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GRDC
GROWNOTES™

GRDC
GRAINS RESEARCH & DEVELOPMENT CORPORATION

CANOLA

SECTION 7

INSECT CONTROL

SEED DRESSINGS | INTEGRATED PEST MANAGEMENT | EARTH MITES | LUCERNE FLEA | SLUGS | DIAMONDBACK MOTH | APHIDS | MANAGEMENT OF BRONZED FIELD BEETLE—A PEST OF CANOLA IN THE SOUTH OF WESTERN AUSTRALIA | HELICOVERPA | DIAGNOSING WEEVILS IN CANOLA | DIAGNOSING CABBAGE WHITE BUTTERFLY | VEGETABLE BEETLE (GONOCEPHALUM MISSELLUM) | OTHER SOIL PESTS

SECTION 7

Insect control

Pests that can pose a problem in canola in Western Australia include blue oat mites (*Penthaleus* spp.), redlegged earth mites (RLEM) (*Halotydeus destructor*), cutworms, diamondback moth, *Helicoverpa*, aphids, Rutherglen bugs, slugs, snails, European earwigs, lucerne flea and wire worms.

7.1 Seed dressings

More information

Canola Diagnostic Tool

Emerging insect pests

'Serial pests' wrap-up—lessons from 2014 and 2015 and some research updates

Insect pests of canola

The seed dressing Gaucho® (imidacloprid) protects emerging seedlings from low numbers of RLEM, blue oat mite and aphids for ~3–4 weeks after sowing. Another seed dressing, Cosmos® (fipronil) protects seedlings from low numbers of RLEM.

Viruses can also occur in canola, carried by aphids that suck sap from leaves, transferring the virus and causing yield loss and sometimes plant death. Protection against early aphid infestation in seedling canola may reduce the incidence of virus in the crop.

Gaucho® (imidacloprid), Poncho Plus® and Cruiser Opti® are seed dressings registered for early season protection from aphids in emerging canola. Sowing canola into standing cereal stubble may help to reduce aphid numbers and hence virus infection. [1]

7.2 Integrated pest management

Pests are best managed using an integrated pest management (IPM) approach. Careful planning prior to sowing, followed by regular monitoring of crops after sowing, will ensure that potential problems are identified and, if necessary, treated early. Monitoring may involve techniques and aids such as sweep nets, a beat sheet or visual assessment.

Integrated pest management uses a range of control tactics to keep pest numbers below the level where they cause economic damage. It is primarily based on biological control of pests, by either encouraging natural enemies or release of biocontrols.

Other methods of control support these biological controls and can include:

- cultural methods such as farm hygiene, weed control, strategic cultivation (pupae busting), physical barriers, quarantine areas, different planting times, crop

[1] L Serafin, J Holland, R Bambach, D McCaffery (2009) Canola: northern NSW planting guide. NSW Department of Primary Industries, http://www.dpi.nsw.gov.au/__data/assets/pdf_file/0016/148300/canola-northern-NSW-planting-guide.pdf

rotations, trap crops, use of attractants for beneficials or repellants for pests, and keeping plants healthy so they resist attack

- host-plant resistance such as genetically resistant varieties or physical features that repel pests
- genetic control measures such as release of sterile male insects
- pheromones to confuse mating or aggregation
- use of microbial pesticides such as *Bacillus thuringiensis* (Bt), nuclear polyhedrosis virus (NPV) or *Metarhizium*.
- manipulation of micro-environmental conditions (e.g. planting density, row spacing, row orientation) to make them less suitable for pests or more suitable for beneficials
- use of chemicals as a last resort
- use of 'soft' chemicals or pest-specific chemicals in preference to broad-spectrum pesticides (especially early in the growing season when it is important to preserve beneficials)

Integrated pest management relies on monitoring the crop regularly, having pests and beneficial insects correctly identified and strategic control decisions made according to established damage thresholds. [2]

7.2.1 Area-wide management

Area-wide management (AWM) is IPM that operates over a broad region and attacks the pest when and where it is ecologically weakest, without regard to economic thresholds. It is a system currently used in managing resistance in *Helicoverpa armigera* in cotton. AWM coordinates farmers in implementing management strategies on their own farms to control local populations of *H. armigera* and prevent numbers building up later in the season. AWM strategies involve a detailed understanding of the biology and life cycle of the pest and of how the pest moves around in a region. Strategies can include coordinated timing of operations such as pupae busting, sowing and destroying of trap crops, and spraying of certain chemical types including 'soft' or biological insecticides. [3]

7.2.2 Biological control

Biological control can be defined as the use of natural enemies to control pest outbreaks. The pest is not usually eradicated, but brought down to levels where it does not cause economic damage. Success with biological control has been varied in many situations. Complete success, where the pests do not exceed the economic thresholds, has occurred in only 19% of cases. Many releases of biocontrol agents have had no significant effect. Success has been more common in long-term agro-ecosystems such as orchards and forests, where pest and natural enemy populations

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

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

are more stable. In annual cropping systems, maintaining resources that favour the buildup of natural enemies, for example greater biodiversity of plants, retaining stubble and groundcover and limiting use of broad-spectrum insecticides, will help to keep pests in check. [4]

Types of biological control

- Natural. An existing control agent is encouraged to control pests. This means avoiding the use of chemicals that may destroy these control agents.
- Single release (classical). The control agent is released with the aim of establishing it as a permanent part of the ecosystem. This is usually carried out for introduced pests.
- Multiple release. The control agent is not usually perfectly adapted to the environment (e.g. drought- or frost-intolerant) and so needs to be re-released. This may occur as a 'top-up' after unfavourable conditions, as a regular seasonal release, or as an inundative release where the control agent does not survive well. In this case, the agent is used as a 'living insecticide' that is released in large numbers to reduce pest numbers before it dies.

Biological control agents for insect pests can include:

- Predators. These actively capture their prey. Beetles, lacewings, bugs, flies, spiders and vertebrates are predators.
- Parasitoids. These are host-specific and need only one host to complete their life cycle. They lay eggs in their host and emerge after using the host as a food source. The host is nearly always killed. Parasitoids differ from parasites, which will coexist with the host. Parasitoids include wasps (e.g. the parasitic wasp, which will lay eggs inside lucerne aphids, white cabbage moth caterpillars and scarab larvae) and flies such as the tachinid fly.
- Pathogens. These include bacteria, viruses, fungi, protozoa and nematodes. A few of these organisms can enter and multiply rapidly within the host, e.g. *Metarhizium*, Bt, NPV.

Parasitoid and pathogen control agents are usually more successful than predators because they are more host-specific.

Trichogramma wasps

Trichogramma pretiosum wasps prey on the eggs of *Helicoverpa* spp., loopers, cabbage moths and others, and are suitable for use in minimally sprayed field crops, maize and vegetables, and for *Helicoverpa* in fruit crops. They are <0.5 mm in size and lay their eggs into moth eggs. The wasp larvae develop into a fully formed wasp inside the moth egg, in the process killing the developing caterpillar. *Trichogramma*

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

are supplied as parasitised moth eggs in capsules. These are distributed around the crop and can be applied with water. [5]

Nuclear polyhedrosis virus (NPV)

Insect viruses are naturally occurring, insect-specific pathogens that have been part of the environment for millions of years and play an important role in the natural control of insect populations. Insects consume the virus from the leaves. The virus then moves through the gut wall and invades the body of the insect, causing the insect to stop feeding and die within 5 days because of the breakdown of its internal organs. The body ruptures after death, releasing virus particles that infect other caterpillars. Gemstar® and Vivus Gold® are commercial products that control *Helicoverpa punctigera* and *H. armigera* in cotton and selected crops, with a liquid concentration of virus particles. Typically, they provide 60–90% control of larvae. Both products fit best within an IPM program that uses natural enemies such as ladybeetles and parasites, but can be alternated with synthetic insecticides. As a biological insecticide, efficacy is dependent on environmental conditions for good performance. It needs to be ingested; therefore, coverage of the target area is essential. [6]

Bacillus thuringiensis

The Bt bacteria produce proteins that are characterised by their potency and specificity to certain species, most of which are agronomically important pests. Mixtures of protein crystals and spores have been sprayed in the same way as a chemical pesticide for many years in horticultural industries, but with variable success in broadacre field crops. The caterpillar ingests the protein, which then attacks the gut wall, causing holes, and the insect stops feeding. The bacterial spores contained in the protein then leak through the gut wall and cause bacterial infection. The insect will die, either from this bacterial infection or from starvation. This is the process that makes the Bt protein highly specific and environmentally desirable. Insertion of the Bt gene into cotton plants has taken many years to develop, and breeding is ongoing of plants that express higher levels of the Bt toxin. Resistance to Bt is being carefully monitored and controlled with the development of management programs and new research on multiple insect-resistance genes. Novel strains of Bt are being isolated for a wide range of pest families, including beetles, flies and locusts. [7]

More information

GRDC Fact Sheet—Integrated Pest Management (National)

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

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

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

7.3 Earth mites

Earth mites are the major pests of seedling canola. Damage can be caused by RLEM, *Bryobia* mites, *Baluastium* mites and blue oat mites, which often occur in mixed populations. *Bryobia* and *Balaustium* mites are an increasing problem in some areas. A good mite-control program starts with a population reduction treatment the previous spring (Table 1). Learn to identify these three species of mites to ensure that the correct insecticide and rate is applied to the correct species.

Bare earth treatments. Germinating and establishing crops can be protected by:

- boom spraying the soil surface of previous pasture or high-risk paddocks with a residual insecticide immediately after sowing
- perimeter-spraying bare ground in low-risk paddocks, not forgetting to spray around trees, rocky outcrops and dams, and along water flow-lines

If you are unsure of the level of risk from mites, spray the whole paddock. Three bare-earth sprays are registered that will give several weeks of residual protection. Bifenthrin is registered for RLEM, blue oat mite and *Bryobia* mites, but application rates vary according to the mite species being targeted. Alpha-cypermethrin will control RLEM, whereas methidathion is registered for both RLEM and blue oat mite.

Seed dressings. Imidacloprid (e.g. Gaucho®) and Poncho® Plus (clothianidin + imidacloprid) are registered for use on canola seed for protection against RLEM, blue oat mite and aphids. Poncho® Plus is also registered to control lucerne flea, wireworm and cutworm. A third seed dressing, Cruiser® Opti (thiamethoxam + lambda-cyhalothrin) is registered for suppression of RLEM and lucerne flea. These seed dressings will protect emerging seedlings for 3–5 weeks after sowing. Use treated seed following a pasture phase if a well-timed spring spray of insecticide has been applied. Apply a bare-earth border spray where untreated pastures border the canola crop. Seed companies can supply seed pre-treated with imidacloprid, Poncho® Plus and Cruiser® Opti. Cosmos® Insecticidal Seed Treatment (fipronil) is also registered for control of RLEM in canola.

Even where a seed-dressing or bare-earth treatment has been used, it is advisable to check seedling canola regularly for mite damage as the seed dressings are not enough to deal with medium to high pressure situations. [8]

Redlegged earth mite and blue oat mite (*P. major*) are two soil-dwelling mites that damage crops in autumn, winter and spring. They are primarily pests of seedlings but can also seriously injure older plants. Winter crops at establishment may be severely damaged, particularly if growth during and following emergence is slow. Damaged plants die or remain stunted and weak. Sometimes seedlings are killed before they emerge. Both mite species prefer light, sandy, gravelly sand or loamy, well-drained soils. [9]

More information

Nutrient management may double as pest control

DAFWA: Pests, mites and spiders

[8] P Matthews, D McCaffery, L Jenkins (2015) Winter crop variety sowing guide 2015. NSW DPI Management Guide. NSW Department of Primary Industries, http://www.dpi.nsw.gov.au/__data/assets/pdf_file/0011/272945/winter-crop-variety-sowing-guide-2015.pdf

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

Table 1: Recommended control strategies for earth mites [10]

Pre-season (previous spring–summer)
Assess risk High-risk situations: History of high mite pressure Pasture going into crop Susceptible crop being planted (e.g. canola, pasture, lucerne) Seasonal forecast is for dry or cool, wet conditions that slow crop growth Actions if risk is high: Ensure accurate identification of species Use Timerite® (redlegged earth mites only) Heavily graze pastures in early-mid spring
Pre-sowing
Actions if risk is high: Use an insecticide seed dressing on susceptible crops Plan to monitor more frequently until crop established Use higher sowing rate to compensate for seedling loss Consider scheduling a post-emergent insecticide treatment Actions if risk is low: Avoid insecticide seed dressings (esp. cereal and pulse crops) Plan to monitor until crop establishment
Emergence
Monitor susceptible crops through to establishment using direct visual searches Be aware of edge effects; mites move in from weeds around paddock edges Actions if spraying: Ensure accurate identification of species before deciding on chemical Consider border sprays Spray prior to the production of winter eggs to suppress populations and reduce risk in the following season Follow threshold guidelines
Crop establishment
As the crop grows, it becomes less susceptible unless growth is slowed by dry or cool, wet conditions

Feeding

Mites feed by rasping the surface of the cotyledons and leaves and by sucking up the sap. Feeding is normally from late afternoon until early morning, but continues through the day in calm, cloudy weather. Mites are very active and, if disturbed on a plant, will drop or descend to the ground and disperse to find shelter. RLEM usually remain clustered together on the soil or on parts of the leaves during the day. Blue oat mites generally hide by day in the soil beneath damaged plants or under plant debris on the ground. [11]

[10] P Umina (2014) Persistent pests; aphids, mites, millipedes and earwigs. GRDC Update Papers, 5 February 2014, http://grdc.com.au/Research-and-Development/GRDC-Update-Papers/2014/02/Persistent-pests-aphids-mites-millipedes-and-earwigs

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

7.3.1 Redlegged earth mite

The RLEM is native to southern Africa, and cape weed is its preferred host plant. Other hosts include prickly paddy melon, wild turnip, common sowthistle, Paterson's curse and chickweed (weeds); and canola, lupins, field peas and linseed (field crops). Sometimes mites may move into young winter cereals from a fenceline or adjoining pasture and cause damage along one or more of the crop edges.

Description

Adult mites are eight-legged and ~1 mm long with oval, flattened black bodies and pinkish-orange legs and mouthparts.

Seasonal development

Three overlapping generations usually occur between mid-autumn and spring, and adult populations are normally highest in May–June and September–October. RLEM survive over summer as unlaid, aestivating eggs in the dead bodies of spring-generation adult mites lying on or near the soil surface. The aestivating eggs are highly resistant to desiccation and usually do not begin to develop until late summer–early autumn. They hatch when favourable conditions of soil temperature and moisture occur in the following mid-autumn to early winter.

TIMERITE® for management of redlegged earth mite

TIMERITE® is an information package that provides individual farmers with the optimum spray date for controlling RLEM during spring on their farm. Developed by CSIRO and Australian Wool Innovation, TIMERITE® predicts the optimum date in spring to control RLEM, just after they have ceased laying normal winter eggs on pasture and just before diapause. (Diapause is when adults produce eggs that are retained in the body of the adult female and are therefore protected from the effects of insecticide applications.) The single, strategic spray has a two-fold effect, controlling RLEM in spring and decreasing the summer population that emerges in the following autumn. The package may form part of an integrated management strategy to control this pest.

Close attention should be paid to individual pesticide labels when controlling earth mites. Application rates vary with situations, such as bare earth or post-crop or pasture emergence. Correct identification of earth mite species is essential. Registrations sometimes include RLEM only, not blue oat mites or *Bryobia* mites. Application rates may vary with earth mite species. READ THE LABEL.

This strategic approach has little effect on non-target invertebrates, both pest and beneficial, during the following autumn. Growers need to identify geographically the location to be sprayed. This can be done by a local feature, such as town or mountain, or the longitude and latitude of the area. This information is used to find the optimum date from the package. The spray date for each farm is the same date each year. For information, phone Australian Wool Innovation toll free on 1800 070 099 or visit the website www.wool.com/woolgrower-tools/timerite/. [12]

More information

Ground Cover: Redlegged earth mites challenge WA growers

IPM Guidelines for Grains: Earth mites

DAFWA: Diagnosing redlegged earth mite

eXtensionaus: Resistant RLEM status update WA

Agriculture Victoria: Redlegged earth mite

Cesar Australia: Redlegged earth mite

Insect pests of canola

DAFWA: Prevent redlegged earth mite resistance

More information

Persistent pests; aphids, mites, millipedes and earwigs

More information

TIMERITE® information package

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

Preventing RLEM resistance to insecticides

Western Australia is the only state to have RLEM that are resistant to the synthetic pyrethroid (SP) insecticides. Resistant RLEM populations are likely to be present in more localities in Western Australia and elsewhere in southern Australia, especially in paddocks that have a history of repeated SP applications (Figure 1).

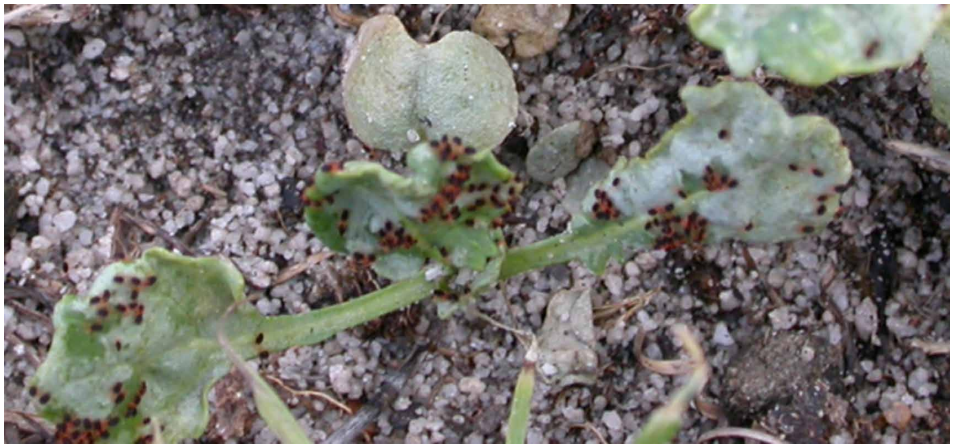

Figure 1: Redlegged earth mites infest seedlings. (Photo: DAFWA)

How does resistance occur?

Repeated use of SP insecticides within seasons and between seasons selects for RLEM resistance to this chemical group. All SPs have the same molecular mode of action; therefore, once RLEM develop resistance to one insecticide, they are resistant to all insecticides in this chemical group (Group 3A).

The repeated cumulative exposure of RLEM to SPs is the main factor behind resistance developing. If SP insecticide is used against pests such as weevils or aphids, RLEM may also receive a dose of the chemical, even though they are not the direct target.

Chemical control options

Growers with resistant RLEM have been able to control these mites by using insecticides from the organophosphate (OP) group (Group 1B), e.g. dimethoate or omethoate. However, residual populations of SP-resistant RLEM were found on weeds along fencelines and in re-infested paddocks and WA now has a confirmed RLEM population resistant to omethoate.

How long does resistance last?

Insecticide resistance in RLEM is inherited and mechanisms to switch it off have not been found. RLEM at one site have been tested each year for 4 years and are still resistant to SPs, even without further SP application. This indicates that resistance, once established, is likely to persist in RLEM populations over many years. We need to prevent further development of resistance by decreasing overall use of SPs.

Spread of resistance

Locations of resistance within the south of Western Australia are geographically distinct, suggesting that resistance develops in isolated RLEM populations within each property. Resistant RLEM have been found on properties near Esperance, Cranbrook, South Stirlings, Tenterden and Boyup Brook, making it unlikely that resistant RLEM have spread between locations. However, resistant RLEM can move into adjacent paddocks from weeds on fencelines.

Managing resistance

Identify your mites

Redlegged earth mites are often found with other mites, such as blue oat mite, *Bryobia* (clover) mite or *Balaustium* mite; however, resistance has been found only in RLEM. In situations where spray failures have occurred, it is important to identify the mite correctly. Blue oat mites are controlled by all chemicals registered for RLEM control, whereas chemical controls for *Bryobia* mite and *Balaustium* mites differ.

Plan ahead to reduce mite numbers

If you prepare paddocks in the preceding season, there will be lower numbers of pests on your crops. Consider the following strategies to reduce pest numbers:

- Control weeds in the crop and along fencelines. Weeds provide habitat for mites. Controlling weeds with herbicides, cultivation or heavy grazing will decrease mite numbers. A weed-free crop will have few mites and oversummering eggs to carry through to the following season.
- Controlled grazing of pasture paddocks in the year prior to a cropping year will reduce RLEM numbers to levels similar to chemical sprays. Sustained grazing of pastures throughout spring to maintain feed on offer levels below 2 t/ha (dry weight) will restrict mite numbers to low levels. Control RLEM in spring.
- Apply insecticides to some paddocks during spring to prevent RLEM populations producing oversummering eggs. This will decrease the pest population in the following autumn. Only specific paddocks should be selected for spring spraying based on levels of feed on offer, future grazing-management options, seed production requirements and intended paddock use next season. The routine spraying of all pasture paddocks in spring using TIMERITE® dates to prevent a buildup of mites is unlikely to be sustainable.
- Use cropping rotations to decrease reliance on pesticides. Some paddocks will have a higher or lower risk of RLEM damage depending on previous crop rotations. The risk is generally highest if paddocks have been in long-term pasture (with high levels of broadleaf plants) where mite populations have been uncontrolled. Lower risk paddocks that generally do not require mite control are those following a cereal or canola weed-free crop, where conditions are less favourable for mite increase.

What you can do this season

Spray only if you need to

Growers with populations of resistant RLEM have mostly used repeated applications of SP chemicals as ‘insurance’ sprays to minimise anticipated pest risks. To decrease

the likelihood of resistance developing on your property, apply insecticides only on paddocks with damaging numbers of pests.

Where spraying is needed, rotate chemical groups

Rotate between SPs and OPs, within and between seasons; this will help to reduce resistance buildup. If spraying other pests such as aphids, try not to use SPs. Consider other chemical options such as pirimicarb.

Predict hatchings of RLEM on your property to target your control strategy

Knowing the approximate time when the first autumn hatchings of RLEM are occurring on your property will help to determine whether they will coincide with seedling crops. RLEM hatch in autumn from their oversummering egg stage after adequate rainfall and at least 7 days of average temperatures <20°C. Crops sown in seasons with 'early breaks' with maximum temperatures well above 20°C (e.g. canola sown in April) will not be damaged by RLEM.

Use insecticide seed treatments

Use insecticide seed treatments for crops and sown pastures with moderate pest pressure rather than spraying whole paddocks. Seed treatments allow smaller quantities of pesticide to be used that directly target plant-feeding pests, allowing any predatory insects to continue their important beneficial role.

Do you suspect you have resistant RLEM?

If you have RLEM that survive registered rates of insecticide treatments or suspect that you have mites resistant to chemicals, contact the Department of Agriculture and Food, Western Australia's (DAFWA) broadacre entomologists. Arrangements can be made to have mites sampled and tested for their level of resistance. [13]

7.3.2 Blue oat mite

Blue oat mites are often confused with RLEM. There are four recognised species of blue oat mite in Australia: *Penthaleus major*, *P. falcatus*, *P. minor* and *P. tectus*. Accurate identification of the species requires examination by an entomologist. The four species vary in their geographical distribution in Australia.

More information

DAFWA: Diagnosing blue oat mite

Crop mites. Back Pocket Guide

Damage to crops and pastures is incurred in the establishment phase. Host-plant preferences vary with the species, as do their life cycles and tolerances to various pesticides. Host plants include black thistle, chickweed, curled dock, dandelion, deadnettle, prickly lettuce, shepherds purse, variegated thistle and wild oat. Cultivated field-crop hosts include wheat, barley, oats, rye, canola, field peas, lupins and linseed.

Description

Adult mites have eight legs and are ~1 mm long with oval, rounded, dark brown to black bodies, bright red or pinkish red legs and mouthparts, and a red spot or streak towards the hind end of the back.

[13] S Micic (2015) Prevent redlegged earth mite resistance. Department of Agriculture and Food Western Australia, https://www.agric.wa.gov.au/mites-spiders/prevent-redlegged-earth-mite-resistance?page=0%2C2

Seasonal development

Overlapping generations of the blue oat mite usually occur between mid-autumn and late spring. Blue oat mites oversummer as aestivating eggs laid in mid–late spring by the second-generation adults. These aestivating eggs are highly resistant to desiccation. They do not begin to develop until late summer–early autumn and they do not hatch until favourable conditions of temperature and moisture occur in the following mid-autumn to early winter. [14]

7.4 Lucerne flea

Lucerne flea is an occasional pest of establishing canola crops. The pest is identified by its action of jumping and hopping between plants rather than flying. Early-sown crops are more at risk of attack. Frequent crop inspection from the time of emergence and early control measures are important because of the impact of seedling vigour on crop performance. Ensure that monitoring is sufficient to detect localised patches or 'hot spots'. Seek advice on management and spray strategies. [15]

7.5 Slugs

Slugs kill plants at the seedling and rosette stages and can leave large, bare-soil areas. Slugs are favoured by wet springs and summers, where abundant growth and damp conditions provide an ideal habitat. This allows slugs to breed and survive into autumn and winter, when they attack newly sown crops.

Canola sown into dense stubble or adjacent to grassy fencelines, creek banks or damp areas is at greatest risk because these areas provide an ideal habitat for slugs to survive over summer. Heavy, cracking soils provide additional hiding places for slugs. Closely monitor crops at risk for 6–8 weeks after sowing, so that any infestation can be treated with slug pellets containing metaldehyde, methiocarb or iron chelate. [16]

7.6 Diamondback moth

Diamondback moth (DBM) (Figure 2) has been observed in canola crops for many years in WA,. They have caused significant economic damage in years where late summer/early autumn rain is experienced and host plants such as wild radish and volunteer canola germinate early, allowing DBM larvae to build numbers as the canola crops are sown.

The larvae of DBM do most damage when large numbers are present in seedling crops or when they move from leaves to graze developing pods during crop ripening.

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

15 P Matthews, D McCaffery, L Jenkins (2015) Winter crop variety sowing guide 2015. NSW DPI Management Guide. NSW Department of Primary Industries, http://www.dpi.nsw.gov.au/__data/assets/pdf_file/0011/272945/winter-crop-variety-sowing-guide-2015.pdf

16 P Matthews, D McCaffery, L Jenkins (2015) Winter crop variety sowing guide 2015. NSW DPI Management Guide. NSW Department of Primary Industries, http://www.dpi.nsw.gov.au/__data/assets/pdf_file/0011/272945/winter-crop-variety-sowing-guide-2015.pdf

Diamondback moth has developed resistance to a range of insecticides. Future management will involve regular monitoring and careful selection of control methods. [17]

Figure 2: Management of diamondback moth involves regular monitoring and careful selection of control methods. (Photo: GRDC)

More information

GRDC Fact Sheet: Diamondback Moth in Canola

DAFWA: Diagnosing Diamondback Moth

FAQ 7.7 Aphids

Aphids are common pests of canola in Western Australia. They suck sap from plants and can be found massed on growing points or lower leaves of canola, depending on the aphid species. During growing seasons preceded by above-average rainfall in March and April, aphids can arrive in crops in large numbers early in the season. Cold weather and heavy rainfall during the growing season can help to suppress aphid numbers. [18]

7.7.1 Description

Three aphid species commonly attack canola in Western Australia:

- turnip aphid (Figure 3)

[17] P Matthews, D McCaffery, L Jenkins (2015) Winter crop variety sowing guide 2015. NSW DPI Management Guide. NSW Department of Primary Industries, http://www.dpi.nsw.gov.au/__data/assets/pdf_file/0011/272945/winter-crop-variety-sowing-guide-2015.pdf

[18] S Micic, P Mangano (2015) Aphid management in canola crops. Department of Agriculture and Food Western Australia, https://www.agric.wa.gov.au/pest-insects/aphid-management-canola-crops?page=0%2C2

- cabbage aphid (Figure 4)
- green peach aphid (Figure 5)

The three species are described in Table 2.

Figure 3: Turnip aphids on canola flowering spike. (Photo: DAFWA)

Figure 4: Cabbage aphids on canola flowering spike. (Photo: DAFWA)

Figure 5: Green peach aphids on underside of canola leaf. (Photo: DAFWA)

Table 2: Distinguishing features of the three species of aphids found attacking canola in Western Australia [19]

	Turnip aphid	Cabbage aphid	Green peach aphid
Length of adult (mm)	1.4–2.4	1.6–2.8	1.2–2.3
Abdomen colour	Greyish to mid green	Greyish to mid green	Shiny yellow to mid green to pink or red
Other features	Body often has a light waxy covering, dark bars on abdomen	Body covered with a dense white mealy wax	Black patch on abdomen of winged adults. Wingless forms uniform in colour
Colony habit	Dense colonies, usually around growing tips and flowering spikes	Dense colonies usually seen on flowering spikes	Mostly found on the underside of lower leaves. Sparse colonies may occur with turnip or cabbage aphids
Abundance on canola	Usually common and abundant; depending on season	Common and abundant on canola	Common but seldom builds up to large colonies
Alternative hosts	Wild radish, wild turnip and self-sown canola	Wild radish, wild turnip and self-sown canola	Wild radish, wild turnip, and self-sown canola, lupins, cape weed

7.7.2 How crop infestations start

Winged aphids fly into the crop from autumn weeds. Winged aphids that migrate to the crop give rise to colonies consisting mostly of wingless aphids. Aphids that arrive in crops in autumn and persist in low numbers over winter may lead to large, damaging populations that peak in late winter and early spring.

Cold and wet conditions during winter tend to suppress aphid populations. Turnip and cabbage aphids are rarely seen together on the same plant, but both form

[19] S Micic, P Mangano (2015) Aphid management in canola crops. Department of Agriculture and Food Western Australia, https://www.agric.wa.gov.au/pest-insects/aphid-management-canola-crops?page=0%2C2

characteristically dense clusters on the terminal flowering spikes and are generally the most damaging and common species encountered in Western Australian crops.

Careful monitoring for crop pests will often reveal aphids hidden on stems amongst the buds and flowering heads of canola. The green peach aphid is often found in seedling crops; on established crops, it prefers to feed on the undersides of older canola leaves, where it causes little or no damage. [20]

7.7.3 Feeding damage

Large populations of aphids that may develop in late winter and early spring cause damage by feeding on the growing shoot tips, causing wilting, flower abortion and reduced podset.

If aphid populations are very large, the sticky honeydew that they exudate can lead to a black mould growth. This mould rarely occurs in canola crops, but if present, it can reduce the ability of plants to photosynthesise and decrease plant vigour. [21]

7.7.4 Results of feeding-damage trials

Significant yield losses of up to 33% were recorded in Western Australia in a replicated field trial in 2003. Growing canola in low-rainfall areas where drought stress is more likely, coupled with the release of cultivars more susceptible to aphid colonisation, has increased the risk of aphid feeding damage and yield losses to canola in these areas.

Furthermore, aphid populations develop more rapidly on plants suffering from moderate drought stress than on healthy, stress-free plants. The stressed plants being targeted by aphids are less able to compensate for aphid feeding damage than healthy plants. [22]

7.7.5 Yield loss from viruses

Aphids can also transmit virus diseases in canola crops; the most common virus is *Beet western yellows virus* (BWYV). BWYV is persistently transmitted by aphids, and green peach aphids are the most important vector.

Most yield loss occurs when aphids transfer the virus very early in the life of the crop, which can lead to stunting and obvious reddening of plants. Studies by Department of Agriculture and Food WA Plant Virologists on the relationship between virus infection

[20] S Micic, P Mangano (2015) Aphid management in canola crops. Department of Agriculture and Food Western Australia, https://www.agric.wa.gov.au/pest-insects/aphid-management-canola-crops?page=0%2C2

[21] S Micic, P Mangano (2015) Aphid management in canola crops. Department of Agriculture and Food Western Australia, https://www.agric.wa.gov.au/pest-insects/aphid-management-canola-crops?page=0%2C2

[22] S Micic, P Mangano (2015) Aphid management in canola crops. Department of Agriculture and Food Western Australia, https://www.agric.wa.gov.au/pest-insects/aphid-management-canola-crops?page=0%2C2

and yield losses in canola have shown that a combination of BWYV and green peach aphids can cause yield losses of up to 50% in canola.[23]

7.7.6 Monitoring for aphids

Canola is most sensitive to aphid damage from bud formation through to late flowering. Crops at this stage should be checked regularly for aphids in case numbers escalate to the extent that they cause economic damage to the crop. Start monitoring from late winter and continue through spring.

Aphid distribution can be patchy. Check at least five points of the paddock and look for aphids on at least 20 plants at each point. Check plants and count the number of flowering spikes infested with aphids.[24]

7.7.7 Look for the beneficials

Beneficials include predators such as ladybirds, hoverflies (Figures 6 and 7) and lacewing (Figures 8 and 9), and parasitic wasps. These are a common form of aphid control during the warmer days of spring and when low to moderate numbers of aphids are present, but they have less impact on heavy infestations of aphids.[25]

Figure 6: Hoverfly larva eating an aphid. Hoverfly adults are more likely to be seen in crops. (Photo: DAFWA)

[23] S Micic, P Mangano (2015) Aphid management in canola crops. Department of Agriculture and Food Western Australia, https://www.agric.wa.gov.au/pest-insects/aphid-management-canola-crops?page=0%2C2

[24] S Micic, P Mangano (2015) Aphid management in canola crops. Department of Agriculture and Food Western Australia, https://www.agric.wa.gov.au/pest-insects/aphid-management-canola-crops?page=0%2C2

[25] S Micic, P Mangano (2015) Aphid management in canola crops, Department of Agriculture and Food Western Australia, https://www.agric.wa.gov.au/pest-insects/aphid-management-canola-crops?page=0%2C2

Figure 7: Hoverfly adults are more likely to be seen in crops. (Photo: DAFWA)

Figure 8: A lacewing larva feeding on aphids. (Photo: DAFWA)

Figure 9: Brown lacewing adult. (Photo: DAFWA)

7.7.8 What parasitic wasps look like

Parasitic wasp species sting the aphid and lay an egg inside. The larva hatches and slowly consumes the aphid, eventually killing it. The parasite larva creates a 'mummy' by spinning a cocoon inside the aphid, then pupates and soon emerges as an adult wasp. The presence of bloated aphids with a pale gold or bronze sheen indicates parasite activity in the canola crop (Figure 10). [26]

Figure 10: Parasitised aphids are bronze in colour. (Photo: DAFWA)

7.7.9 Threshold for aphids

If >20% of plants are infested with colonies of aphids, control measures should be considered to avoid yield losses. Factors that increase the risk of economic yield losses are poor finishing rains or crops already under some degree of drought stress. [27]

7.7.10 Encourage beneficials

Predators and parasites should be encouraged as a natural way of suppressing aphid numbers. This can be achieved by using 'softer' chemicals (such as pirimicarb), which are aphid-specific and less harmful to other insects. [28]

[26] S Micic, P Mangano (2015) Aphid management in canola crops. Department of Agriculture and Food Western Australia, https://www.agric.wa.gov.au/pest-insects/aphid-management-canola-crops?page=0%2C2

[27] S Micic, P Mangano (2015) Aphid management in canola crops. Department of Agriculture and Food Western Australia, https://www.agric.wa.gov.au/pest-insects/aphid-management-canola-crops?page=0%2C2

[28] S Micic, P Mangano (2015) Aphid management in canola crops. Department of Agriculture and Food Western Australia, https://www.agric.wa.gov.au/pest-insects/aphid-management-canola-crops?page=0%2C2

7.7.11 Cultural controls

Implement early control of weeds such as wild radish and wild turnip on your property to prevent aphid buildup. Sow crops early to enable plants to begin flowering before aphid numbers peak. [29]

7.7.12 Chemical control

Pirimicarb and Sulfoxaflor (Transform®) are currently registered for aphid control in canola crops in this state. Check with your local Department of Agriculture and Food office or the Australian Pesticides and Veterinary Medicines Authority for any off-label permits each growing season. [30]

7.7.13 Green peach aphids and resistance

Green peach aphid has developed resistance to the SP, carbamate and OP groups of insecticides. Transform™ (sulfoxaflor) is a new selective insecticide for control of early-season infestations of green peach aphid. [31]

Aphids can infest crops in the spring, especially in years of moisture stress. Large populations of aphids are more evident and potentially damaging in dry seasons. Monitoring for beneficial insects is important, because control may not be justified in some cases. If control is warranted, careful selection of an insecticide is essential to ensure that damage is not caused to nearby beehives or to beneficial insects within the crop. Ensure that the harvest-withholding period (WHP) of the insecticide is adhered to. Seek advice on thresholds and product registrations or permits before spraying. [32]

Large numbers of green peach aphids occasionally occur on young, vegetative canola. SPs and some OPs have given poor kill results when applied to aphid-infested canola. Often the crop needs to be re-sprayed after SP application, which achieves less-than-optimum kill rates. Avoid using SPs for this reason and because this chemical group selects for insecticide resistance and kills non-target organisms including beneficial insects. [33]

Aphid flights can occur in autumn and winter in some years and can infest young canola crops. Crops may need to be treated with insecticide to prevent transmission

[29] S Micic, P Mangano (2015) Aphid management in canola crops. Department of Agriculture and Food Western Australia, https://www.agric.wa.gov.au/pest-insects/aphid-management-canola-crops?page=0%2C2

[30] S Micic, P Mangano (2015) Aphid management in canola crops. Department of Agriculture and Food Western Australia, https://www.agric.wa.gov.au/pest-insects/aphid-management-canola-crops?page=0%2C2

[31] P Matthews, D McCaffery, L Jenkins (2015) Winter crop variety sowing guide 2015. NSW DPI Management Guide. NSW Department of Primary Industries, http://www.dpi.nsw.gov.au/__data/assets/pdf_file/0011/272945/winter-crop-variety-sowing-guide-2015.pdf

[32] P Matthews, D McCaffery, L Jenkins (2015) Winter crop variety sowing guide 2015. NSW DPI Management Guide. NSW Department of Primary Industries, http://www.dpi.nsw.gov.au/__data/assets/pdf_file/0011/272945/winter-crop-variety-sowing-guide-2015.pdf

[33] S Micic, P Mangano (2015) Aphid management in canola crops. Department of Agriculture and Food Western Australia, https://www.agric.wa.gov.au/pest-insects/aphid-management-canola-crops?page=0%2C2

More information

Reducing aphid and virus risk

Resistance management strategy for the green peach aphid in Australian grains

Unified attack on pests and diseases

Insect pests—resistance, virus vectors and lessons from 2014

Crop aphids. Back Pocket Guide

Insect management in fababeans and canola recent research

of virus diseases, and to reduce seedling damage and the risk of spring infestations. The green peach aphid is the major vector of *Beet western yellows virus*, which caused major crop damage in area of South Australia in 2014. Seed treated with imidacloprid (e.g. Gaucho®), Poncho® Plus or Cruiser® Opti can protect seedling canola for up to 5 weeks. This is especially important in seasons and at sites where early infestation with aphids occurs. [34]

7.8 Management of bronzed field beetle—a pest of canola in the south of Western Australia

The larvae of the bronzed field beetle (*Adelium brevicorne*) (Figure 11), known as false wireworm, chew stems of young canola plants at ground level, causing plant death and thinning of the crop or the destruction of large areas. Most of the damage occurs to seedlings, but larger plants may be damaged if there are enough large larvae.

Figure 11: Bronzed field beetle (Adelium brevicorne), known as false wireworm. (Photo: DAFWA)

Distribution

Larvae of bronzed field beetle cause economic damage to canola in Western Australia and South Australia, but it is not considered a serious pest in Victoria. In Western Australia, it is most abundant in the South Coast, Great Southern and Lakes areas. It is less prevalent in areas north of Perth and in the eastern wheatbelt.

In South Australia, this pest is most common on Lower Eyre Peninsula and in the Mid North and the South East.

Description

Adults are up to 11 mm long and are a shiny black with a slight bronze appearance in some light (Figure 12). Larvae are dark brown and grow to 12 mm long and 2–3 mm wide, with 12 body segments, the last one having two distinct upturned spines.

[34] P Matthews, D McCaffery, L Jenkins (2015) Winter crop variety sowing guide 2015. NSW DPI Management Guide. NSW Department of Primary Industries, http://www.dpi.nsw.gov.au/__data/assets/pdf_file/0011/272945/winter-crop-variety-sowing-guide-2015.pdf

Figure 12: Larva, pupa, new adult, and hardened bronzed field beetle adult. (Photo: DAFWA)

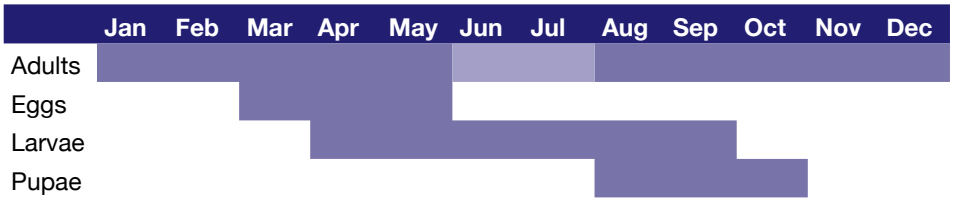
Lifecycle

Over summer and autumn, adults shelter in crop residue, and under wood, rocks or tufts of grass. They do not fly but become very active after autumn rains, when a large proportion of a female's body may be taken up with eggs.

Eggs hatch from late March, depending on soil moisture. When hatching occurs early, these larvae may reach a length of ≥5 mm before the crop is seeded. The larger the larval stage is at seeding, the more damage occurs.

In August, larvae begin changing to the pupal stage and new adults appear soon after. The duration of the life stages is shown in Figure 13.

Figure 13: Duration of lifecycle stages of the bronzed field beetle. (Source: DAFWA)



7.9 *Helicoverpa*

Helicoverpa originate in pastoral regions bordering agricultural areas. Moth flights are monitored from late winter through spring. Ten to 14 days after flights are observed there will be hatchings in susceptible crops. These will need to be monitored to determine if they need to be controlled.

Agronomist's view

Helicoverpa (also known as heliothis or Native Budworm) caterpillars are a regular pest of canola in WA, particularly in the Northern and South East coastal areas, which may require control measures if they are present in large numbers during canola pod fill. Because of the seasonal variation in incidence and timing of infestation relative to crop growth stage, growers should seek advice and check the harvest WHP of the chosen insecticide before deciding to spray.

Seasonal biology

There are generally three or four overlapping generations of caterpillars of the native budworm between September and May. [35]

Scout crops regularly

The amount of damage caused by native budworm and corn earworm varies considerably from year to year. Moth activity alone cannot be taken as a guide for spraying. In some years when moths are common, egg and caterpillar numbers are often limited by adverse cool or cold, wet weather, parasitoids, predators and diseases, and damage may be restricted or insignificant. In other years, a relatively small moth population may produce many caterpillars and cause significant damage. Periodic outbreaks of caterpillars of both species in summer are often associated with heavy rainfall. Check crops at least a week after heavy rainfall. Look for moths, eggs and very small caterpillars, and treat if necessary. Spraying thresholds are unlikely ever to be more than guidelines for timing sprays. Examine crops at least twice a week during the various danger periods.

Before deciding to spray, consider the following:

- likely extent and severity of the infestation
- ability of the crop to tolerate caterpillar damage without any significant loss or to replace leaves or fruiting parts lost to the caterpillars
- value or likely loss if the crop is left untreated
- cost of treatment [36]

7.9.1 Native budworm

Native budworm is widely distributed throughout mainland Australia and during winter breeds in semi-arid parts of Western Australia. The native budworm is indigenous to Australia and can develop large populations over extensive areas on native plants. These populations often migrate into agricultural regions in late winter and spring, causing damage to crops. Migratory flights are unpredictable, and moths may be carried hundreds of kilometres from breeding areas by high-altitude air currents. [37]

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

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

37 DAFWA (2015) Management and economic thresholds for native budworm. Department of Agriculture and Food Western Australia, https://www.agric.wa.gov.au/grains/management-and-economic-thresholds-native-budworm

7.9.2 Descriptions of eggs and caterpillars

Eggs

Newly laid eggs are white or yellowish white, dome-shaped, flattened at the base, ribbed and 0.5 mm in diameter. Not all eggs are fertile. Fertile and infertile eggs are laid at the same time, and sometimes all eggs laid are infertile. Fertile eggs change to greenish yellow with an irregular brown or reddish brown ring around the middle. Before hatching, the blackish head and grey body of the caterpillar shows through. They hatch in 3–5 days in warm weather and 6–16 days in cooler weather. Infertile eggs appear cylindrical within ~12 h of being laid and then shrivel to a pyramid shape.

Caterpillars

Newly hatched caterpillars are 1–1.5 mm long with dark heads and dark-spotted white bodies. Young caterpillars up to about 15 mm long have dark heads and pale yellow, greenish or brownish bodies with conspicuous upper body hairs in dark bases and, often, narrow dark stripes down the back and along each side. Older caterpillars up to 50 mm long vary greatly in colour from yellow to almost black, often have a broad pale stripe along each side, and their upper body hairs are usually on raised processes.

Egg laying

Egg laying is usually confined to the period from flower bud formation until flowering ends. When moths are exceptionally abundant, infestation can be expected before flowering commences. Eggs are laid, usually singly, on the upper parts of plants—vegetative or floral growing points, young tender leaves, stems and flower buds, flowers and fruits. The moths prefer the more advanced and succulent portions of crops for egg laying and usually avoid poorly grown areas. Eggs may not be obvious to the untrained eye because they are minute. However, moderate to heavy egg lays should be obvious to trained observers. [38]

7.10 Diagnosing weevils in canola

Weevils are beetles with long snouts and can damage or kill young seedlings. Species that damage canola include: the vegetable weevil, more common in high-rainfall areas and often next to trees or bush; *Desiantha* weevil (also known as spotted vegetable weevil), which is widespread; and small lucerne weevil and Fuller's rose weevil, which mainly occur on the south coast of Western Australia (Figure 14).

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

Figure 14: Weevils infesting canola in Western Australia. (Photos: DAFWA)

7.10.1 What to look for

In the paddock:

- Areas of chewed and lopped canola seedlings will be visible.
- Damage from vegetable weevil is usually worst next to paddock edges and bush areas, or in parts of the paddock that had cape weed in the previous year.

On the plant:

- Seedling leaves, petioles and stems will be chewed.
- Stems may be severed, causing rapid death.
- Leaves have crescent-shaped pieces removed, giving them a serrated appearance.

Adult insects:

- Weevils are generally grey and often hard to find.
- Vegetable weevil is about 10 mm long with two short white stripes at an angle on each side of its abdomen.
- *Desiantha* weevil is about 5 mm long, dark-coloured and sometimes has grey flecks on its back.
- Small lucerne weevil is about 5 mm long, light grey in colour, with a white stripe on each side.
- Fuller's rose weevil is about 8–10 mm long but has yellow stripes on its side and back.

7.10.2 What else could it be?

Other pests that might be mistaken for weevils are presented in Table 3.

Table 3: Similarities/differences between other pests and weevils (source: DAFWA)

Condition	Similarities	Differences
Vegetable beetle damage	Chew stem, petiole, leaves and sever the seedling stem	Weevils can cause scalloped leaf damage and have characteristic long snouts. They are usually found in the vicinity of the damage
Cutworm in canola and pulses	Chew stem, petiole, leaves and sever the seedling stem	
False wireworm	Stem ringbarked, sudden plant death	Weevils also chew leaves and petioles, weevils hidden nearby

7.10.3 Where did it come from?

With the exception of the vegetable weevil, weevils are flightless and remain in the paddock during their life cycle. Adults eat canola and a range of broadleaf weeds, particularly cape weed. Adults emerge from the soil in spring–early summer and survive by hiding in soil litter, and under stones, plants or clods. Eggs are laid into the surface of the soil and hatch when there is sufficient moisture for plant germination. *Desiantha* larvae feed on grass, and cereal seedlings.

Vegetable weevils rarely fly but adults rest in the soil in bush or paddock edges during summer. They are attracted to any paddock that has cape weed present, and after cape weed germination, they move into the paddock to feed and lay eggs. In early winter, the eggs hatch into green larvae that feed on the plants on which they hatched. The adult weevils also move into the edges of canola paddocks to feed soon after crop emergence.

7.10.4 Management strategies

- An insecticide border spray at crop emergence will help to control vegetable weevil before it moves into the crop. Paddock boundaries should be checked every few days until the crop has four or five true leaves.
- *Desiantha*, small lucerne and Fuller's rose weevil are not controlled by border sprays because they tend not to migrate out of paddocks.
- Paddocks where *Desiantha* weevil larvae damaged cereals in the year before will have *Desiantha* weevil adults present in the current year.
- Weevil numbers in crop can be reduced by controlling plant hosts such as cape weed before canola is sown.
- Spray 'green break' summer weeds.

7.10.5 How can it be monitored?

Check paddock boundaries every few days for vegetable weevil incursion until the crop has four or five true leaves. [39]

7.11 Diagnosing cabbage white butterfly

Larvae of cabbage white butterfly are often found in canola crops (Figure 15). The larvae consume leaves, but numbers are rarely high enough to cause serious damage to the crop.

Figure 15: Life stages of cabbage white butterfly. (Photos: DAFWA)

7.11.1 What to look for

On the plant:

- large irregular holes chewed in leaves
- foliage preferred over floral parts

Insect nymph:

- velvety green caterpillar up to 30 mm long with a pale yellow stripe down the back

Adult insect:

- large moths with 30–40 mm wingspan, predominantly white with black wingspots and markings

[39] S Micic (2015) Diagnosing weevils in canola. Department of Agriculture and Food Western Australia, https://www.agric.wa.gov.au/mycrop/diagnosing-weevils-canola

7.11.2 What else could it be?

Diamondback moth has a similar green caterpillar that eats holes in leaves. Cabbage white butterfly is smaller, lighter green, and more irritable, often dangling from a silken thread when disturbed.

7.11.3 Management strategies

Cabbage white butterfly is not an economic problem of canola but can be controlled with foliar insecticides. [40]

7.12 Vegetable beetle (*Gonocephalum missellum*)

7.12.1 Description

Adult

- About 9 mm long.
- Matte grey, sometimes encrusted with soil on its back.

Figure 16: Vegetable beetle adult. Photo: DAFWA

Larvae

- about 18 mm long and 2 mm wide when fully grown.
- Three pairs of legs on thorax, shiny, hard skin, worm-like shape ('false wireworm').

[40] S. Micic (2015) Diagnosing cabbage white butterfly. Department of Agriculture and Food Western Australia, https://www.agric.wa.gov.au/mycrop/diagnosing-cabbage-white-butterfly

Figure 17: Vegetable beetle larva. Photo: DAFWA

7.12.2 Damage

Adult

- Often present in clusters and found under debris or vegetation.
- Feeds on decaying vegetation, but known to attack seedlings.
- More active than African black beetle.

Larvae

- Larvae are soil dwelling and feed on organic matter.
- Can be pests of summer grown crops.
- If present as large larvae when potatoes are near harvest can chew holes in them. [41]

More information

DAFWA: Cockchafer damage in broadacre crops

DAFWA: Diagnosing bryobia mite

DAFWA: MyPestGuide app

DAFWA: Identifying soil beetle pests

7.13 Other soil pests

As with slugs, there are increasing reports of European earwigs causing significant damage to emerging crops. Stubble retention, in combination with wet springs and summers and an early autumn break, appear to favour the buildup of these insects. The damage caused by earwigs can be difficult to identify, and because control can also be difficult, growers should seek advice if they suspect or see earwigs. Several soil-dwelling insect pests such as cutworms, wireworms, bronzed field beetle, cockchafers and false wireworms have caused damage to emerging canola seedlings in recent years. In severe cases, plant stands can be thinned to such an extent that the paddock requires re-sowing. Occurrence of these pests is difficult to predict, so advice on their control should be sought prior to sowing if any problems are foreseen. The most severe damage tends to occur in crops following pasture, or if stubble has been retained. [42]

[41] S. Micic (2015) Vegetable beetle. Department of Agriculture and Food Western Australia, https://www.agric.wa.gov.au/pest-insects/identifying-soil-beetle-pests?page=0%2C1#smartpaging_toc_p1_s6_h2

[42] P Matthews, D McCaffery, L Jenkins (2015) Winter crop variety sowing guide 2015. NSW DPI Management Guide. NSW Department of Primary Industries, http://www.dpi.nsw.gov.au/__data/assets/pdf_file/0011/272945/winter-crop-variety-sowing-guide-2015.pdf