop using sweep net for pea weevil.*

Photo: DPIRD (2016) https://www.agric.wa.gov.au/pest-insects/management-pea-weevil

### 8.5.5 Control

A 40 m border spray will control pea weevil that is moving into a crop. Spray with synthetic pyrethroids at registered rates.

Insecticides are only effective on adult pea weevil, so apply sprays only after adults first appear but before egg lay commences and before small pods are visible.

In early crops, beetle flights may occur over an extended period, so more than one spray application may be necessary.

If heavy infestations are detected or if seed infested with live weevil was sown, the entire paddock needs to be sprayed.[33]

## 8.6 Aphids and viruses

Aphids can damage field pea crops by spreading viruses or through direct damage when feeding on plants. Feeding damage generally requires large populations, but virus transmission can occur before aphids are noticed.[34]

Direct aphid feeding rarely causes major damage to broadacre field pea crops, and control measures are generally unnecessary, as parasitoids and predators keep populations in check. Exceptions occur when aphid populations are extreme (particularly early) or the compensatory ability of the crop is compromised by stress (particularly moisture stress), and aphid impact on flowering or pod-set/fill may be significant.[35]

The main species affecting pea are the pea aphid (*Acyrthosiphon pisum*), green peach aphid (*Myzus persicae*), bluegreen aphid (*Acyrthosiphon kondoi*) and occasionally cowpea aphid (*Aphis craccivora*). It is unusual for aphids to colonise field pea, typically as winged aphids move through the crop they may spread viruses.[36]

MORE INFORMATION

GRDC Fact Sheet Aphids and viruses in pulse crops, https://grdc.com.au/GRDC-FS-AphidsandVirusesinPulses

### 8.6.1 Aphids and virus transmission

Aphids are small, soft-bodied insects that grow up to 4 mm in length. Adult aphids can be winged or wingless; all immature aphids are wingless. Some aphid species will colonise individual plants, while other aphid species will move through a crop and be difficult to detect.

Different aphid species transmit different viruses to particular crop types; species identification is important because management strategies can vary.

Aphids can spread viruses persistently or non-persistently (Table 3). Once an aphid has picked up a persistently transmitted virus, it carries the virus for life, infecting every plant where it feeds. Aphids carrying non-persistently transmitted viruses, such as Cucumber mosaic virus (CMV), carry the virus temporarily and only infect new plants in the first one or two probes.

33 D Hardie, S Micic (2015) Management of pea weevil. Department of Agriculture and Food, Western Australia, https://www.agric.wa.gov.au/pest-insects/management-pea-weevil

34 GRDC (2010) Aphids and viruses in pulse crops, Fact Sheet. Grains Research and Development Corporation, www.grdc.com.au/GRDC-FS-AphidsandVirusesinPulses

35 Department of Agriculture & Fisheries (2016) IPM guidelines for grains, Aphids, http://ipmguidelinesforgrains.com.au/pests/aphids/

36 S Micic (2015) Diagnosing aphid damage in field peas. https://agric.wa.gov.au/n/4458

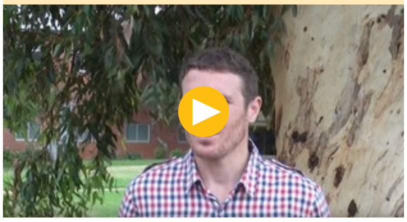
**Table 3:** Examples of transmission of one persistent and two non-persistent viruses for four aphid species.

| Aphid | Cucumber mosaic virus (CMV) | Pea seed-borne mosaic virus (PSbMV) | Beet western yellows virus (BWYV) |
|---|---|---|---|
| | Non-persistent | Non-persistent | Persistent |
| Green peach aphid | Yes | Yes | Yes |
| Pea aphid | Yes | Yes | No |
| Cowpea aphid | Yes | Yes | Yes |
| Bluegreen aphid | Yes | No | No |

Source: GRDC (2010) https://grdc.com.au/__data/assets/pdf_file/0019/205642/aphidsvirusesfactsheets.pdf.pdf

**VIDEO**

Green peach aphids and Beet western yellows virus https://youtu.be/1MIRtsfydkc



**MORE INFORMATION**

For more information on viruses, refer to Section 9 Diseases

Green peach aphids, www.grdc.com.au/GPAResistanceStrategy

Russian wheat aphid: tactics for future control, https://grdc.com.au/rwa-tacticsfuturecontrol

## Persistently transmitted aphid-borne viruses

The common virus in this category is Beet western yellows virus (BWYV). Persistent transmission means that when an insect vector feeds on an infected plant, the virus has to pass through its body and lodge in its salivary glands before it can be transmitted to a healthy plant, a process that takes more than a day. Once the insect is infectious it remains so for the rest of its life. Important aphid vectors such as the green peach aphid tend to colonise the hosts they transmit the virus to. Because acquisition of the virus is slow, insecticides that kill aphids work well in suppressing virus spread. Luteoviruses are not seed-borne and require a continuous 'green bridge' of host plant material, such as an infected lucerne pasture or broadleafed weeds surviving in isolated wet spots over summer, in order to pass from one crop to the next.

## Non-persistently transmitted aphid-borne viruses

These viruses are also seed-transmitted to varying extents. Pea seed-borne mosaic virus (PSbMV) is the most common and economically damaging virus that reduces yield and seed quality in pea.

Non-persistent transmission means that the insect vector can land on a virus-infected plant, make a brief probe, acquire the virus on its mouth parts within seconds and then transmit it immediately when probing on a healthy plant. The aphid loses the virus after it probes a healthy plant one or two times. After this, the insect does not infect further plants. The whole process is so quick that insecticides do not act fast enough to prevent transmission, and can make things worse by making the aphids hyperactive, causing them to flit from plant to plant. Many aphid species are vectors of this type of virus, including some that do not colonise legumes but just land and probe pulse crops while searching for their preferred hosts, such as oat and turnip aphids.

Close proximity to a substantial external virus reservoir, seed infection, and high summer and autumn rainfall before the growing season are the most important factors that predispose pea crops to severe virus infection. Summer and autumn rainfall stimulate early growth of pastures, weeds and crop volunteers upon which aphids build up before the growing season starts. This results in early aphid flights to newly emerged crops and early virus infection. The infected plants then act as reservoirs for further spread of infection within the crop so the final virus incidence is high. In contrast, dry starts to the season and minimal virus sources result in little virus spread and absence of any economic losses.[37]

37 B Coutts (2015) Diagnosing virus damage in field peas. Department of Agriculture & Food, Western Australia, https://agric.wa.gov.au/n/4489

## MORE INFORMATION

For more information see Crop Aphids: The Back Pocket Guide https://grdc.com.au/CropAphidsBackPocketGuide

### 8.6.2 Aphid types

The pea aphid (Photo 18) is up to 4 mm long and may be yellow, green or pink in colour. They have black knees and dark joints on their antennal segments. These aphids feed primarily on pea, faba bean and lucerne.

The green peach aphid (GPA) tends to be shiny or waxy, and ranges from yellow, through to green and pink (Photo 19). They can be similar in colour to young unfurled field pea leaves. Green pea aphid has a wide host range including canola, lupin and other pulse crops, and can also be found on weeds including wild radish, doublegee and blackberry nightshade.

The bluegreen aphid (BGA) is up to 3 mm long, and matt bluish-green (Photo 19). Large numbers of winged BGA fly from pastures to crops later in the growing season.

The cowpea aphid (CPA) has a black body and black and white legs (Photo 19), it is not typically found on field pea, but often colonises lupin and faba bean plants.

Russian wheat aphid (RWA) is one of the world's most economically important and invasive pests of wheat, barley and other cereal grains. Since first being discovered in South Australia in 2016, RWA has been found widespread in cereal-growing regions of South Australia, Victoria, New South Wales and Tasmania.

Their small size, green colour, elongate shape, very short antennae and apparent lack of siphuncles readily distinguish RWA from other pest aphids found in Australian cereal crops. Russian wheat aphid injects salivary toxins during feeding that cause rapid, systemic phytotoxic effects on plants, resulting in acute plant symptoms and potentially significant yield losses.

Please see http://cesaraustralia.com/sustainable-agriculture/pestnotes/insect/Russian-wheat-aphid for more details.

**Photo 18:** *Pea aphid.*

Photo: DPIRD (2014) https://www.agric.wa.gov.au/mycrop/diagnosing-aphid-damage-field-peas

**Photo 19:** *Green peach aphid (top), bluegreen aphid (centre) and cowpea aphid (bottom).*

Photo: DPIRD (2015) https://www.agric.wa.gov.au/mycrop/diagnosing-aphid-damage-field-peas

## 8.6.3 Management strategies

Aphid colonies do not usually develop on field pea; control is only warranted if aphid colonies are impacting on the growth of plants.

Correct identification of the aphids is critical. Green peach aphids are resistant to organophosphorus, carbamate and synthetic pyrethroid insecticides, and can be difficult to control. Green peach aphids are easily identified: they tend to be found on the underside of leaves and vary in colour from bright green to pink.

Spraying insecticides to stop virus spread is unlikely to be of any benefit because insecticides do not act fast enough to prevent the rapid spread of the virus by aphids and may increase rather than reduce virus spread because aphids move around more on sprayed plants.[38]

38 S Micic (2015) Diagnosing aphid damage in field peas. https://www.agric.wa.gov.au/mycrop/diagnosing-aphid-damage-field-peas

Practices that minimise virus damage are:

1. Where the virus source is internal, especially with Pea seed-borne mosaic virus (PSbMV), sow healthy seed stocks to minimise initial infection sources within the crop.
2. Where the virus source is external, sow non-host barrier-crop strips and spray pastures adjacent to the crop. These measures decrease virus spread into the crop from an external source.
3. Sow at high seeding rates to generate high plant densities and promote early crop canopy development. These measures minimise virus infection sources (seed-infected and/or early infected plants), diminish aphid landing rates and dilute numbers of infected plants.
4. Sow at narrow row spacing and maximise retained stubble. These measures diminish aphid landing rates before the crop canopy develops.
5. Do not plant pea after another pulse to avoid volunteer seed-borne pulse infection sources within the crop.
6. Maximise weed control to minimise potential weed virus infection sources within the crop.
7. Sow early maturing varieties to decrease final infection incidence, especially in prolonged growing seasons.[39]

Studies indicate that both Maki and Yarrum have a high level of resistance to PSbMV and useful levels of resistance to Bean leaf roll virus (BLRV).[40]

**Photo 20:** *Planting field pea into standing stubble can disrupt aphids' flight and deter them from landing on the ground.*

Photo: Wayne Hawthorne, formerly Pulse Australia

39 B Coutts (2015) Diagnosing virus damage in field peas. Department of Agriculture & Food, Western Australia, https://agric.wa.gov.au/n/4489

40 S Moore, G Cumming, L Jenkins, J Gentry (2010) Northern Region Field Pea Management Guide. Pulse Australia,http://sydney.edu.au/agriculture/documents/pbi/pbi_region_north_field_pea_management_guide.pdf

## 8.7 Snails

Snails are a significant problem in field pea crops across the southern region. Snails cause damage to emerging crops and contamination at harvest. This means monitoring and managing snails regularly throughout the year (Figure 6).

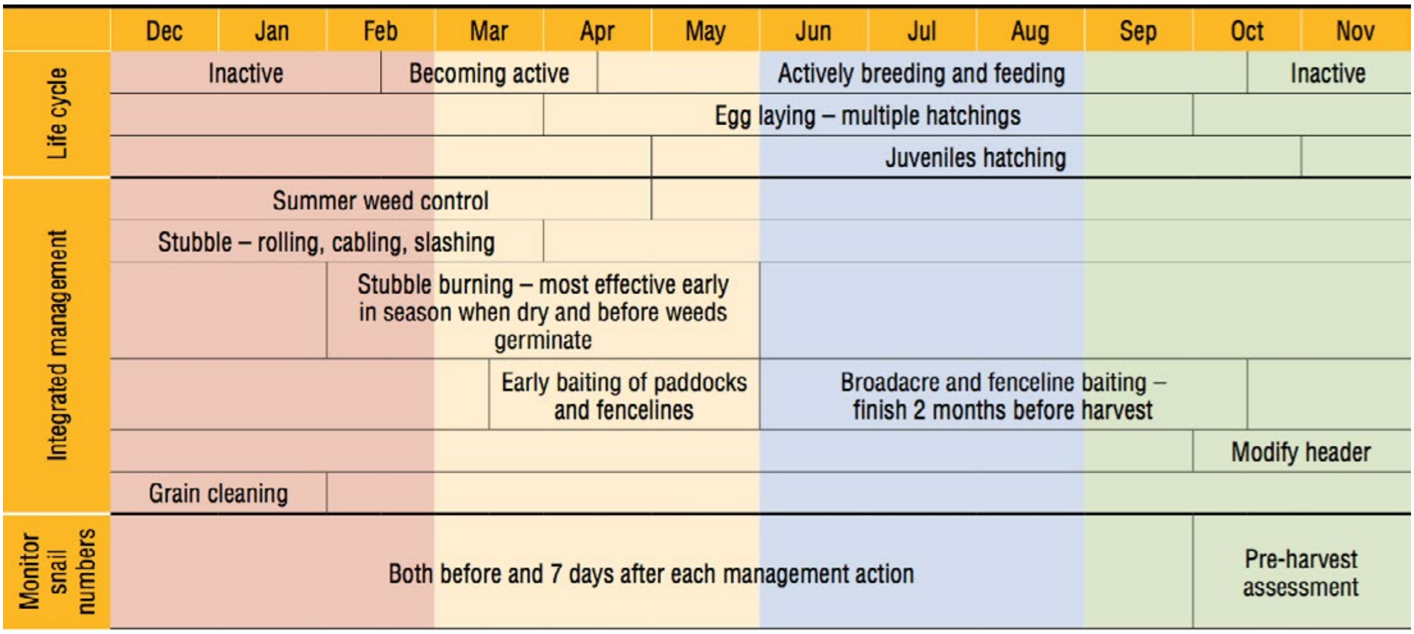



**Figure 6:** *Integrated snail management calendar.*

Source: GRDC (2011) Snail Identification and Control: The Back Pocket Guide. GRDC, https://grdc.com.au/Resources/Publications/2011/03/Snail-Identification-and-Control-The-Back-Pocket-Guide

Comprehensive information on snail management is available in the publications:

GRDC Snail Management Fact Sheet;
www.grdc.com.au/GRDC-FS-SnailManagement

GRDC Snail Bait Application Fact Sheet
https://grdc.com.au/Resources/Factsheets/2015/01/Snail-Bait-Application

Snail Identification and Control: The Back Pocket Guide
www.grdc.com.au/BPG-SnailIdentificationAndControl

Bash 'Em, Burn 'Em, Bait 'Em: Integrated snail management in crops and pastures
www.grdc.com.au/GRDC-Snails-BashBurnBait

### 8.7.1 Types of pest snails

In Australia there are both native and introduced snail species. The four species of introduced snails are the pests of grain crops and pastures in the southern region. These can be divided into two distinct groups: round or white snails, and conical or pointed snails.

Species are found across southern Australia but not always in pest proportions. Numbers continue to rise and new areas are colonised.

Snails are proficient hitchhikers, moving between regions on transport. Farm machinery and produce such as hay should be inspected and cleaned of snails before transport.[41]

41 GRDC (2011) Snail Identification & Control: The Back Pocket Guide, https://grdc.com.au/Resources/Publications/2011/03/Snail-Identification-and-Control-The-Back-Pocket-Guide

### White (round) snails (*Cernuella virgata* and *Theba pisana*)

Two species of white (or round) snails exist: the vineyard or common white snail (*Cernuella virgata*) and the white Italian snail (*Theba pisana*).[42] They are found throughout the agricultural districts of South Australia, and the Victorian Mallee and Wimmera. They also occur in Western Australia, New South Wales and Tasmania.

Both species have similar shapes: white, coiled shells up to 20 mm diameter, which may have brown bands around the spiral.[43] The common white snail has an open umbilicus, whereas the umbilicus of the Italian snail is partly closed.[44] The umbilicus of a white snail is the hollow space on the underside of the shell.

**Photo 21:** *Vineyard or common white snail. Note the umbilicus (hollow space) is open.*

Photo: SARDI Southern/western field pea best management practices training course, module 7-2016

**Photo 22:** *White Italian snail. Note the umbilicus (hollow space) is partly closed.*

Photo: SARDI Southern/western field pea best management practices training course, module 7-2016

42 Pulse Australia (2016) Southern Faba & Broad Bean – Best Management Practices Training Course, module 7-2016

43 GRDC (2011) Snail Identification & Control: The Back Pocket Guide, www.grdc.com.au/BPG-SnailIdentificationAndControl

44 Pulse Australia (2016) Southern Faba & Broad Bean – Best Management Practices Training Course, module 7-2016

### Conical (pointed) snails (*Cochlicella acuta* and *C. barbara*)

Two species of conical snails exist: conical snails (*Cochlicella acuta*) and small conical snails (*C. barbara*).

Conical snails are also known as pointed snails (Photo 23). They have fawn, grey or brown shells. Mature conical snails have shells 12–18 mm long, whereas the shells of small conical snails are 8–10 mm long.

Highest numbers of conical snails (*C. acuta*) are found on the Yorke Peninsula in South Australia. Isolated populations are also present in other parts of SA, Victoria, NSW and WA.

The small conical snail, *C. barbara* (Photo 24), occurs throughout SA, but is most abundant in the higher-rainfall areas (>500 mm). It is also widely spread in Victoria, NSW and WA.[45]

**Photo 23:** *Conical snail, also known as pointed snail.*

Photo: SARDI Southern/western field pea best management practices training course, module 7-2016

**Photo 24:** *Small conical snail, also known as small pointed snail.*

Photo: SARDI Southern/western field pea best management practices training course, module 7-2016

45 Pulse Australia (2016) Southern Faba & Broad Bean – Best Management Practices Training Course, module 7-2016

### 8.7.2 Damage by snails

White snails mainly damage crops during establishment and harvest. Both common white and Italian snails may feed on young crops and destroy substantial areas, which then need re-sowing. In late spring, snails climb plants.

Conical snails contaminate grain at harvest, especially cereals and canola. They feed mostly on decaying plant material but can damage cereal and canola seedlings. The small conical snail feeds on growing plants and can contaminate grain. Lucerne is a favourite plant.

The contaminated grain may be downgraded or rejected and live snails in grain pose a threat to exports.[46] Grain will be rejected if more than half a dead or one live snail is found in a 0.5-litre wheat sample or 200-gram pulse sample (Grain Trade Australia). Check with your buyers for specific regulations.[47]

### 8.7.3 Life cycle of snails

Snails appear to build up most rapidly in canola, field pea and faba bean. However, they can feed and multiply in all crops and pastures.[48] White snails are dormant in summer. Young snails hatch about 2 weeks after eggs are laid. They feed and grow through the winter and spring and then climb fence posts or plants in late spring or summer where they go into summer dormancy. Snails live for 1–2 years, and move only short distances. They are spread in hay or grain, or by machinery or vehicles.

Conical snails have a similar life cycle to white snails. Conical snails may over-summer under stones, as well as on posts and plants.

Small conical snails over-summer on the ground in the leaf litter and under stones and stumps.[49]

### 8.7.4 Monitoring snails

Early baiting before eggs are laid is critical for snail control.[50]

Monitor snails regularly to establish their numbers, type(s) and activity, as well as success of controls.

Look for snails early in the morning or in the evening when conditions are cooler and snails are more active.

The key times to monitor snail populations are:

- summer to pre-sowing – check numbers in stubble before and after rolling, slashing or cabling;
- 3–4 weeks before harvest, to assess need for harvester modifications and cleaning; and
- after summer rains – check if snails are moving from resting sites.[51]

A wide range of snail sizes in an area indicates that snails are breeding there; if most snails are the same size, snails are moving in from other areas.[52] Size range of snails is important as juveniles don't take baits. [53]

46 Pulse Australia (2016) Southern Faba & Broad Bean – Best Management Practices Training Course, module 7-2016

47 GRDC (2012) Snail Management: All-year-round attack on snails required. Southern and Western Region Fact Sheet. Grains Research and Development Corporation, www.grdc.com.au/GRDC-FS-SnailManagement

48 GRDC (2012) Snail Management: All-year-round attack on snails required. Southern and Western Region Fact Sheet. Grains Research and Development Corporation, www.grdc.com.au/GRDC-FS-SnailManagement

49 Pulse Australia (2016) Southern Faba & Broad Bean – Best Management Practices Training Course, module 7-2016

50 Pulse Australia (2016) Southern Faba & Broad Bean – Best Management Practices Training Course, module 7-2016

51 NIPI & field pea IPM: Snails in seedling crops, http://ipmguidelinesforgrains.com.au/pests/slugs-and-snails/snails-in-seedling-crops/

52 GRDC (2012) Snail Management: All-year-round attack on snails required. Southern and Western Region Fact Sheet. Grains Research and Development Corporation, www.grdc.com.au/GRDC-FS-SnailManagement

53 Pulse Australia (2016). Southern/western field pea best management practices training course, module 7-2016, Draft. Pulse Australia Limited

Monitoring technique:

- Sample a 30 x 30 cm quadrat at 50 locations across the paddock.
- If two snail groups are present (round and conical), record the number of each group separately.
- To determine the age class of round snails, place into a 7 mm sieve box, shake gently and they will separate into two sizes: >7 mm (adults) and <7 mm (juveniles).
- Sieve boxes can be constructed from two stackable containers e.g. sandwich boxes. Remove the bottom from one and replace by a punch-hole screen. Suggested screen size is 7 mm, round or hexagonal.
- Five sampling transects should be taken in each paddock. One transect is taken at 90° to each fence line, while the fifth transect runs across the centre of the paddock.
- Take five samples, 10 metres apart along each transect.

Record the size and number of the snails in each sample. Average the counts for each transect and multiply this figure by 10 to calculate the number of snails per square metre in that area of the paddock.[54]

When looking for snails, check under weeds, and shake and thresh samples of mature crops onto a small tarp or sack, to see if snails are in the portion of crop that will enter the harvester.[55]

Record live snails before and 7 days after baiting or the paddock operation and calculate the reduction in numbers.[56]

If pulse crops have more than 5 snails/m$^2$, growers are likely to have grain contamination at harvest.[57]

## 8.7.5 Control

The keys to snail management and control are:

- Stubble management:
  - » cabling or rolling in summer;
  - » slashing in summer; and
  - » burning in autumn.
- Summer weed control.
- Baiting in autumn.
- Harvest and delivery:
  - » reducing snail intake during harvest (windrowing, brushes, bars);
  - » header settings; and
  - » cleaning after harvest.

Snail control starts in the summer before sowing. The best control is achieved by stubble management on hot days, or burning, followed by baiting, in autumn before egg-laying.

Rolling, harrowing or dragging a cable over stubble on hot days reduces snail numbers by knocking snails to the ground to die in the heat (air temperature >35°C). Some snails may also be crushed by rollers.

Burning in autumn can reduce snail numbers by up to 95%, provided there is sufficient stubble for a hot and even burn. Note that wind or water erosion become a risk on burnt stubble.

54 NIPI & field pea IPM: Snails in seedling crops, http://ipmguidelinesforgrains.com.au/pests/slugs-and-snails/snails-in-seedling-crops/

55 GRDC (2012) Snail Management: All-year-round attack on snails required. Southern and Western Region Fact Sheet. Grains Research and Development Corporation, www.grdc.com.au/GRDC-FS-SnailManagement

56 Pulse Australia (2016) Southern Faba & Broad Bean – Best Management Practices Training Course, module 7-2016

57 GRDC (2012) Snail Management: All-year-round attack on snails required. Southern and Western Region Fact Sheet. Grains Research and Development Corporation, www.grdc.com.au/GRDC-FS-SnailManagement

**VIDEO**

Burning Snails and Weed Seeds
https://youtu.be/zqQKFFqndKQ

**MORE INFORMATION**

For more information on managing snails at harvest see Section 11.5 Managing snails

While control measures for conical snails are the same as those used on white snails, they are generally less effective as conical snails can shelter in cracks in the ground or under stones. Dragging harrows or a cable before burning improves the control of conical snails by exposing more snails to burning.

It is important to understand the factors that determine baiting efficacy. Bait in autumn when snails have commenced activity following rain. Baiting may be necessary to reduce damage to young crops. Fence-line baiting can also be vital to prevent reinfestation of the paddock. Do not bait within 2 months of harvest.

Three bait types are available for snail control: methiocarb, metaldehyde and iron chelates. They are comparable in their effectiveness. Standard rate is 5 kg/ha of bait. If there are more than 80 white snails (>7 mm in diameter) per square metre then the rate should be 8–10 kg/ha. For conical snails, repeat applications of 5 kg/ha rate are more efficient than a single application of 10 kg/ha.

Windrowing can reduce white snail numbers harvested. Snails are knocked from the crops during windrowing, and most reclimb the stalks between the windrows rather than in the windrow.

Grain can be cleaned on-farm where snail contamination is so high that grain will be downgraded or rejected.

Biological controls are not yet available for white snails.[58] Native nematode species have shown promise against the four pest snail species but commercially trialled with limited success.[59]

## 8.8 Slugs

Slugs are a growing problem in the high-rainfall zones with zero-till and stubble-retention. No single control method will provide complete protection; an integrated approach is best.

Slug populations are regulated by moisture. Cool, wet summers and heavy stubble provide ideal conditions for slugs, as they need moisture and shelter to thrive.

The two main pest species are the grey field slug, or reticulated slug (*Deroceras reticulatum*) and the black keeled slug (*Milax gagates*).

Details of other species can be found in *Slugs in Crops: The Back Pocket Guide* (https://grdc.com.au/resources-and-publications/all-publications/publications/2011/03/slugs-in-crops-the-back-pocket-guide).

Slugs have caused major damage in emerging canola, pulse and wheat crops, especially in high-rainfall areas, but have also caused damage in lower-rainfall areas in wetter years. Damage is usually greater in cracking clay soils.

Slugs will attack all plant parts. Seedlings are the most vulnerable and can suffer major economic damage.

Slugs are hermaphrodites (individuals are both male and female). Each individual can lay about 100 eggs.

Moisture is essential for slug survival and some species may move down the soil to depths of 20 cm or more in dry periods and reappear when conditions improve.

Cultivation and rolling, and burning stubble after weeds are controlled will reduce slug populations. Rolling the soil after seeding can also reduce slug damage.

Bait after seeding if crop damage from slugs is expected. Buried bait is less effective than bait on the soil surface.

58 Pulse Australia (2016) Southern Faba & Broad Bean – Best Management Practices Training Course, module 7-2016

59 M Nash (2013) Slug control – new insight. GRDC Update paper, https://grdc.com.au/Research-and-Development/GRDC-Update-Papers/2013/07/Slug-control-new-insights

The most effective baits are metaldehyde and iron chelates. Metaldehyde damages the mucus-producing cells and is therefore less affected by cold and wet conditions. Rates of up to 10 kg/ha may be necessary.

Baiting will generally only kill 50% of the slug population at any one time.[60]

For more information:

Slug control: slug identification and management
https://grdc.com.au/GRDC-FS-SlugControl

Slugs in Crops: The Back Pocket Guide
https://grdc.com.au/GRDC-BPG-Slug

Slug control: new insights
https://grdc.com.au/Research-and-Development/GRDC-Update-Papers/2013/07/Slug-control-new-insights

New insights into slug and snail control
https://grdc.com.au/Research-and-Development/GRDC-Update-Papers/2016/02/New-insights-into-slug-and-snail-control

Field Peas: The Ute Guide Available as an Android™ app on Google play and for the iPhone and iPad on the App Store

Identification and control of pest slugs and snails for broadacre crops in Western Australia
https://agric.wa.gov.au/n/2671

## 8.9 Redlegged earth mite (*Halotydeus destructor*)

Redlegged earth mites (RLEM) are active from autumn to late spring and are found in southern Australia.

### 8.9.1 Identification of RLEM

Adults and nymphs of RLEM have a 'velvety' black body. Adult RLEM are 1 mm long with 8 red-orange legs. Newly hatched mites are only 0.2 mm long and pinkish-orange with only 6 legs.

**Photo 25:** *Adult redlegged earth mite (RLEM).*

Photo: GRDC The Ute Guide, Southern region. GRDC Ground Cover Direct, https://grdc.com.au/resources-and-publications/all-publications/publications/2009/04/field-peas-the-ute-guide

**MORE INFORMATION**

Redlegged Earth Mite Agnote
http://agriculture.vic.gov.au/agriculture/pests-diseases-and-weeds/pest-insects-and-mites/redlegged-earth-mite

Redlegged earth mite resistance management strategy – NSW, SA, Tasmania and Victoria
https://grdc.com.au/resources-and-publications/all-publications/factsheets/2016/08/redlegged-earth-mite-rms

*Crop Mites: The Back Pocket Guide*
www.grdc.com.au/BPG-CropMites

**VIDEO**

Watch GCTV9: Redlegged Earth Mites
https://youtu.be/tMnUVGOUXu8

60 Pulse Australia (2016) Southern Faba & Broad Bean – Best Management Practices Training Course, module 7-2016

**Photo 26:** *RLEM feeding causes leaves to first turn silvery, then brown and shrivelled, so that plants look scorched.*

Photo: GRDC The Ute Guide, Southern region. GRDC, https://grdc.com.au/resources-and-publications/all-publications/publications/2009/04/field-peas-the-ute-guide/

### 8.9.2 RLEM damage

The RLEM is called an earth mite because it spends 90% of its time on the soil surface, rather than on the foliage of plants. The mites feed on the foliage for short periods and then move around before settling at another feeding site. Other mites are attracted to volatile compounds released from the damaged leaves.

Typical RLEM damage appears as silvering or whitening of the attacked foliage. RLEM are most damaging to emerging crops, greatly reducing seedling survival and development.

In severe cases, entire crops may need re-sowing following RLEM attack. RLEM feed on a wide range of plant species.[61]

### 8.9.3 RLEM life cycle

RLEM are usually active between April and November. During this period, RLEM may pass through 2–3 generations, with each generation surviving 6–8 weeks. Long, wet springs favour the production of over-summering eggs.

Autumn rains trigger hatching in 3–9 days. False autumn breaks can cause large losses in mite numbers. Mites take 20–25 days from hatching to mature and start laying eggs.[62]

### 8.9.4 RLEM monitoring

Inspect field pea crops from autumn to spring for mites and their damage, particularly in the first few weeks after sowing.

Mites feed on the leaves in the morning or on overcast days. In the warmer part of the day RLEM tend to gather at the base of plants, sheltering in leaf sheaths and under debris. They crawl into cracks in the soil to avoid heat and cold. When disturbed during feeding they will drop to the ground and seek shelter.[63]

61 P Umina (2007) Redlegged earth mite. Agnote AG0414, January 2007, Agriculture Victoria, http://agriculture.vic.gov.au/agriculture/pests-diseases-and-weeds/pest-insects-and-mites/redlegged-earth-mite

62 Pulse Australia (2016) Southern Faba & Broad Bean – Best Management Practices Training Course, module 7-2016

63 Pulse Australia (2016) Southern Faba & Broad Bean – Best Management Practices Training Course, module 7-2016

FEEDBACK

MORE INFORMATION

GRDC Fact Sheet Resistance management strategy for the redlegged earth mite https://grdc.com.au/FS-RLEM-Resistance-strategy-South

### 8.9.5 RLEM control and insecticide-resistance management

Control strategies that only target RLEM may not entirely remove pest pressure. Other pests can fill the gap, and this is particularly evident after chemical applications which are generally more effective against RLEM than other mite pests.

Non-chemical options are becoming increasingly important due to evidence of resistance in RLEM populations and concern about long-term sustainability. If using a chemical spray, choose one that has least environmental impact and aim to reduce the number of chemical applications. Pesticide groups exist with low to moderate impacts on many natural enemies, such as cyclodienes.[64]

Insecticide resistance in RLEM is presently confined to Western Australia. High levels of resistance to pyrethroids exist within WA populations. Resistance to organophosphates has also evolved. A strategy to manage insecticide resistance in RLEM populations is available for use by grain growers and their advisers.[65]

### 8.9.6 Chemical control of RLEM

While insecticides are registered for control of active RLEM, none currently registered are effective against RLEM eggs.[66] Commonly used insecticides registered for use on RLEM are shown in Table 4 with details in Table 5.

Four chemical sub-groups are registered to control RLEM in grain crops: organophosphates (Group 1B); synthetic pyrethroids (Group 3A); phenylpyrazoles (Group 2B); and neonicotinoids (Group 4A). The latter two are registered only for use as seed treatments.[67]

If spraying in autumn, control the first generation of mites before they lay eggs. Pesticides used at or after sowing should be applied within 3 weeks of the first appearance of mites, before adults begin to lay eggs. Rotate products with different modes of action, to reduce the risk of insecticide resistance.

Autumn insecticide application includes:

- pesticides with persistent residual activity used as bare earth treatments to protect seedlings;
- foliage sprays applied after crop emergence, which are generally an effective control; and
- systemic pesticides applied as seed dressings, which act by maintaining the pesticide at toxic levels within the seedling. Note: if mite numbers are high, plants may suffer significant damage before the pesticide has much effect.

MORE INFORMATION

TIMERITE® information package https://www.wool.com/globalassets/start/woolgrower-tools/timerite/timeriteinformationpackage.pdf

A correctly timed spray in spring can reduce populations of RLEM the following autumn. Use climatic variables and tools such as TIMERITE® (http://ipmguidelinesforgrains.com.au/pests/earth-mites/earth-mites-autumn-sown-crops-and-pasture/timerite/) to determine the optimum date for spraying. While TIMERITE® has less relevance in pulse cropping, it has an important role in pastures and RLEM population management.[68] Research in southern Australia has shown the use of a TIMERITE® spring spray is effective in reducing RLEM populations by 93%.[69]

Users need to be mindful of its limitations and the issues around repeated insecticide applications according to this approach.

Spring RLEM sprays will generally not be effective against other pest mites.[70]

64 Pulse Australia (2016) Southern/western field pea best management practices training course, module 7-2016, Draft. Pulse Australia Limited

65 GRDC (2016) Resistance Management Strategy for the Redlegged earth mite in Australian Grains and Pastures, Southern Region, https://grdc.com.au/FS-RLEM-Resistance-strategy-South

66 Pulse Australia (2016) Southern Faba & Broad Bean – Best Management Practices Training Course, module 7-2016

67 GRDC (2016) Resistance Management Strategy for the Redlegged earth mite in Australian Grains and Pastures, Southern Region, https://grdc.com.au/FS-RLEM-Resistance-strategy-South

68 Pulse Australia (2016) Southern Faba & Broad Bean – Best Management Practices Training Course, module 7-2016

69 TJ Ridsdill-Smith, C Pavri (2015) Controlling redlegged earth mite, Halotydeus destructor (Acari: Penthaleidae), with a spring spray in legume pastures. Crop and Pasture Sci., 66: 938–946

70 Pulse Australia (2016) Southern/western field pea best management practices training course, module 7-2016, Draft. Pulse Australia Limited

### 8.9.7 Biological control of RLEM

At least 19 predators and one pathogen are known to attack earth mites in eastern Australia, particularly other mites, although small beetles, spiders and ants also play a role. Benefits of a predatory mite (*Anystis wallacei*) that has been released are yet to be demonstrated.

Natural enemies of RLEM residing in windbreaks and roadside vegetation need to be protected also, so avoid pesticides with residual activity applied as border sprays to prevent mites moving into a crop or pasture.

MORE INFORMATION

Blue oat mite Pest Notes Southern
http://www.pir.sa.gov.au/__data/assets/pdf_file/0004/274090/Blue_oat_mite.pdf

Blue Oat Mite Agnote
http://agriculture.vic.gov.au/agriculture/pests-diseases-and-weeds/pest-insects-and-mites/blue-oat-mite

*Crop Mites: The Back Pocket Guide*
www.grdc.com.au/BPG-CropMites

Insect ID: The Ute Guide app
https://grdc.com.au/resources-and-publications/apps/insect-id-the-ute-guide

### 8.9.8 Cultural control of RLEM

Cultural control measures include:

- rotating crops or pastures with non-host crops, such as cereals;
- cultivating, which can also help reduce RLEM populations;
- clean fallowing and controlling weeds around crop and pasture perimeters; and
- controlling weeds, especially thistles and capeweed, to remove breeding sites for RLEM.[71]

## 8.10 Blue oat mite (*Penthaleus* spp.)

### 8.10.1 Identification of blue oat mites (BOM)

Adult blue oat mites (BOM) are 1 mm long and have 8 red-orange legs. They can be identified by their dark blue-black bodies with a distinct oval red/orange spot on the back (Photo 27), which distinguishes them from the redlegged earth mite. They generally feed singularly and are active from autumn to late spring. BOM are distributed widely across southern Australia.

**Photo 27:** *Adult blue oat mites have a dark blue-black body with distinct oval red/orange spot on the back.*

Photo: CESAR, Field Peas: The Ute Guide, Southern region. GRDC Ground Cover Direct, https://grdc.com.au/resources-and-publications/all-publications/publications/2009/04/field-peas-the-ute-guide

There are three species of BOM in Australia, which complicates identification and control. These are *Penthaleus major*, *P. falcatus* and *P. tectus*. Two of these species (*P. major* and *P. falcatus*) have been found on field pea and cause feeding damage.[72] The BOM species differ in their distribution, pesticide tolerance and crop plant preferences. BOM are often misidentified and treated as RLEM, which means the damage caused by BOM has been under-represented.[73] Spring spraying using TIMERITE® against BOM is not recommended as it is largely ineffective.[74]

71 Pulse Australia (2016) Southern Faba & Broad Bean – Best Management Practices Training Course, module 7-2016

72 GRDC (2009) Field Peas: The Ute Guide, Southern region. GRDC, https://grdc.com.au/resources-and-publications/all-publications/publications/2009/04/field-peas-the-ute-guide

73 P Umina (2007) Blue Oat Mite. Agnote AG1300, July 20017, Agriculture Victoria, http://agriculture.vic.gov.au/agriculture/pests-diseases-and-weeds/pest-insects-and-mites/blue-oat-mite

74 P Umina, S Hangartner (2015) Blue oat mite, Pest Notes Southern. cesar and the South Australian Research and Development Institute, http://www.pir.sa.gov.au/__data/assets/pdf_file/0004/274090/Blue_oat_mite.pdf

### 8.10.2 Blue oat mite damage

Feeding causes a silver or white discolouration of leaves and distortion or shrivelling if severe (Photo 28). Mites are most damaging to emerging crops, greatly reducing seedling survival and development.

**Photo 28:** *Blue oat mite feeding damage.*

Photo: PIRSA, Blue oat mite, PestNotes, southern, http://www.pir.sa.gov.au/__data/assets/pdf_file/0004/274090/Blue_oat_mite.pdf

### 8.10.3 Blue oat mite life cycle

BOM are active during cooler, wetter parts of the year (April to late October), and over-summer as eggs. Autumn rains trigger hatching in 3–9 days. False breaks in the season can cause large losses in mite numbers. Mites take 20–25 days from hatching to mature and start laying eggs.[75]

### 8.10.4 Blue oat mite monitoring

Check paddocks prior to sowing in autumn and throughout winter. It is important to monitor germinating pulse crops.

Examine plants for damage and search for mites on leaves and the ground, especially in late-sown crops.[76]

BOM spend most of their time on the soil surface, rather than on the foliage. They are most active during the cooler parts of the day, feeding in the mornings and in cloudy weather. They seek protection during the warmer part of the day on moist soil surfaces or under foliage, and may even dig into the soil under extreme conditions.[77]

### 8.10.5 Chemical control

Each species of BOM differs in its distribution, pesticide tolerance and crop plant preferences.

BOM is often misidentified as RLEM[78] and some BOM species are more tolerant than RLEM to a range of synthetic pyrethroid and organophosphate insecticides.[79]

All current pesticides are only effective against the active stages of mites, and do not kill mite eggs.

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

75 Pulse Australia (2016) Southern Faba & Broad Bean – Best Management Practices Training Course, module 7-2016

76 GRDC (2009) Field Peas: The Ute Guide, Southern region. GRDC https://grdc.com.au/resources-and-publications/all-publications/publications/2009/04/field-peas-the-ute-guide

77 Pulse Australia (2016) Southern Faba & Broad Bean – Best Management Practices Training Course, module 7-2016

78 P Umina (2007) Blue Oat Mite. Agnote AG1300, July 20017, Agriculture Victoria, http://agriculture.vic.gov.au/agriculture/pests-diseases-and-weeds/pest-insects-and-mites/blue-oat-mite

79 GRDC (2009) Field Peas: The Ute Guide, Southern region. GRDC https://grdc.com.au/resources-and-publications/all-publications/publications/2009/04/field-peas-the-ute-guide

Control first generation mites before they can lay eggs to avoid a second spray. Pesticides used at or after sowing should be applied within 3 weeks of first appearance of mites, as adults will then begin laying eggs.

Spraying in spring using the TIMERITE® program is not a recommended strategy with BOM.

Pesticides with persistent residual effects can be used as bare-earth treatments. If applied by sowing, these treatments can protect the plants throughout their seedling stage.

Systemic pesticides applied as seed dressings maintain the pesticide at toxic levels within the seedlings as they grow. This can help minimise damage to plants during the sensitive establishment phase, however, if mite numbers are high, significant damage may still occur before the pesticide has much effect.

Commonly used insecticides registered for use on BOM are shown in Table 4 with details in Table 5.

### 8.10.6 Biological and cultural control

A number of predator species are known to attack earth mites in Australia. The most important predators of BOM appear to be other mites, although small beetles, spiders and ants may also play a role. The French anystis mite is an effective predator but is limited in distribution. Snout mites will also prey upon BOM, particularly in pastures. The fungal pathogen *Neozygites acaracida* is prevalent in BOM populations during wet winters and could be responsible for observed 'population crashes'.

Preserving natural enemies when using chemicals is often difficult because the pesticides generally used are broad spectrum and kill beneficial species as well as the pests.[80]

Cultural controls such as rotating crops or pastures with non-host crops can reduce pest colonisation, reproduction and survival, decreasing the need for chemical control. Non-preferred crops are:

- *P. major* – canola;
- *P. tectus* – chickpea; and
- *P. falcatus* – wheat, barley.

Pre- and post-sowing weed management (particularly broadleaf weeds) is important.[81]

80 P Umina (2007) Blue Oat Mite. Agnote AG1300, July 20017, Agriculture Victoria, http://agriculture.vic.gov.au/agriculture/pests-diseases-and-weeds/pest-insects-and-mites/blue-oat-mite

81 P Umina, S Hangartner (2015) Blue oat mite, Pest Notes southern. CESAR and the South Australian Research and Development Institute, http://www.pir.sa.gov.au/__data/assets/pdf_file/0004/274090/Blue_oat_mite.pdf

MORE INFORMATION

Lucerne flea, Pest Notes southern: http://www.cesaraustralia.com/sustainable-agriculture/pestnotes/insect/Lucerne-flea

## 8.11 Lucerne flea (*Sminthurus viridis*)

### 8.11.1 Lucerne flea identification

Lucerne flea is an introduced pest commonly found in Victoria, South Australia, Tasmania, New South Wales and Western Australia. The insect is 3 mm in length, green-yellow globular shaped and wingless (Photo 29). It is commonly found on loam and clay soils in broadleaf crops and pastures. Lucerne fleas have a furcula underneath their abdomen that acts like a spring and enables them to 'spring off' vegetation when disturbed.[82]

**Photo 29:** *Lucerne flea with eggs. Adults are green-yellow and may have dark markings.*

Photo: Grain Legume Handbook (2008), chapter 7

### 8.11.2 Lucerne flea damage

Lucerne flea works up plants from ground level leaving distinctive transparent 'window' damage on the leaves (Photo 30). A severe infestation may remove all green material. They are present from autumn to spring with numbers tending to peak in late spring.

Crops are most susceptible to damage immediately following seedling emergence, however, they can also damage older crops.[83]

**Photo 30:** *Leaf damage caused by lucerne flea feeding, resulting in a distinctive transparent 'window' appearance.*

Photo: Grain Legume Handbook (2008), chapter 7.

82 P Umina, S Hangartner, G McDonald (2015) Lucerne flea, Pest Notes southern. CESAR and South Australian Research and Development Institute, http://www.cesaraustralia.com/sustainable-agriculture/pestnotes/insect/Lucerne-flea

83 GRDC (2009) Field Peas: The Ute Guide, Southern region. GRDC https://grdc.com.au/resources-and-publications/all-publications/publications/2009/04/field-peas-the-ute-guide

### 8.11.3 Lucerne flea life cycle

Female lucerne fleas lay their eggs in the ground in batches of 20–60.

Depending on temperature and moisture availability, lucerne fleas can have up to six generations per year between autumn and spring. The length of each generation can be from 3–5 weeks. The first generation often hatches from over-summering eggs in March–April after soaking autumn rainfall. In mid to late spring lucerne fleas die off from the onset of warmer weather, leaving over-summering eggs on the soil surface.

The rate of growth of lucerne flea populations is very moisture-dependent; they do well in moist conditions or under dense canopies of pasture.[84]

### 8.11.4 Monitoring

Pulse crops should be inspected for damage from autumn to spring, and frequently at and immediately following emergence, when they are most susceptible to damage.

Lucerne fleas are often concentrated in localised patches or 'hot spots' so it is important to have a good spread of monitoring sites within each paddock. Examine foliage for characteristic lucerne flea damage and check the soil surface, where insects may be sheltering.

Monitoring lucerne flea populations for growth stage as well as numbers can also be important for accurate timing of some sprays.

### 8.11.5 Chemical control of lucerne flea

Insecticides provide the most effective means of control.

In southern Australia, the standard recommendation is to spray 4 weeks after the first significant autumn rain of the season.

Spring spraying can reduce the number of insects in the following autumn by preventing the laying over-summering eggs. A planned program of timely spring and autumn sprays with effective chemicals over 2–3 years can reduce populations to very low levels.

There are no formal spray thresholds for lucerne flea damage in crops. However, the key is early control because of the impact of seedling vigour on crop performance. Damage levels can be used to determine whether or not spraying is necessary.[85]

It is important to assess the complex of pests present before deciding on the most appropriate control strategy. When both lucerne flea and redlegged earth mite are present, control strategies should consider both pests.

Avoid 'insurance sprays', which select for insecticide resistance, and rotate insecticide groups to avoid resistance developing.

Spray immature lucerne fleas before they have a chance to reproduce. Organophosphates (OPs) are recommended for lucerne flea and *Bryobia* mite control.

Most synthetic pyrethroids are not effective on lucerne flea as well as *Bryobia* or *Balaustium* mites.

Several chemicals registered for redlegged earth mite are not effective against lucerne flea: synthetic pyrethroids such as alpha-cypermethrin and imidacloprid seed dressings.

If spraying, use an organophosphate insecticide, for example, omethoate. A border spray may be sufficient to stop invasion from neighbouring pastures or crops. Spot spraying, rather than blanket spraying, may be all that is required.

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84 P Umina, S Hangartner, G McDonald (2015) Lucerne flea, Pest Notes southern. CESAR and South Australian Research and Development Institute, http://www.cesaraustralia.com/sustainable-agriculture/pestnotes/insect/Lucerne-flea

85 G Jennings (2002) Knowledge, timing, key to lucerne flea control. Grains Research Advice, November 2002, Grains Research and Development Corporation

If warranted, treat the infested area approximately 3 weeks after lucerne flea has been observed on a newly emerged crop. This will allow for the further hatch of over-summering eggs but will be before lucerne flea reaches maturity and begins to lay winter eggs.[86]

### 8.11.6 Biological and cultural control of lucerne flea

Several predatory mites, for example, snout mites, various ground beetles and spiders prey on lucerne flea.

Clean fallows and control of weeds within crops and around pasture perimeters, especially capeweed, helps reduce lucerne flea numbers.

Cultivation using trap, border crops and mixed cropping can help reduce the overall infestation levels, particularly when used in conjunction with other measures. Grasses and cereals are less favourable to lucerne flea and as such can be useful for crop borders.[87]

**MORE INFORMATION**

Plague Locust Control – Fact Sheet: https://grdc.com.au/resources-and-publications/all-publications/factsheets/2010/08/plague-locust-control-factsheet

Australian plague locust Pest Notes southern: http://www.cesaraustralia.com/sustainable-agriculture/pestnotes/insect/australian-plague-locust

## 8.12 Australian plague locust

Locusts and grasshoppers will cause damage to field pea in the same way that they will cause damage to any green vegetation when in plague numbers. Native to Australia, most locust plagues occur primarily in inland breeding areas, including parts of Queensland, New South Wales, South Australia and Western Australia. Outbreaks occur in some seasons when favourable conditions in inland breeding areas result in extensive population build-up over sequential generations. Up-to-date advice can be obtained from the Australian Plague Locust Commission, and SA, Victorian or NSW state departments of primary industries.[88]

### 8.12.1 Australian plague locust identification

Adults of the Australian plague locust have a characteristic black spot on the tip of the hind wing. Nymphs or hoppers are more difficult to identify. If swarming in a large band, then it is likely to be the Australian plague locust.

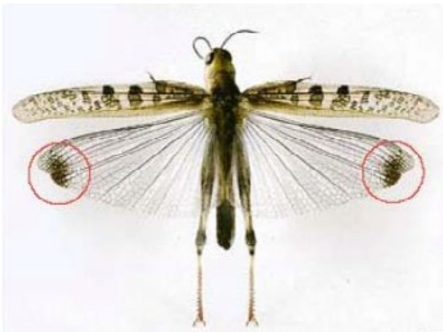

**Photo 31:** *Australian plague locust. Note the black spot on the tip of the hind wing.*

Photo: APLC via PIRSA, Pulse Australia (2016) Southern/western field pea best management practices training course, module 7-2016. Pulse Australia Limited, Page 41, Image 7.38

86 Pulse Australia (2016) Southern Faba & Broad Bean – Best Management Practices Training Course, module 7-2016

87 Pulse Australia (2016) Southern Faba & Broad Bean – Best Management Practices Training Course, module 7-2016

88 P Umina (2015) Australian plague locust, PestNotes southern. CESAR and South Australian Research and Development Institute, http://www.cesaraustralia.com/sustainable-agriculture/pestnotes/insect/australian-plague-locust

### 8.12.2 Australian plague locust damage

Pulses are susceptible to attack while they remain green; the susceptibility of drying pulse crops is unknown. Early harvesting of pulse crops should be considered in high-risk situations.[89] Rejection at grain delivery can occur if adult locust or parts of them are present in the sample, or objectionable stains and odours exist.

### 8.12.3 Australian plague locust life cycle

Most locust plagues originate in south-west Queensland and adjacent areas of SA, NSW and the Northern Territory. Populations develop following rainfall in this area.

With suitable conditions, autumn swarms may migrate 200–500 km into pastoral and adjacent agricultural areas. On arrival, they lay millions of eggs in bare ground, which can produce the spring outbreak.

### 8.12.4 Control

The Australian Plague Locust Commission (APLC) undertakes surveillance threat assessments, forecasting and control measures when locust populations in outbreak areas have the potential to cross into agricultural locations.

In the event of a plague, local government may undertake some spraying operations within their own area. Where significant problems are expected, government agencies may undertake large-scale control in pastoral and adjacent agricultural areas.

Effective locust suppression can only be achieved by landowners, and local government and government agencies working cooperatively, together with ongoing APLC activities.

Cultivating egg beds will destroy the eggs. Use approved insecticides to target the bands of nymphs before they take flight. Advice on timings and chemicals can be obtained from state government departments or local chemical resellers. Often Australian Veterinary Medicines Authority (APVMA) Permits are required for chemical use.[90]

89 GRDC (2010) Plague locust control: a coordinated approach to control plague locusts. Fact Sheet, September 2010, Grains Research and Development Corporation and Australian Plague Locust Commission, https://grdc.com.au/Resources/Factsheets/2010/08/Plague-Locust-Control-Factsheet

90 Pulse Australia (2016) Southern Faba & Broad Bean – Best Management Practices Training Course, module 7-2016

## 8.13 Etiella or lucerne seed web moth (*Etiella behrii*)

The lucerne seed web moth, also referred to as *Etiella* is widespread throughout Australia. Although they only occur sporadically, when present they are potentially a very serious pest of crops (field pea, lentil, lupin, soybean) in South Australia, Victoria, Western Australia, New South Wales and Queensland (peanuts).

### 8.13.1 Lucerne seed web moth identification

Adult moths are 10–15 mm long, greyish-brown in colour and when at rest they are long and slender in appearance. They have a tan-coloured band that runs across the forewings and a white strip that runs their full length along the outer edge of the forewings (Photo 32).

**Photo 32:** *Adult lucerne seed web moth.*

Photo: SARDI, The Ute Guide, Southern region. GRDC https://grdc.com.au/resources-and-publications/all-publications/publications/2009/04/field-peas-the-ute-guide

### 8.13.2 Lucerne seed web moth lifecycle

Lucerne seed web moth or *Etiella* can have up to three generations per year occurring from spring to autumn. Larvae from the previous autumn overwinter in the soil and adults emerge from September. Adult females are capable of laying approximately 200 eggs. These are laid on the surface of leaves, stems and flowers, and hatch in between 1–14 days depending on temperature. Shortly after larvae hatch they bore into seed pods, where they feed as they grow (Photo 33). First moth flights usually take place during September.

**Photo 33:** *Etiella larva in a pea pod with damaged peas.*

Photo: SARDI, http://www.cesaraustralia.com/sustainable-agriculture/pestnotes/insect/Lucerne-seed-web-moth-or-Etiella

### 8.13.3 Monitoring

Start to monitor crops in spring during early pod development. This will coincide with the first moth flights, which usually take place during September. There are various monitoring tools:

- Use the degree-day model produced by SARDI to help identify the predicted onset of moth flights and when critical crop monitoring will be required. (The model requires that you add local maximum and minimum temperatures, beyond 21 June, to the spreadsheet.)
- Use pheromone traps to monitor moth flights in paddocks by placing a minimum of 2 traps 25 cm above the crop. Light traps are another means of monitoring moth numbers.
- A sweep net can be used to monitor larval activity, and seed pods should be checked visually for the presence of grubs. A minimum of three groups of 20 sweeps taken randomly across the paddock will be required to accurately check for pest activity.

**MORE INFORMATION**

Lucerne seed web moth or Etiella, http://www.cesaraustralia.com/sustainable-agriculture/pestnotes/insect/Lucerne-seed-web-moth-or-Etiella

### 8.13.4 Biological and cultural control of lucerne seed web moth

There are several parasitic wasps and flies that attack the larvae of lucerne seed web moths. Predatory bugs such as the glossy shield bug and spined predatory shield bug also prey upon larvae.

Time of sowing and variety selection (early-maturing varieties) can result in crops flowering and setting pods prior to peak activity of the moths.[91]

### 8.13.5 Chemical control of lucerne seed web moth

Chemical control of *Etiella* is only effective on adult moths. Once larvae are in pods they cannot be controlled by insecticides.

Successful control relies on thorough crop monitoring in order to time insecticide applications to target adult moths prior to egg lay.

Continue to monitor for 1 week after chemical applications.[92]

## 8.14 Occasional pests of field pea

The pests listed below are seldom seen in field pea crops, but have been known to occur over the years and under ideal conditions may occasionally represent an economic threat. See more specific publications for full details.

**MORE INFORMATION**

For more details on identification, see: Insects the Ute Guide. https://grdc.com.au/Resources/Ute-Guides/Insects/Moths-butterflies-caterpillars/West/Cutworms-Bogong-Moth-Black-Cutworm-Pink-Cutworm-And-Herringbone-Cutworm

### 8.14.1 Cutworms: common cutworm or Bogong moth, black cutworm, brown or pink cutworm, and herringbone cutworm (*Agrotis infusa*, *Agrotis ipsilon*, *Agrotis munda* and other *Agrotis* species)

#### Cutworm identification and life cycle

Cutworm larvae are hairless with dark heads and, usually, dark bodies. They live in the soil and grow to 50 mm long. They curl up and remain still if disturbed.

Female moths lay eggs in soil in lightly vegetated or bare areas. Larvae have six growth stages (instars).

91 P Umina, B Kimber (2015) Lucerne seed web moth or Etiella, Pest Notes southern. CESAR and South Australian Research and Development Institute, http://www.cesaraustralia.com/sustainable-agriculture/pestnotes/insect/Lucerne-seed-web-moth-or-Etiella

92 Department of Agriculture & Fisheries (2016) IPM guidelines for grains, Etiella. http://ipmguidelinesforgrains.com.au/pests/etiella/

### Cutworm monitoring, damage and control

Cutworm is a sporadic emergence pest. It attacks all crops and pastures including field pea.

Large larvae (20–40 mm long) ringbark or cut off seedlings at ground level; the final 6th stage larvae eat 86% of food.[93]

Check crops from emergence to establishment. Damage is often patchy. Larvae are usually just beneath the surface; check the base of healthy or recently damaged plants adjoining damaged, bare or thin areas.

Control by selective spraying. Treat affected patches with a standard insecticide (synthetic pyrethroid). Commonly used insecticides registered for use on cutworm are shown in Table 4 with details in Table 5.

Biological controls include a number of parasites, disease, spiders.[94]

MORE INFORMATION

For more details on identification, see: Insects the Ute Guide: https://grdc.com.au/Resources/Ute-Guides/Insects/Mites/South/Balaustium-Mite

*Crop mites: the back pocket guide* www.grdc.com.au/BPG-CropMites

## 8.14.2 Balaustium mite (*Balaustium medicagoense*)

### Balaustium mite identification and life cycle

Correct identification is critical for control. *Balaustium* mite adults grow to 2 mm long and may be variable in colour but are mainly dark red to brown. They are slow moving and have characteristic short hairs covering the body. They also have a 'pad'-like structure on the forelegs. Newly hatched nymphs have 6 bright orange legs, while adults have 8 red legs.

*Balaustium* mite activity is from March to November in a Mediterranean climate. The mite requires autumn rainfall for over-summered eggs to hatch.

### Balaustium mite monitoring, damage and control

Check crops throughout the growing season, particularly in paddocks with a history of chemical treatments for redlegged earth mite.

Most synthetic pyrethroids are not effective on *Balaustium*, or *Bryobia* mites and lucerne flea.

*Balaustium* mite is also more tolerant of organophosphate insecticides than RLEM.[95 96]

MORE INFORMATION

For more details on identification, see: Insects the Ute Guide: https://grdc.com.au/Resources/Ute-Guides/Insects/Mites/South/Clover-Mite

## 8.14.3 Clover mite or Bryobia mite (*Bryobia* spp.)

### Bryobia mite identification and life cycle

Adults are 0.75–1 mm long with pale orange legs and a dark grey-brown to fawn-orange coloured body, which is oval and flattened. Their front legs are 1.5 times their body length. *Bryobia* mite leave distinct feeding trails.

*Bryobia* mite is highly active during warm conditions in autumn, spring and early summer. They are found in low numbers in winter when they are unlikely to cause problems. Summer rains followed by a warm autumn increases their survival.

### Bryobia mite monitoring, damage and control

Control summer weeds early in paddocks to be cropped. Before sowing, look for damage and their presence on clover and *Brassica* weeds.

Monitor during crop establishment. Mites are difficult to find in wet conditions; check during the warmer part of the day.

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93 Pulse Australia (2016) Southern Faba & Broad Bean – Best Management Practices Training Course, module 7-2016

94 GRDC (2009) Field Peas: The Ute Guide, Southern region. GRDC https://grdc.com.au/resources-and-publications/all-publications/publications/2009/04/field-peas-the-ute-guide

95 Pulse Australia (2016). Southern/western field pea best management practices training course, module 7-2016, Draft. Pulse Australia Limited

96 GRDC (2009) Field Peas: The Ute Guide, Southern region. GRDC https://grdc.com.au/resources-and-publications/all-publications/publications/2009/04/field-peas-the-ute-guide

Spray only when necessary – avoid insurance sprays and rotate insecticide groups to reduce the risk of insecticide resistance. Faba bean is not a good break crop against *Bryobia* mite.

Most synthetic pyrethroids are not effective on *Bryobia* mites, lucerne flea or *Balaustium* mites. Organophosphates are recommended for *Bryobia* mites and lucerne flea. Insecticide rates commonly used for redlegged earth mite are generally ineffective against *Bryobia* mite.[97 98]

### 8.14.4 Earwigs – European earwig and native earwig (*Forficulina auricularia* and *Labidura truncata* plus other species)

For more details on identification, see: Insect ID: The Ute Guide https://grdc.com.au/Resources/Ute-Guides/Insects/Earwigs/South/European-Earwig-and-Native-Earwig

For information on management, see: GRDC Fact Sheet European earwigs, www.grdc.com.au/GRDC-FS-Earwigs

**MORE INFORMATION**

For more details on identification, see: *Crop weevils: the back pocket guide* www.grdc.com.au/GRDC-BPG-CropWeevils

### 8.14.5 Mandalotus weevil (*Mandalotus* spp.)

For more details on identification, see: Insect ID: The Ute Guide: https://grdc.com.au/Resources/Ute-Guides/Insects/Beetles-larvae/South/Mandalotus-Weevil

### 8.14.6 Onion thrips, plague thrips and western flower thrips (*Thrips tabaci*, *Thrips imaginis* and *Frankliniella occidenttalis*)

For more details on identification, see: Insect ID: The Ute Guide: https://grdc.com.au/Resources/Ute-Guides/Insects/Thrips/South/Onion-Thrips-Plague-Thrips-and-Western-Flower-Thrips

### 8.14.7 Brown pasture looper (*Ciampa arietaria*)

For more details on identification, see: Insect ID: The Ute Guide: https://grdc.com.au/Resources/Ute-Guides/Insects/Moths-butterflies-caterpillars/South/Brown-Pasture-Looper

### 8.14.8 Looper caterpillar (*Chrysodiexis* spp.)

For more details on identification, see: Insect ID: The Ute Guide: https://grdc.com.au/Resources/Ute-Guides/Insects/Moths-butterflies-caterpillars/South/Looper-Caterpillar

### 8.14.9 Bronze field beetle (*Adelium brevicorne*)

For more details on identification, see: Insects the Ute Guide: https://grdc.com.au/Resources/Ute-Guides/Insects/Beetles-larvae/South/Bronzed-Field-Beetle

### 8.14.10 False wireworm (*Gonocephalum misellum*)

For more details on identification, see: Insect ID: The Ute Guide: https://grdc.com.au/Resources/Ute-Guides/Insects/Beetles-larvae/South/False-Wireworms

97 Pulse Australia (2016) Southern Faba & Broad Bean – Best Management Practices Training Course, module 7-2016

98 GRDC (2009) Field Peas: The Ute Guide, Southern region. GRDC https://grdc.com.au/resources-and-publications/all-publications/publications/2009/04/field-peas-the-ute-guide

### 8.14.11 Onion seedling maggot (*Delia platura*)

For more details on identification, see: Insect ID: The Ute Guide: https://grdc.com.au/Resources/Ute-Guides/Insects/Flies/South/Onion-Maggot

## 8.15 Exotic field pea insects

### 8.15.1 Exotic seed beetles/bruchids

(*Coleoptera*: Family: *Chrysomelidae*, sub-family: *Bruchinae*)

Seed beetles, also known as bruchids, are a group of relatively small beetles that attack ripe or ripening seeds, especially legumes. There are over 200 species of bruchids world-wide from several genera that are important primary pests with significant economic impact on pulses.

Several pest bruchid species occur in Australia, such as the pea weevil (*Bruchus pisorum*) that attacks field pea, and cowpea weevils (*Callosobruchus* spp.) that attack a range of pulses.

For more information see Section 8.5 Pea weevil (*Bruchus pisorum*)

Infestation commonly starts in the field, where eggs are laid on maturing pods before harvest and carry over into storage, where substantial losses can occur (species dependent). Surveillance should include field monitoring for adults and pod infestations, as well as seed sampling of stored product.

The presence of damaged seed (round holes) in stored grain is an indication of bruchids. The general form of bruchids and their association with pulses make it unlikely to be confused with other beetle pests associated with stored product. It is suggested that any bruchids found in the field or in storage should be sent in for further identification. Call the Exotic Pest Hotline (1800 084 881).

### 8.15.2 Exotic leafminers (*Diptera*: family *Agromyzidae*)

The Agromyzidae are a group of small flies whose larvae feed internally on living plant tissue, often as leaf and stem-miners. Key exotic Agromyzid species for field pea include the American serpentine leafminer (*Liriomyza trifolii*) and pea leafminers (*Chromatomyia horticola*, *Liriomyza huidobrensis*).

Leaf-mining (tunnelling) is the most obvious symptom that can be seen and surveyed for in the field. Leaf-mining damage caused by exotic Agromyzidae species can be confused with native leafminer species and moth larvae. Any suspect mining should be sent in for identification. Call the Exotic Plant Pest Hotline (1800 084 881).

Control of *Liriomyza* is difficult. Economic impacts could be highly significant in most crops and across most cropping regions if eradication is not achieved.[99]

**MORE INFORMATION**

Exotic leafminers fact sheet: http://www.planthealthaustralia.com.au/wp-content/uploads/2014/02/Exotic-leaf-miners-FS-Grains.pdf

99 Pulse Australia (2016) Southern Faba & Broad Bean – Best Management Practices Training Course, module 7-2016

## 8.16 Beneficial species

All pest populations are regulated to some degree by the direct effects of other living organisms. Beneficial organisms include a range of wasps, flies, bugs, mites, lacewings, beetles and spiders that can reduce insect pest populations through predation and parasitisation. Viruses and fungal diseases also provide control.

A wide range of beneficial organisms can be grouped into three categories:

- **Parasites** – organisms that feed on or in the body of another host. Most eventually kill their host and are free-living as an adult (parasitoids), e.g. aphid wasp parasites.
- **Predators** – mainly free-living insects that consume a large number of prey during their lifetime, e.g. shield bugs, lacewings, hoverflies, spiders, predatory mites and predatory beetles.
- **Insect diseases** – including bacterial, fungal and viral infections of insects.

Inappropriate use of an insecticide that reduces the number of beneficial species can result in a more rapid build-up of insect populations and reliance on further use of insecticide.

Integrated pest management (IPM) in its simplest form is a management strategy in which a variety of biological, chemical and cultural control practices are combined to provide stable, long-term pest control.[100] See Section 8.1 Integrated pest management (IPM)

**Photo 34:** *A pea aphid being consumed by the seven-spotted lady beetle (Coccinella septempunctata).*

Photo: Brad Stokes, University of Idaho, Pulse Australia (2016) Southern Faba & Broad Bean – Best Management Practices Training Course, module 7-2016.

A list of some beneficial organisms is provided below. For more details and photographs of beneficial organisms in insect management, see:

- CESAR website, http://www.cesaraustralia.com/sustainable-agriculture/identify-an-insect/
- The GRDC *Insect ID: The Ute Guide* (https://grdc.com.au/resources-and-publications/apps/insect-id-the-ute-guide) and *Field peas: The Ute Guide* (https://grdc.com.au/resources-and-publications/all-publications/publications/2009/04/field-peas-the-ute-guide)
- *Beneficial insects: the back pocket guide* (south and west), www.grdc.com.au/BPG-BeneficialInsects-SW

100 Pulse Australia (2016) Southern Faba & Broad Bean – Best Management Practices Training Course, module 7-2016

### Beetles

- Carabid beetle (*Notonomous gravis*) https://grdc.com.au/Resources/Ute-Guides/Insects/Predators/South/Carabid-Beetles
- Transverse ladybird and common ladybird https://grdc.com.au/Resources/Ute-Guides/Insects/Predators/South/Predatory-Ladybird-Beetles-Transverse-Ladybird-Common-Spotted-Ladybird-Minute-TwoSpotted-Ladybird-And-Others

### Bugs

- Damsel bug (family: Nabidae) https://grdc.com.au/Resources/Ute-Guides/Insects/Predators/South/Damsel-Bug
- Assassin bug https://grdc.com.au/Resources/Ute-Guides/Insects/Predators/South/Assassin-Bugs
- Glossy shield bug https://grdc.com.au/Resources/Ute-Guides/Insects/Predators/South/Glossy-Shield-Bug
- Spined predatory shield bug (*Oechalia schellenbergii*) https://grdc.com.au/Resources/Ute-Guides/Insects/Predators/South/Spined-Predatory-Shield-Bug

### Flies

- Hoverfly (family: Syrphidae)
- Tachinid fly https://grdc.com.au/Resources/Ute-Guides/Insects/Parasites/South/Tachinid-Calliphorid-and-Sarcophagid-Flies

### Lacewings

- Green lacewing (family: Chrysopidae) https://grdc.com.au/Resources/Ute-Guides/Insects/Predators/South/Green-Lacewings
- Brown lacewing (family: Hemerobiidae) https://grdc.com.au/Resources/Ute-Guides/Insects/Predators/South/Brown-Lacewings

### Mites

- Pasture snout mite (*Bdellodes lapidaria*) https://grdc.com.au/Resources/Ute-Guides/Insects/Predators/South/Snout-Mites-Pasture-Snout-Mite-And-Spiny-Snout-Mite
- French Anystis mite https://grdc.com.au/Resources/Ute-Guides/Insects/Predators/South/French-Anystis-Mite
- *Crop mites: the back pocket guide* https://grdc.com.au/resources-and-publications/all-publications/publications/2012/06/bpg-cropmites

### Caterpillar wasps

- Orange caterpillar parasite wasp https://grdc.com.au/Resources/Ute-Guides/Insects/Parasites/South/Orange-Caterpillar-Parasite
- Two-toned caterpillar wasp
- Banded caterpillar wasp https://grdc.com.au/Resources/Ute-Guides/Insects/Parasites/North/Banded-Caterpillar-Parasite
- *Telenomus* wasp and *Trichogramma* wasp https://grdc.com.au/Resources/Ute-Guides/Insects/Parasites/South/Caterpillar-Egg-Parasites
- Orchid dupe https://grdc.com.au/Resources/Ute-Guides/Insects/Parasites/South/Orchid-Dupe
- Braconid wasp (*Microplitis demolitor*) https://grdc.com.au/Resources/Ute-Guides/Insects/Parasites/North/Microplitis-demolitor

### Aphid wasps

- *Aphidius ervi* and *Trioxys complanatus* wasps https://grdc.com.au/Resources/Ute-Guides/Insects/Parasites/South/Aphid-Parasites

FEEDBACK

### Spiders

- Wolf spider (family: *Lycosidae*)
- Jumping spider (family: *Salticidae*)

### Insect diseases – viral & fungal

- *Bacillus thuringiensis* (*Bt*)
- Nuclear polyhedrosis virus (NPV)

## 8.17 Commonly used registered pesticides

**Table 4:** Registered insecticides commonly used in pulse crops in Australia.[101]

| Active ingredient Example trade name | Red legged earth mite (RLEM) | Blue oat mite (BOM) | Lucerne flea | Bluegreen aphid | Native budworm | Brown pasture looper | Cutworm | Locust | Withholding period (days) | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | Harvest | Grazing |
| alpha-cypermethrin DOMINEX® DUO | NSW ACT Vic TAS SA WA | NSW ACT Vic TAS SA WA | | | NSW, ACT, Vic, SA, WA | | NSW ACT Vic TAS SA WA | P | 28 | 35 |
| chlorpyrifos LORSBAN® 500 EC | NSW | NSW | | | | | | | | 2 |
| cypermethrin SCUD® | | | | | NSW Vic TAS SA WA | | | P | 28 | 35 |
| deltamethrin DECIS® OPTIONS | | | | All states | | | All states | | 7 | |
| dimethoate Various | All states | | All states | | | | | | | 14 |
| endosulfan* Various | All states | NSW WA | | | | | | | Nil | 49 |
| esfenvalerate SUMI-ALPHA FLEX® | All states | All states | | | All states | | | | 14 | 2 |
| gamma-cyhalothrin TROJAN® | NSW Vic Tas SA WA | | | | Sth NSW, WA, Vic, SA, ACT | | | P | 7 | 7 |
| lambda-cyhalothrin KARATE® ZEON | NSW Vic Tas SA WA | | | | NSW Vic SA WA | | | P | 7 | 7 |
| Maldison FYFANON® ULV | All states | | | | | | | | | |
| omethoate LE-MAT® | NSW Vic Tas SA WA | Qld NSW | | | | | | | | 1 |
| metarhizium anisopliae GREEN GUARD® | | | | | | | | All states | | |

■ Registered for use in the indicated states. * Endosulfan not permitted post-emergence in pulses. P = Permit only so check if still applicable and which crops are listed on the permit.

Source: Pulse Australia (2016) Southern Faba & Broad Bean – Best Management Practices Training Course, module 7-2016.

101 Pulse Australia (2016) Southern Faba & Broad Bean – Best Management Practices Training Course, module 7-2016

### 8.17.1 Comments on insecticides

Registrations and use details may differ between states. Always read the label for specific details and information on registration status and insects controlled. Check the APVMA website (http://apvma.gov.au/) for labels.

**Table 5:** Comments on insecticides.

| Insecticide & trade name | Remarks |
|---|---|
| alphacypermethrin DOMINEX® | Best results if sprayed at egg hatching of native budworm. Apply when damaging numbers first appear in the crop. Use higher rate if native budworm larvae >10 mm. Use higher rate if native budworm are >20 mm for Fastac®. Can be used post-emergence for redlegged earth mite control in field pea. |
| beta-cyfluthrin BULLDOCK® | Use higher rate if native budworm larvae are >10 mm. Bulldock® Duo can also be mixed with mineral oil and applied at ULV rates. |
| chlorpyrifos LORSBAN® | Active against a wide range of insect pests. Not systemic. Rainfast within 4 hours. Toxic to fish. |
| cypermethrin SCUD®, SONIC® | Use higher rate if native budworm larvae are >10 mm. Control of larvae >20 mm is unreliable at this rate. |
| deltamethrin DECIS® OPTIONS | Apply as soon as infestation occurs. Use lower rates only when infestation is low and most larvae are <5 mm long. Longer larvae not readily controlled. Use higher rate for pea weevil under high infestation and for chickpea, faba bean and lentil. |
| dimethoate Various | Apply to the emerged crop, not to bare ground. Has contact and systemic activity. Rain within 24 hours may reduce effectiveness. Can also be used as a seed treatment at 150 ml in 1 L water/100 kg seed, but not mixed with rhizobia. |
| endosulfan* Various | For redlegged earth mite use 0.5 L/ha for broad area spraying of bare earth after sowing. Use 1 L/ha for perimeter spray to prevent reinvasion. Do not use post-emergence on any crop. |
| esfenvalerate SUMI-ALPHA FLEX® | Use 130 ml/ha for native budworm larvae less than 10 mm, 200 ml/ha if 10–20 mm long and 330 ml/ha for >20 mm long. |
| gamma-cyhalothrin TROJAN® | For native budworm use higher rate if larvae are >10mm or the crop is dense. Rainfast within 30 minutes. S5 poison schedule. |
| lambda-cyhalothrin KARATE® ZEON | For control of native budworm apply at hatching or soon after when the larvae are small. Use the higher rate if larvae are >10 mm or if the crop is dense. |
| omethoate LE-MAT® | Spray crop 2–5 weeks after opening rains and before serious damage occurs. Rainfast in 1 hour. Application in spring (according to TIMERITE®) will reduce redlegged earth mite the following year. |
| metarhizium anisopliae GREEN GUARD® | Biological control agent. Apply in 75–225 L/ha of water for best results when locusts and grasshoppers are at the nymph stage. Do not apply in gusty conditions with winds >8 m/sec or rainfall imminent in next 6 hours. Surfactant and oil required. |

* Endosulfan not permitted post-emergence in pulses.

Source: Pulse Australia (2016) Southern Faba & Broad Bean – Best Management Practices Training Course, module 7-2016.