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NOVEMBER 2017

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GRAINS RESEARCH & DEVELOPMENT CORPORATION

# FABA BEAN

## SECTION 7

## INSECT CONTROL

INSECT CONTROL THRESHOLDS | HELICOVERPA SPECIES | APHIDS | OTHER INSECT PESTS | MITES | MONITORING FABA BEAN FOR INSECT PESTS

MORE INFORMATION

For assistance with pest identification, visit My Crop at https://www.agric.wa.gov.au/mycrop

# Insect control

### Key messages

- The main insect pest of faba beans in WA, the native budworm, appears late in the season.
- Control thresholds should be followed when considering management options.

The main insect pest of faba beans in Western Australia is the larvae of native budworm (*Helicoverpa punctigera*) which occurs late in the season and can cause yield loss and damage to grain quality (Photo 1). [1]

**Photo 1:** *Helicoverpa sp. larva damaging a maturing pod.*

Photo: M. Miles, DAF Qld

## 7.1 Insect control thresholds

The following factors should be monitored and considered when using thresholds and making decisions about spraying:

- Environmental conditions and the health of the crop.
- Extent and severity of the infestation and how quickly the population increases.

1 Pulse Breeding Australia (2013) Southern/Western Faba & Broad Bean—Best Management Practices Training Course. Module 7—Insect Management.

- Prevalence of natural control agents such as parasitic wasps, predatory shield bugs and ladybirds.
- Type and location of pest damage, and whether it will affect yield indirectly or directly.
- Stage in the life cycle of the pest and the potential for damage.
- Crop stage and ability of the crop to compensate for damage.
- Amount of damage which has already occurred and the additional damage that will occur if the crop is not sprayed.
- Value of the crop compared to the cost of the spraying and the likely yield or quality benefit gained from control. (High-value crops cannot sustain too much damage as a small loss in yield or quality can mean a large financial loss.) [2]

The impact of insects can be far greater on grain quality in pulses than on yield damage. This must be accounted for when calculating thresholds because in pulses visual quality has a large impact on price.

Faba beans are susceptible to attack from establishment pests such as redlegged earth mites, lucerne fleas, cutworms, and aphids; however their large leaves and early plant vigour make faba beans less susceptible than some other pulses.

While snail populations do not build up as readily under faba beans as they do under field peas, they can still be a problem. Snails climb onto standing faba bean plants, and even onto standing cereal stubble in a stubble-retention system. They can enter the grain sample at harvest with or without having climbed onto the faba bean plant. [3]

## 7.2 *Helicoverpa* species

### 7.2.1 Native budworm

Native budworm (*Helicoverpa punctigera*) is widely distributed throughout mainland Australia and during winter breeds in semi-arid parts of WA.

Native budworm occurs mostly in southern Australia in September, October and early November.

To manage the *Helicoverpa* spp. effectively, it is important to be able to sample and identify the different larval instars. An instar is a stage in the growth of the larva, marked by the shedding of the exoskeleton. Proportions, colours and other features may change between instars. Familiarity with these different life stages is critical because knowledge about them is used to determine the likelihood of damage occurring, and to optimise timing of control.

### 7.2.2 Life cycle and development

Adult moths (Photo 2) are active at night, but during the day may be disturbed when sampling or walking through the crop. Moths vary in colour from grey-green to pale cream and have a wing span of 3–4.5 cm.

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

3 Pulse Australia (2016) Faba bean production: southern and western region, http://www.pulseaus.com.au/growing-pulses/bmp/faba-and-broad-bean/southern-guide

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

Photo: SARDI

The female moths lay round eggs (0.5 mm in diameter) singly on the host plant. The eggs are white but turn brown just before hatching (Photo 3). In the spring, eggs hatch within seven to 10 days (depending on temperature) and larvae feed for four to six weeks. The larvae can grow to 5 cm in length. [4]

**Photo 3:** *Left to right: fresh white eggs, brown ring and black larval head visible in the eggs close to hatching.*

Photo: DAF Qld

Larvae develop through five to six instars. Categorising larval size can be done in terms of instar, or more commonly, a size category (Figure 1): very small (1st instar), small (2nd instar), medium (3rd and 4th instars) and large (5th and 6th instars).

4 Pulse Breeding Australia (2013) Southern/Western Faba & Broad Bean—Best Management Practices Training Course. Module 7—Insect Management.

| Actual larval size | Larval length (mm) | Size category |
|---|---|---|
|  | 1-3 | very small |
|  | 4-7 | small |
|  | 8-23 | medium |
|  | 24-30+ | large |

**Figure 1:** *Size categories of larvae of Helicoverpa species.*

Once fully developed, larvae leave the plant and tunnel down to as much as 10 cm into the soil where they form a chamber in which they pupate (Figure 2).

Pupae will normally develop to produce a moth in two to three weeks. The moth emerges, feeds, mates and is then ready to begin the next cycle by laying eggs. As with all insect development, the duration of pupation is determined by temperature, taking around two weeks in summer and up to six weeks in spring and autumn.

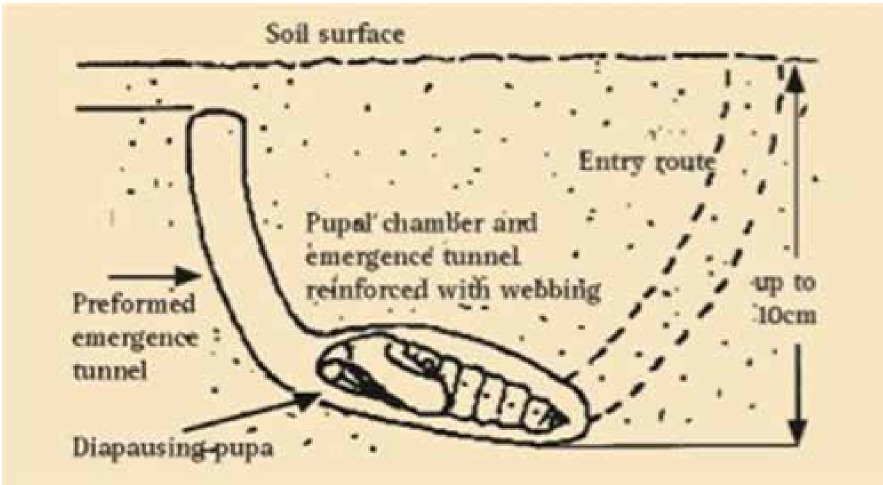


**Figure 2:** *Helicoverpa pupa in pupal channel, with the entry and exit tunnels that are excavated before the larva pupates.*

Source: DPIF 2005

Ninety per cent of all feeding (and therefore damage) by *Helicoverpa* spp. is done by larvae from the third instar (small–medium larvae that are 8–13 mm long) onwards. Large *Helicoverpa* larvae (>24 mm) are the most damaging, since larvae consume about 80% of their overall diet in the fifth and sixth instars. This highlights the importance of controlling the larvae while they are still very small to small (<7 mm).

Full-grown, sixth instar larvae are up to 40 mm long with considerable variation in markings and colours, and which range through green, yellowy-pink and reddish brown to almost black (Photo 4). [5]

5 Pulse Breeding Australia (2013) Southern/Western Faba & Broad Bean—Best Management Practices Training Course. Module 7—Insect Management.

**Photo 4:** *Helicoverpa larvae occur in a range of colours.*

### 7.2.3 Budworm management

The following management strategy is recommended for effective budworm control in faba beans.

1. Start sampling for budworm spp. when the crop starts flowering. Be aware of the limitations of both the beat sheet and sweep net in detecting low densities and smaller larvae.
2. Use a visual sample to detect small larvae in the terminal leaves, buds and flowers before they reach medium size.
3. Aim to treat the crop before larvae reach medium size and become capable of damaging pods.
4. Consider including a low rate of nucleopolyhedrovirus (NPV), a naturally occurring virus where available.

**Photo 5:** *Helicoverpa larva killed by NPV*

Photo: M. Miles, DAF Qld

*Sampling*

Egg counts are an unreliable indicator of Native budworm larval densities, and therefore of potential crop damage. Eggs are difficult to find and count, and egg survival through to larvae is generally very low because eggs fall off plants in the wind or rain, or are eaten by predators. Therefore, counting eggs is not recommended.

Similarly, counting very small larvae is not recommended, as it does not give reliable information, either. Larvae < 3 mm are difficult to find in the crop; and mortality in other crops is known to be high. Given the high level of beneficial insect activity in faba beans, we can assume that many eggs and very small larvae will be eaten by predators (such as predatory bugs, ladybeetles, red and blue beetles, and lacewings).

Visible egg lays and moth activity in the crop indicate Helicoverpa spp. pressure on the crop, and are signs that they need to be monitored for in coming days and weeks.

Exactly which larval stages have the capacity to cause damage in faba beans has not been researched. At this point it is assumed Native budworm behave similarly in faba beans to how it behaves in other pulses.

It is typically the medium–large larvae (≥8 mm) that cause the most loss in pulses. This is why it is important to implement control, if required, before larvae reach this stage.

The natural mortality of larger larvae is lower than for earlier stages, although there are a number of natural enemies (e.g. parasitoids, predatory bugs) that will attack medium–large larvae.

*Damage*

Budworm larvae feed on leaves, buds and flowers, and on the developing grain in pods. It is not known if they have a preference, but preliminary examination of their distribution on faba bean plants during flowering and podding has shown few larvae on leaves compared with the number on the reproductive structures (Photo 7).

Whilst the poor rate of conversion of flowers to pods in faba beans is acknowledged, there seems to be a general acceptance that the plant produces an excess of flowers and that protecting these is not necessary. Observations during trial work by DAF Queensland has shown that damage to flowers can be significant enough to result in non-viable flowers. The larvae feed directly on the pollen sacs or on the ovary of the flower (Photo 6).

**Photo 6:** *Budworm caterpillar damage to flowers: to the pollen sacs (left) and the ovary (right).*

Photos: M. Miles, DAF Qld

Budworm caterpillars are very damaging to faba bean pods, making many more exploratory holes and partially consuming more grain than in other pulses.

The holes make the pods vulnerable to infection by fungi and bacteria, which may in turn increase the likelihood of weathered and discoloured grain (Photo 7).

**Photo 7:** *Helicoverpa damage to faba bean pods. Multiple entry points in a pod and partially consumed grain are typical.*

Photos: M. Miles, DAF Qld

**Table 1:** *Economic thresholds (ET) for native budworm on faba beans*

| 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 (>15mm) per m2 |
|---|---|---|---|---|---|---|
| Faba bean | 280 | 10 | 90 | 0.4 | 2 | - |

Note: Growers using this table to calculate spray thresholds should substitute their own control costs and the current on-farm grain price expected.

Where:

ET = Economic threshold (numbers of grubs in 10 sweeps)
C = Control cost ( includes price of chemical + application) ($ per ha)
K = Kilogram per hectare (ha) eaten for every one caterpillar netted in 10 sweeps or per square metre
P = Price of grain per kg (price per tonne ÷ 1000)

Source: DAFWA

MORE INFORMATION

DAFWA Management and economic thresholds for native budworm

## Yield and quality thresholds

Considerations when making control decisions based on budworm larval densities are:

- environmental conditions and the health of the crop
- how quickly the crop is finishing, and how long it will be susceptible to damage
- how likely wet weather is—it may exacerbate the *Helicoverpa* damage through weathering
- the prevalence of natural control agents such as parasitic wasps, predatory shield bugs, ladybirds and diseases

- the type and location of pest damage, and whether it affects yield indirectly or directly
- the stage in the life cycle of the pest, and therefore its potential to cause damage
- the crop stage and its ability to compensate for damage
- the value of the crop—high-value crops cannot sustain too much damage as a small loss in yield or quality could mean a large financial loss—versus the cost of the spraying and the likely yield or quality benefit gained from control [6]

Losses attributed to native budworm come from direct weight loss through seeds being wholly or partly eaten.

Grain quality may also be downgraded through unacceptable levels of chewed grain or fungal infections introduced via caterpillar entry into pods, especially in faba bean and albus lupin pods.

The percentage of broken, chewed and defective seed found in grain samples affects the final price of pulse crops marketed for human consumption. This applies particularly to the large-seeded crops such as faba bean, kabuli chickpea and field pea. [7]

*Control*

Within the range of options available for pest control in faba beans, there is considerable variability in the impact they will have on beneficial insects (predators, parasitoids, bees) in the crop. It is worth being familiar with the relative impact of the softer, moderate and highly disruptive options.

### Always read the label

Apart from questions about the legality of such an action, the use of products for purposes or in manners not on the label involves risks. These risks include reduced efficacy, exceeded MRLs and litigation.

Be aware that pesticide-use guidelines on the label are there to protect product quality and Australian trade by keeping pesticide residues below specified MRLs. Residue limits in any crop are at risk of being exceeded or breached where pesticides:

- are applied at rates higher than the maximum specified
- are applied more frequently than the maximum number of times specified per crop
- are applied within the specified withholding period (i.e. within the shortest time before harvest that a product can be applied)
- are not registered for the crop in question

## 7.3 Aphids

### Identification

Although several aphid species may infest faba beans, the cowpea aphid (*Aphis craccivora*) is the most commonly observed because it forms clearly visible dark colonies (Figure 3).

Characteristics of adult aphids:

- The pea aphid 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 field 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. They can be similar in colour to young unfurled field

6 Pulse Breeding Australia (2013) Southern/Western Faba & Broad Bean—Best Management Practices Training Course. Module 7—Insect Management.

7 DAFWA (2017) Costs of native budworm https://www.agric.wa.gov.au/grains/management-and-economic-thresholds-native-budworm?page=0%2C1

pea leaves. GPA has a wide host range including canola, lupins 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. 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. It often colonises lupin and faba bean plants. [8]

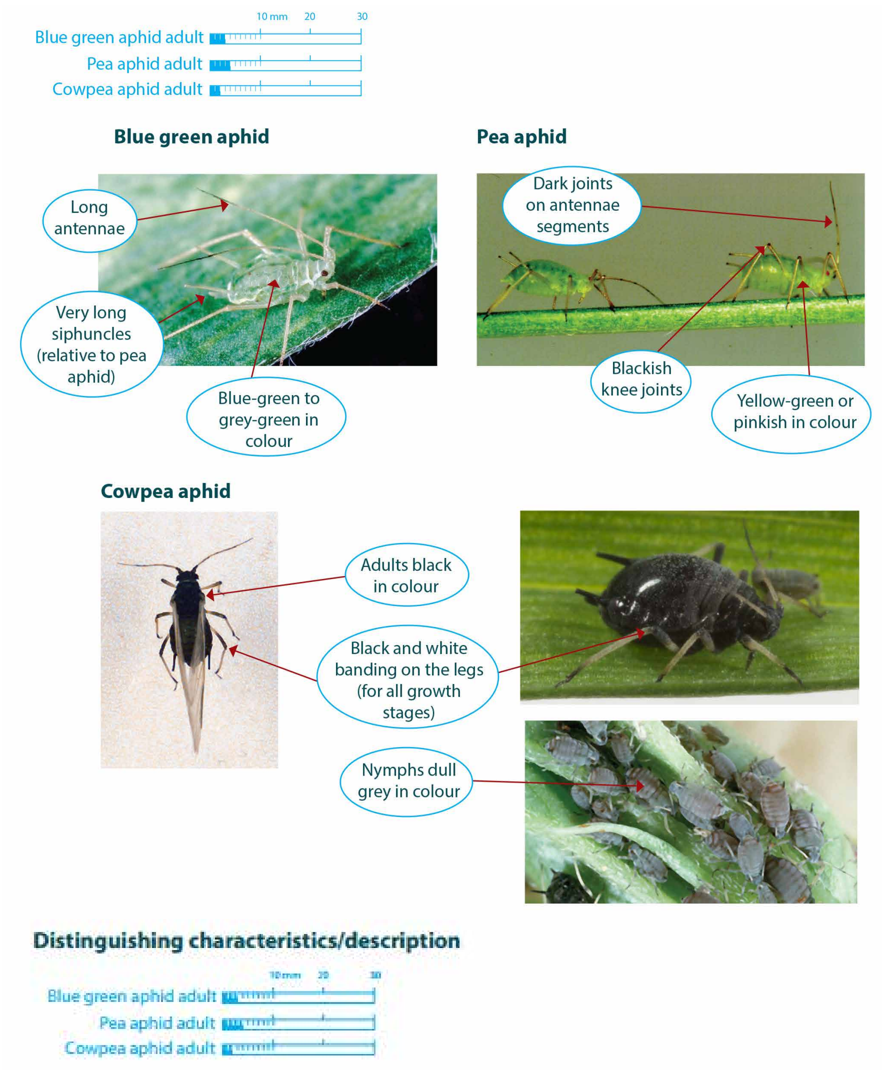


**Figure 3:** *Characteristics of the blue-green, pea and cowpea aphids.*

## MORE INFORMATION

[GRDC (2015) Crop Aphids Back Pocket Guide.](#)

[GRDC (2015) Resistance Management Strategy for the Green Peach Aphid in Australia Grains. Fact Sheet.](#)

[J Bellati, P Mangano, P Umina and K Henry (2012) I Spy: Insects of Southern Australian Broadacre Farming Systems Identification Manual and Education Resource. PIRSA, DAFWA and Cesar.](#)

Cowpea aphid *(Aphis craccivora)* is the only black-coloured aphid. The nymphs of brown smudge bugs and cowpea aphids superficially look alike, but the cowpea aphid is unlikely to be confused with other aphids of pulses, as it is the only black aphid (Photo 8). Adults are small (up to 2.5 mm long) and are shiny black, whereas the nymphs are slate grey.

The cowpea aphid is the major Bean leafroll virus (BLRV) vector, as well as the most efficient Subterranean clover stunt virus (SCSV) vector and a vector of Cucumber mosaic virus (CMV).

8 DAFWA (2015) Diagnosing aphid damage in field peas Department of Agriculture and Food, Western Australia, https://www.agric.wa.gov.au/mycrop/diagnosing-aphid-damage-field-peas

**Photo 8:** *Cowpea aphid (Aphis craccivora). Note the different aphid ages—young to old. The older aphids are shiny black. All life stages have black-and-white-banded legs. The white cast is a skin, which is shed as the aphid grows.*

Photo: Grain Legume Handbook, 2008

## Adult life cycle

In Australia, most pest aphid species produce only females, which may be winged (alates) or wingless (apterae), and give birth to live young.

Spring often triggers a rapid increase in aphid numbers as increasing temperatures and flowering crops provide favourable breeding conditions. Most aphids form dense colonies before winged aphids are produced. These move onto surrounding plants further into the crop, creating hot spots. Rain, and the activity of natural enemies can impact significantly on aphid survival and population growth.

Many aphids are plant host-specific, and require this host for survival. Aphid populations usually decline over summer, as most species are adapted to cooler environments because they were introduced from the northern hemisphere. The availability of suitable host plants (e.g. specific weed families on roadsides and verges) allows populations to survive and increase.

Winged aphids move into crops in autumn, and aphid numbers will usually start to build up along crop edges. Where mild autumn conditions persist, aphid populations can build quickly, but they generally decline as temperatures drop in winter. The formation of winged aphids and aphid movement generally increase when host plants are dying or when overcrowding occurs because of high populations.

In some seasons, aphids form large colonies and heavy infestations may produce large amounts of a sticky secretion known as honeydew. The reaction of faba bean leaves to honeydew and/or the fungi that grow on the honeydew can be seen when there are heavy aphid infestations (Photo 9).

**Photo 9:** *Spotting on lower leaves associated with dense aphid infestations and the production of honeydew and associated fungi.*

Photo: M. Miles, DAF Qld

### Direct-feeding damage

Aphids damage plants by direct feeding, although they generally cause minimal damage unless they are in extremely high numbers. Direct-feeding damage is typically seen in hot spots, often along the margins of a paddock where the aphids have first colonised the crop. Cowpea aphids will colonise the plant terminal and gradually spread lower on the plant if densities are high (Photo 10).

**Photo 10:** *A moderate infestation of cowpea aphid in the terminal of a vegetative faba bean plant. Some distortion of the leaves is evident as a result.*

Photo: M. Miles, DAF Qld

The impact of direct aphid feeding is not well understood, although in most instances the crop grows out of the symptoms. The main concern with aphids is their capacity to act as vectors that carry and transfer virus diseases during feeding or sucking.

## Aphids as vectors of viruses

Two virus-disease symptoms are seen: virus mosaic (dark and light green areas on leaves), usually accompanied by leaf roughness or distortion; and virus yellowing, accompanied usually by leaf stiffness or rolling, stunting, and root blackening.

Two of the major viruses are BLRV and BYMV. Both survive summer on green legume plants (such as lucerne), and can infect plants only through aphid vectors. Chemical control may prevent infection with BLRV, as the aphid needs a relatively long period to feed on the plant and transmit the virus. Chemical control will not have any effect on the rapidly transmitted BYMV. There are no current guidelines for the application of aphicides on faba beans to control virus. Early sowing, while maximising yield, will increase the exposure of crops to aphid flights, potentially resulting in more virus infection.

Cultural controls are the first options to be implemented. These include:

- Sow even plant stands into standing stubble.
- Control weeds that host aphids, including around the perimeter of the crop and in neighbouring paddocks. Keep in mind that aphids may migrate long distances into crops, and local weed control may not always prevent aphid infestation. However, local weed control will contribute to minimising the persistence of virus reservoirs.
- Avoid sowing faba beans in paddocks adjacent to legume pastures.
- Avoid practices that lead to crop stress (e.g. late sowing into cold soils, excessive herbicide application, poor nutrition) that reduce crop vigour.

- Block faba bean paddocks together and limit aphid entry points into paddocks.

## How aphids transmit viruses

*Persistent transmission*

Persistent transmission means that when an insect vector feeds on an infected plant, the virus has to pass through the body of its vector and lodge in its salivary glands before it can be transmitted to a healthy plant, a process that takes >1 day (Figure 4). Once the insect is infectious, it remains so for the rest of its life.

Very few aphid species are vectors of this kind of virus in pulses. These species of aphids tend to colonise their hosts. The pea aphids and green peach aphids are important as vectors of luteoviruses in pulses. Because acquisition of the virus is slow, insecticides that kill aphids work well (except in the case of insecticide-resistant green peach aphid) in suppressing the spread of these viruses (Figure 5), which include:

- BLRV
- BWYV
- SCRLV
- SCSV

*Non-persistent transmission*

Non-persistent transmission means that the insect vector can land on a virus-infected plant, make a brief probe, acquire the virus on its mouthparts within seconds, and then transmit it immediately when probing on a healthy plant (Figure 5). The aphid loses the virus after it probes a healthy plant once or twice. After this, the insect does not infect further plants. The whole process is so fast that insecticides do not act quickly enough to prevent transmission, and can exacerbate the situation by making the aphids hyperactive, so that they flit between more plants than usual.

Many aphid species are vectors of this type of virus; they include ones such as oat and turnip aphids that do not colonise legumes but just land and probe pulse crops while searching for their preferred hosts. Such viruses include:

- AMV
- BYMV
- CMV
- PSbMV [9]

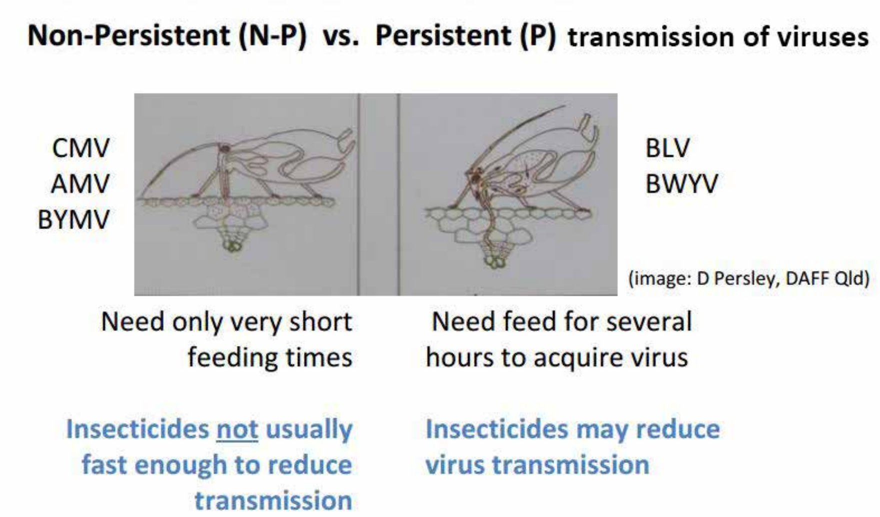


**Figure 4:** *Persistent v. non-persistent transmission of viruses.*

9 Pulse Breeding Australia (2013) Southern/Western Faba & Broad Bean—Best Management Practices Training Course. Module 7—Insect Management.

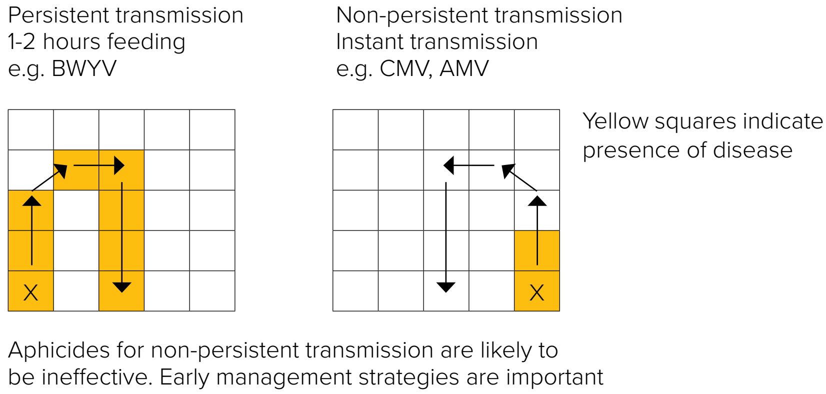


**Figure 5:** *Differences in the progression of infection within a field of persistent and non-persistent viruses transmitted by aphids.*

Source: Bellati et al. 2012

## 7.4 Other insect pests

### 7.4.1 Cutworms

The common name cutworm is derived from the larval habit of severing the stems of young seedlings at or near ground level, causing the collapse of the plant.

#### Identification

Larvae are up to 50 mm long, hairless, with dark heads and usually darkish coloured bodies, often with longitudinal lines and/or dark spots. If picked up larvae curl into a C-shape and remain still. Moths are a dull brown-black colour (Photo 11). Cutworms may be confused with armyworms and *Helicoverpa* larvae.

#### Damage

Cutworm larvae can sever stems of young seedlings at or near ground level, thereby causing collapse of the plant (Photo 12). Sometimes the young plant is partially dragged into the soil where the larvae feed on it. Larvae may also climb plants and browse on or cut off leaves. Crop areas attacked by cutworms tend to be patchy, and the destruction of seedlings in one area may cause cutworms to migrate to adjacent fields. The risk period is summer and spring, and there is one generation per crop.

#### Monitoring and thresholds

Inspect emerging seedlings twice a week, and plants up to the budding stage once a week. Check 1 m of row at a number of locations. Check along the plant row, at the base of seedlings under the soil surface and stubble. The placement of a hessian bag on the soil surface may draw cutworms to the surface. Check for their presence in the morning. Treat seedlings when there is a rapidly increasing area or proportion of crop damage. Treat older plants if 90% of field checks reveal that cutworms are present, or if defoliation exceeds 75%.

#### Management

- Controlling weeds prior to planting will reduce the risk of cutworm infestations. Moths will lay on weeds, and large larvae move from the weeds to establishing crops when weeds are sprayed, cultivated or deteriorate with age.
- A late-afternoon spray, close to the time when feeding commences, gives the best results.
- Spot spraying of infested patches may suffice.
- Cutworms are killed by a number of natural enemies such as parasitoids, predators and diseases, and it may be possible to capitalise on these.


**Photo 11:** *Bogong moth.*

Photo: L. Gibson and K. Walker, Museum Victoria

**Photo 12:** *Cutworm larvae, which will grow to about 40 mm in length before pupating.*

Photo: P. Room

**MORE INFORMATION**

DAFWA (2016) Diagnosing cutworm in canola and pulses.

### 7.4.2 Thrips

Several species of thrips will damage faba bean crops, but little is known of their economic impact. Leaf-feeding damage can occur in seedlings, because thrips cause distortion of the emerging and expanding leaves. Unless the thrip pressure is extreme, and the crop emergence compromised by limited moisture or cold, plants will grow out of the damage, which is therefore considered to be cosmetic rather than damaging.

More commonly, thrips are observed in flowers. They feed on the pollen in flowers and it is thought that they affect the development of small pods. However, the link between thrips and pod damage is not well established. Thrip numbers almost always exceed the nominal threshold of four to six per flower. [10]

Onion thrips (*Thrips tabaci*), plague thrips (*T. imaginis*), tomato thrips (*Frankliniella schultzei*, Photo 13) and western flower thrips (*Frankliniella occidentalis*) are all likely to be present in faba beans.

### Thrips damage

Damaged leaves and older pods are marked with silvery-brown blotches. Unless excessive, e.g. on seedlings where growth has slowed because of cool, wet or dry conditions, plants will grow through this damage.

### Monitoring and thresholds

Seedling thrip infestation can be monitored by gently pulling up seedlings to examine for the presence of thrips; a hand lens may be used. In budding and flowering plants, beat the growing points and flowers onto a surface to dislodge any thrips.

**Photo 13:** *Adult tomato thrips (Frankliniella schultzei).*

Photo: L. Wilson

## 7.4.3 Snails

Numbers of slugs and snails have increased in broadacre cropping in Western Australia with the use of minimum tillage and stubble retention. These systems increase the organic content of paddocks and the soil moisture content leading to higher survival levels of slugs and snails.

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

Slug and snail pests in Australia have come from other countries, mainly the Mediterranean region. They damage plant seeds (mainly legumes), recently germinated seeds, seedlings and leaves and can be a contaminant of grain at harvest. [11]

Even in a less susceptible crop like faba beans, snails climb onto standing plants and onto standing cereal stubble in a stubble-retention system. Therefore, they can enter the grain sample at harvest with or without having climbed onto the crop plant.

### White snails

There are two species of white snail of interest to faba beans growers: the vineyard or common white snail (*Cernuella virgata*), and white Italian snail (*Theba pisana*) (Photos 14 and 15).

The species look similar: both have white, coiled shells up to 20 mm in diameter; the shells may have brown bands around the spiral. The common white snail has an open umbilicus, whereas that of the white Italian snail is partly closed. [12]

**Photo 14:** *Vineyard or common white snail.*

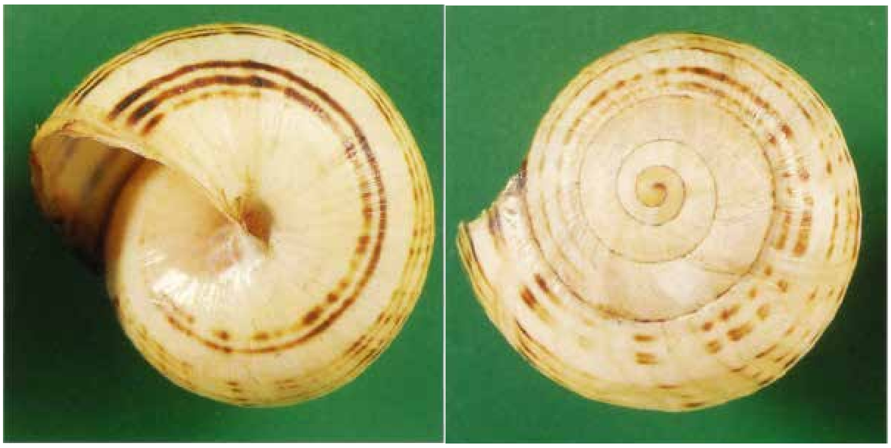

**Photo 15:** *White Italian snail.*

Photos: SARDI

## MORE INFORMATION

DAFWA (2016) Identification and control of pest slugs and snails for broadacre crops in Western Australia.

DPIPWE (2010) Common white snail (*Cernuella virgata*). Fact sheet.

11 DAFWA (2017) Identification and control of pest slugs and snails for broadacre crops in Western Australia https://www.agric.wa.gov.au/grains/identification-and-control-pest-slugs-and-snails-broadacre-crops-western-australia

12 Pulse Breeding Australia (2013) Southern/Western Faba & Broad Bean—Best Management Practices Training Course. Module 7—Insect Management.

### Pointed or conical snails

There are two pointed snails that cause damage in faba beans: the pointed snail (*Cochlicella acuta*) (Photo 16) and the small pointed snail, either *Cochlicella barbara* or *Prietocello barbara* (Photo 17). Both snails are fawn, grey or brown in colour.

**Photo 16:** *Pointed snail. The ratio of its shell length to its base diameter is always greater than two.*

Photo: SARDI

**Photo 17:** *Small pointed snail. The ratio of its shell length to its base diameter is always two or less.*

Photo: SARDI

MORE INFORMATION

SARDI (2014) Small pointed snail. Pest notes.

## Damage

Damage caused by snails is mainly at crop establishment and at harvest. Both common white and white Italian snails may feed on young crops and damage substantial areas which then need re-sowing. In late spring, the snails climb plants, and are in the upper part of the crop when it is harvested, thereby contaminating the grain. Contaminated grain may be downgraded, or even rejected. In addition, live snails in grain pose a threat to exports.

Conical snails feed mostly on decaying plant material but can damage seedlings. The small pointed snail feeds on growing plants and can contaminate grain.

## Life cycle

White snails are dormant in summer. They feed and grow through the winter and spring, and then climb fence posts and plant stems in late spring, where they go into summer dormancy. Snails live for 1–2 years, and move only short distances. They are spread in hay, grain, machinery and vehicles.

Pointed snails have a similar life cycle to the white snails. They may live under stones as well as up on posts and plants (whereas small conical snails live on the ground in the leaf litter).

## Monitoring

Monitoring and baiting early, before egg laying, are critical for snail control.

To sample snail numbers, mark out a 32 cm x 32 cm quadrat on the ground and count all live snails within it. If round-shelled and conical-shelled snails are present, record the numbers of each type. To determine sizes, place the snails in a sieve box and shake gently to separate into two groups: larger and smaller than 7 mm. Round snails and small conical snails <7 mm are unlikely to be controlled by bait.

MORE INFORMATION

SARDI (2003) Bash 'em, burn 'em, bait 'em: Integrated snail management in crops and pastures. South Australian Research and Development Institute.

DAFWA (2014) Snails–economic considerations for management.

### Control

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 are laid. Rolling, harrowing or dragging a cable over stubble on hot days reduces snail numbers by knocking snails to the ground, where they die in the heat (when the air temperature is over 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. (Wind or water erosion becomes a risk when stubble is burnt.)

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 re-infestation of the paddock. Do not bait within 2 months of harvest.

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

Control measures for conical snails are the same as those used on white snails, but are generally less effective as these snails shelter in cracks in the ground or under stones.

Dragging harrows or a cable before burning it improves the control by exposing more snails to burning. [13]

## 7.4.4 Slugs

The main slug pests of faba beans are the reticulated slug (*Deroceras reticulatum*) and the black-keeled slug (*Milax gagates*). Usually grey in colour, the adult slugs range from about 2–4 cm long (Photo 18). Slug attacks on emerging crops can cause economic losses, even when slug numbers are relatively low. Slugs will eat all parts of a crop plant; however seedlings are the most vulnerable, and this is when economic losses can occur. [14]

Faba beans are probably one of the more slug-tolerant winter crops, and generally grow out of slug damage without any adverse impact.

The black-keeled slug has also been found in canola and wheat paddocks. This slug is uniform black to grey, and 4–5 cm long and is an issue in south-eastern WA.

**Photo 18:** *Top: Reticulated slug (Deroceras reticulatum). Bottom: black-keeled slug (Milax gagates).*

Photo: Peter Mangano, DAFWA

13 Pulse Breeding Australia (2013) Southern/Western Faba & Broad Bean—Best Management Practices Training Course. Module 7—Insect Management.

14 GRDC (2014) Slugging slugs. Media Centre. 5 June 2014. GRDC, https://grdc.com.au/Media-Centre/Hot-Topics/Slugging-slugs

### Life cycle

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 into the soil to depths of 20 cm or more in dry periods and reappear when conditions improve. [15]

**Photo 19:** *Slug damage in a faba bean seedling. Beans tolerate slug damage better than many other crops do, particularly compared with lupins and canola.*

Photo: W. Hawthorne, Pulse Australia

### Damage

Plants are eaten to ground level, or irregular patches or strips are chewed from the leaves. Leaves can look shredded (Photo 19). There can be poor legume emergence from slugs feeding in furrows.

Slugs are usually found on heavy soils and wet areas in high rainfall areas and can be a problem in canola or pulse paddocks with high levels of stubble retention or rock piles, which provide protection over the summer.

### Monitoring and thresholds

Monitoring has recently been shown to be an unreliable way to assess slug densities. This is principally because slug distribution across a field is highly variable, and they are only active under a narrow range of conditions. Slugs can be found on the heavier clay soils, but can spread to lighter and gravel soil types which makes it difficult to target by soil type.

In WA the recommended threshold for control in pulses is 1-2 snails or slugs per square metre. [16]

### Management

Baits are more effective in controlling slugs and snails when there is no green material (i.e. weeds or emerging crops) to provide an alternative food source. Spread pellets when slugs are active after rain and to apply at recommended rates.

Baits alone may not provide sufficient control so it is necessary to carry out additional management practices.

**MORE INFORMATION**

GRDC (2013) Slug identification and management. Fact sheet.

A Snug Blog is maintained by SARDI slug researcher Michael Nash, and via Facebook.

My Pest Guide

15 Pulse Breeding Australia (2013) Southern/Western Faba & Broad Bean—Best Management Practices Training Course. Module 7—Insect Management.

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

MORE INFORMATION

GRDC (2013) Slug identification and management. Fact sheet.

A Snug Blog is maintained by SARDI slug researcher Michael Nash, and via Facebook.

DAFWA (2015) Diagnosing redlegged earth mite.

GRDC (2016) RLEM resistance management strategies. Ground Cover Radio. No. 122. 4 May 2016. Audio file.

GRDC (2012) Crop mites: The back pocket guide. GRDC.

Control of summer weeds ('green-bridge') results in fewer slugs being present in crops and also increases the effectiveness of baits by removing food competition.

Burning and tillage will reduce reticulated slugs but black keeled slugs are unaffected. [17]

## 7.5 Mites

Mites are among the most diverse and successful of all the invertebrate groups. Because they are tiny they often go unnoticed; however, they are one of the most important pests of Australian grain crops. Some species have become more problematic over the last decade as farming practices have changed, and others are proving difficult to control due to tolerance and chemical resistance. [18]

### 7.5.1 Redlegged earth mite

The mite grows to about 1 mm in length. Adults have a velvety black body and eight red legs (Photo 20). Newly hatched mites are 0.2 mm long, and have pinkish-orange with six legs. Nymphs develop into mature adults in approximately four to six weeks.

In autumn, over-summering eggs hatch when there is significant rainfall and the mean daily temperatures fall below approximately 21°C.

Redlegged earth mites can have three generations a season.

**Photo 20:** *Redlegged earth mite close up.*

Photo: Grain Legume Handbook, 2008

#### Life cycle

Earth mites are active in the cool, wet part of the year, usually between April and November. During this winter–spring period, RLEM may pass through three generations, with each generation surviving six to eight weeks. Prolonged plant growth during long, wet springs favours the production of over-summering eggs.

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

18 P Matthews, D McCaffery, L Jenkins (2016) Winter crop variety sowing guide 2016. NSW DPI, http://www.dpi.nsw.gov.au/content/agriculture/broadacre/guides/winter-crop-variety-sowing-guide

Autumn rains trigger hatching in three to nine days. Mites take 20–25 days to mature and start laying eggs (Figure 6). False breaks in the season can cause large losses in mite numbers. [19]

## Monitoring

Inspect susceptible crops for mites and their damage from autumn to spring, particularly in the first few weeks after sowing. Mites feed on the leaves in the morning or on overcast days, and in the warmer part of the day RLEM tend to gather at the base of plants, sheltering in leaf sheaths and under debris. They will crawl into cracks in the ground to avoid heat and cold. When disturbed during feeding they will drop to the ground and seek shelter.

## Control

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.

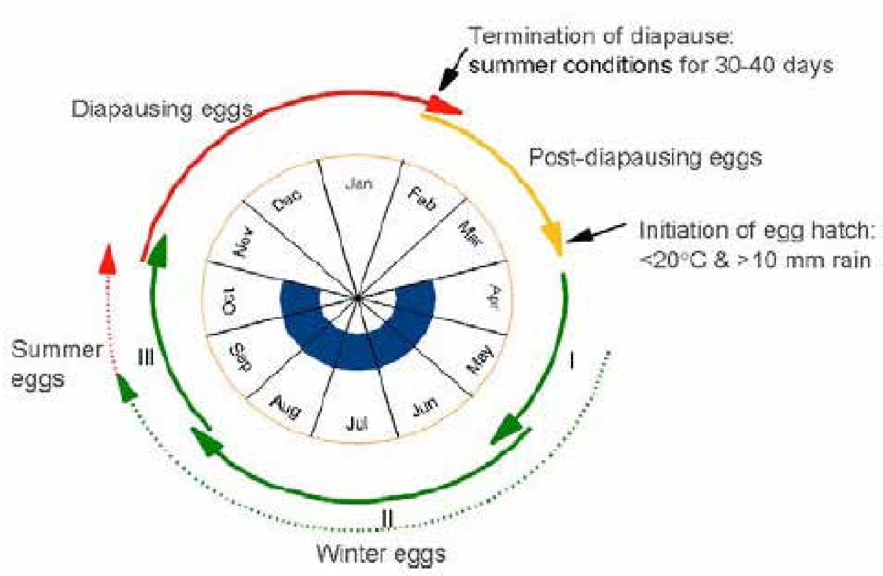


**Figure 6:** *Life cycle of redlegged earth mite.*

Source: Umina 2006

## Chemical control

Chemicals are the most commonly used control for earth mites. Chemicals are registered for control of active RLEM, but none currently registered are effective against RLEM eggs.

DAFWA reports RLEM that are resistant to commonly applied insecticides including synthetic pyrethroids (Group 2A), the organophosphates (Group 1B) omethoate and chlorpyrifos were first found in Western Australia. Resistant RLEM populations are likely to be present in paddocks that have a history of repeated insecticide applications.

DAFWA advises growers with SP resistant RLEM to control these mites by using insecticides from the OP group (Group 1B), for example, dimethoate or omethoate.

RLEM with omethoate tolerance or chlorpyrifos can not be controlled by using registered rates of these insecticides. As populations have been found with

19 Pulse Breeding Australia (2013) Southern/Western Faba & Broad Bean—Best Management Practices Training Course. Module 7—Insect Management.

omethoate tolerance and SP resistance is showing that reliance on insecticides for the control of RLEM is starting to break down.

In all cases residual populations of resistant or tolerant RLEM were found on weeds along fencelines and re-infested paddocks. [20]

### Autumn sprays

Control first-generation mites before they lay eggs. Pesticides used at or after sowing should be applied within three weeks of the first appearance of mites, before adults begin to lay eggs.

Timing of chemical application:

- Pesticides with persistent residual activity can be used as bare-earth treatments to protect seedlings.
- Foliage sprays applied after the crop has emerged and are generally an effective control.
- Systemic pesticides applied as seed dressings act by maintaining the pesticide at toxic levels within the seedling. If mite numbers are high, plants may suffer significant damage before the pesticide has much effect.

### Spring sprays

A correctly timed spring spray can reduce populations of RLEM the following autumn. Use climatic variables, and tools such as Timerite® to determine the optimum date for spraying. Spring RLEM sprays will generally not be effective against other pest mites.

Do not keep using the 'spring spray' technique year in, year out. To avoid pesticide resistance evolving, rotate spring-spray products with different modes of action.

### Other controls

Cultural control measures include:

- Rotating crops or pastures with non-host crops, e.g. cereals
- Cultivating, which can reduce RLEM populations
- Clean fallowing and controlling weeds around crop and pasture perimeters
- Controlling weeds, especially thistles and capeweed, to remove breeding sites for RLEM. [21]

## 7.5.2 Lucerne flea

Broadleaf seedlings—including canola, faba beans, lupins, field peas, clovers and lucerne—are most susceptible to the lucerne flea (*Sminthurus viridis*). This pest, which is actually a springtail, requires cool, moist conditions to hatch, and will produce up to five generations in most years.

### Life cycle

Long, wet springs favour flea build-ups, which often cause more serious outbreaks in the following autumn. Over-summering eggs are laid in the soil and hatch soon after soaking autumn rains. The eggs take about two weeks to hatch and the immature stages a further three weeks before the flea reaches sexual maturity.

A second generation may be completed before winter temperatures retard development and reduce the numbers. In spring a second burst of activity occurs when rising temperatures allow both pests to breed faster and increase their numbers. This period of activity stops in late spring when dry conditions lead to the production of over-summering eggs.

20 DAFWA (2017) Prevent redlegged earth mite resistance https://www.agric.wa.gov.au/mites-spiders/prevent-redlegged-earth-mite-resistance

21 Pulse Breeding Australia (2013) Southern/Western Faba & Broad Bean—Best Management Practices Training Course. Module 7—Insect Management.

The final generation of females each season lay eggs that over-summer in the soil. The female will excrete a substance that contains ingested soil particles to form a protective mass that protects and camouflages the eggs (Photo 21). [22]

**Photo 21:** *Lucerne flea with eggs.*

Photo: Grain Legume Handbook, 2008

## Monitoring

Monitoring from autumn through spring is the key to reducing the damage caused by lucerne fleas. Crops are most susceptible to damage immediately following seedling emergence.

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, such as windowing of leaves, and check the soil surface where insects may be sheltering.

It is important to assess the complex of pests present before deciding on the most appropriate control strategy.

It is also important to note the growth stage of the lucerne flea population. Spray immature lucerne fleas before they have a chance to reproduce to reduce the size of subsequent generations.

Damage includes chewed leaves.

## Chemical control

If warranted, treat the infested area approximately three weeks after lucerne fleas have been observed on a newly emerged crop. This will allow for any remaining over-summering eggs to hatch, but will occur be before the lucerne fleas reach maturity and begin to lay winter eggs.

## Biological and cultural control

Several predatory mites (e.g. snout mites), various ground beetles and spiders prey on lucerne fleas. Clean fallows and the control of weeds, especially capeweed, within crops and around pasture perimeters helps reduce lucerne flea numbers.

Grasses and cereals are less favourable to the lucerne flea and as such can be useful for crop borders. [23]

22 GRDC (2014) Beating the lucerne flea. Media Centre. 5 June 2014, https://grdc.com.au/Media-Centre/Hot-Topics/Beating-the-lucerne-flea

23 Pulse Breeding Australia (2013) Southern/Western Faba & Broad Bean—Best Management Practices Training Course. Module 7—Insect Management.

## 7.6 Monitoring faba bean for insect pests

There are a number of sampling methods that can be used in faba beans, and the use of one or more of these methods when checking crops depends on the crop stage, and which pests are expected.

It is likely that more than one method may be necessary to effectively estimate pest density. For example, when sampling for *Helicoverpa* spp. a beat sheet or sweep net will not dislodge small larvae in terminals and flowers, so a visual inspection of a number of plants is also required.

**Photo 22:** *The beat sheet can be used between the rows (as is done in chickpeas, left) or in larger crops, draped over the adjacent row to maximize the capture of insects dislodged when sampling (right)*

Photos: GRDC, DAF Qld

### How to use a beat sheet to sample faba beans

Check crops at least once a week with a beat sheet, from flowering through to harvest.

To avoid possible edge effects, start sampling at least 50 m into the field.

Each inspection, take 5–10 samples across the field. The number of samples should be influenced by what you find. Consistently high or low numbers of insects will require fewer samples be taken because the overall picture is clear. Where pests are patchy and numbers are variable, more samples will be needed to be confident in averaging the counts to get an estimate of pest numbers.

An estimate of pest density is usually the average of all individual samples taken (e.g. 5 + 1 + 4 + 3 + 2 + 5 + 5 = 25; 25 ÷ 7 = 3.6 per sampling unit).

In addition to larval counts, visual observation of crop growth stage, progress of flowering and podding, and the presence of natural enemies of insect pests (beneficials) all provide useful information for making decisions.

When using a beat sheet, it is worth converting pest density estimates into standard units, generally the number per $m^2$. This conversion adjusts for the amount of crop (linear metres of row) at different row configurations.

To convert pest density to $m^2$, use the following formula:

Number / $m^2$ = Average number of pest ÷ row spacing (in metres)

MORE INFORMATION

Watch a video on using a beat sheet in canola or chickpeas on the Beatsheet YouTube channel.

### How to use a sweep net to sample faba beans

A standard beat sheet is made from plastic or tarpaulin with heavy dowel on each end to weigh it down. It is typically 1.3 m wide by 1.5 m long.

Lay the sheet on the ground under the plants. Using a 1-m-long stick (dowel, heavy conduit), shake the row vigorously 10 times to dislodge larvae from the plants. Size and count larvae that drop onto the sheet. The beat sheet is wider than the stick so that there is an extra 0.15 m on each side to catch insects thrown out sideways.

Where crops are sown on narrow row spacings, and it is not possible to get a beat sheet between the rows, a sweep net can be used to sample faba beans.

Hold the sweep-net handle in both hands and sweep it across the front of your body in a 180° arc. Take a step with each sweep. Keep the head of the net upright so the bottom of the hoop travels through the canopy. Use sufficient force in the sweep to pass the hoop through the canopy and dislodge larvae.

Take 10 sweeps and then stop and check the net for insects.