9. Pests of canola and their management

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A number of insects and mites can damage canola crops. Most are usually of only limited importance. Some, such as the redlegged earth mite, blue oat mite, lucerne flea, cutworms, aphids, Rutherglen bug and caterpillars of diamondback moth, corn earworm and native budworm, cause severe and widespread losses in some years. Significant damage is most likely to occur during establishment and from flowering until maturity. Growers should be prepared to treat each year at, or soon after, sowing to control mites and budget for an aerial spray between flowering/podding and maturity.

CULTURAL CONTROL OF ESTABLISHMENT PESTS

Canola crops often follow a pasture phase. Pasture is the natural habitat of some establishment pests, including redlegged earth mite, blue oat mite and false wireworms. These pests can be reduced by a period of fallow between cultivation of the pasture and sowing of the crop.

Early ploughing and maintaining a clean fallow by occasional cultivations are often beneficial. Weedy fallows and the retention of cereal stubble can promote pest build-up or provide shelter for pests.

Many weeds provide food for insect pests. Large populations may develop or shelter in grassy or weedy headlands and then move into nearby crops. Clean cultivation of headlands during summer and autumn stops pests from breeding or sheltering there.

ESTABLISHMENT PESTS

Regular monitoring is essential to detect pest activity early before significant damage to germinating canola can occur. Once canola seedlings are severely damaged they do not recover. Many of the establishment pests can quickly create large bare areas which will require resowing.

The damage caused to germinating canola by a number of pests (for example, several false wireworm species, slugs, common white and white Italian snails, European earwigs) can be difficult to distinguish and therefore attributed to the wrong pest. Correct identification of canola pests and pest damage is vital to ensure appropriate management.

Redlegged earth mite (*Halotydeus destructor*) and blue oat mite (*Penthaleus major, P. falcatus, P. tectus* sp. n.)

Both redlegged earth mite (RLEM) and blue oat mite (BOM) (a complex of several species) feed on the cotyledons and leaves of seedlings by a rasping and sucking action. Heavily infested plants have mottled and then whitened cotyledons and leaves. Very severely damaged plants die and severely damaged plants usually remain stunted and weak. Sometimes the seedlings are killed before they emerge.

The mites normally feed from late afternoon until early morning but in calm, overcast weather feeding continues

Mites attack seedlings as soon as, or even before, they emerge, weakening or even killing them. PHOTO: A. PHILBY, NSW DPI

Redlegged earth mite. Actual length 1 mm. Silvery patches indicate mite damage. PHOTO: R. COLTON, NSW DPI

Damage from earth mite feeding. Note white-silvering effect. PHOTO: P. UMINA, UNIVERSITY OF MELBOURNE

Redlegged earth mite. Note the black body and red legs, length about 1 mm.
PHOTO: P. UMINA, UNIVERSITY OF MELBOURNE

Blue oat mite. Note blue-black body with orange-red spot on back, red legs, length about 1 mm.
PHOTO: P. UMINA, UNIVERSITY OF MELBOURNE

during the day. They are very active and when disturbed on a plant will drop or descend to the ground and quickly hide in the soil or under vegetation.

RLEM and BOM are similar in appearance in all their life stages and they both prefer light, sandy or loamy, well drained soils. They often occur together in crops and pastures on the tablelands, slopes and plains of southern NSW, where they may cause crop damage. In northern NSW, BOM causes all of the mite damage to canola. In some regions of northern NSW, BOM is more tolerant to the registered insecticide rates that may result in chemical control failures.

Canola is a good host for breeding of *P. falcatus* and RLEM, but *P. major* and *P. tectus* sp. n. cannot successfully breed in canola. It may therefore be an ideal crop in rotation programs where either *P. major* or *P. tectus* sp. n. is prevalent.

Both adult mites are eight-legged, oval shaped and about 1 mm long. Redlegged earth mites have somewhat flattened black bodies and pinkish orange legs and mouthparts; blue oat mites have rounded, dark blue to black bodies, bright red or bright pinkish red legs and mouthparts, and a red spot in the centre of the lower back.

Both RLEM and BOM survive over summer as eggs. With RLEM, the final generation adults produce these eggs (known as aestivating or diapause eggs) in mid to late spring. By contrast, BOM produce aestivating eggs in autumn almost immediately after emergence and continue producing these eggs throughout the period when adults are active. Neither the RLEM or BOM eggs hatch until favourable conditions of temperature and moisture occur in the following mid autumn to early winter. BOM eggs generally hatch in autumn earlier than those of RLEM. Both RLEM and BOM develop through two to three generations a year.

Control of RLEM the previous spring. The size of the oversummering RLEM egg population can be greatly reduced by treating mite-infested pasture paddocks with a systemic (foliage absorbed) insecticide during August or early September, the year before sowing. If this management procedure is not carried out, canola sown into pasture paddocks is at risk from RLEM. To help achieve the optimal spray date consult the TIMERITE® website (www.timerite.com.au). Because BOM can produce oversummering eggs from autumn through to spring, chemical control strategies aimed at reducing the spring diapause generation do not work for this species.

Control at sowing. Three insecticidal control tactics are available:

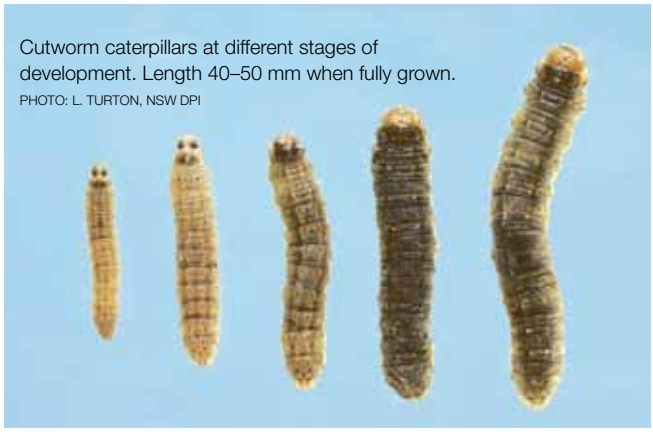
1. Sowing insecticide-treated seed
2. Bare-earth spraying the soil surface immediately after sowing
3. Spraying the seedling foliage with a systemic insecticide. For this tactic to be effective the mites must be detected early. Monitor carefully for mites every two or three days by estimating mite numbers in a 10 x 10 cm (100 cm^2) ground area. Repeat at 5–10 sites in the crop. Avoid monitoring in bright light by choosing cloudy days and/or early morning or late afternoon. Treat if 10 or more mites are found per 100 cm^2 sample.

Cutworms (*Agrotis* spp.)

Cutworm caterpillars can occasionally cause serious damage. They climb the seedlings and young plants and eat the leaves, or cut the stems near ground level and eat the top growth.

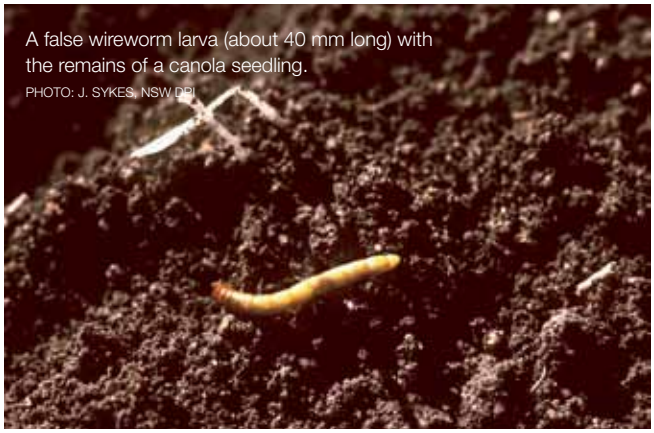
Large patches of the crop may be damaged if caterpillars are numerous during establishment. They usually feed in the evening and at night and sometimes pull the young plants into the ground.

A cutworm caterpillar feeding on young canola seedlings.
PHOTO: J. SYKES, NSW DPI



Cutworm caterpillars at different stages of development. Length 40–50 mm when fully grown.
PHOTO: L. TURTON, NSW DPI

Larvae and adults (below) of bronzed field beetle.
PHOTOS: G. BAKER, SARDI



A false wireworm larva (about 40 mm long) with the remains of a canola seedling.
PHOTO: J. SYKES, NSW DPI

Inspect emerging and established crops in the evening, or at night, for cutworms. The caterpillars are 40–50 mm long when fully grown and grey-green, dark grey or nearly black, often with dark spots on the back and sides of the body. Treat promptly when they are feeding. Spot spraying may be all that is needed.

False wireworms (family Tenebrionidae); including bronzed field beetle (*Adelium brevicorne*) and grey false wireworm (*Isopteron punctatissimus*)

False wireworms have become a serious pest of germinating canola, probably due to the increased use of minimum or zero tillage. The larvae can stunt or kill the seedlings by feeding on their roots and stems (seedling part attacked depends on the wireworm species), which may result in light thinning of the crop through to destruction of large areas (bare patches). Because different species can differ in their feeding behaviour, correct species identification of wireworm larvae is critical for choosing appropriate control methods.

Clean cultivating paddocks and headlands can control false wireworms during summer and autumn. The oversummering beetles must eat to live and, in the absence of shelter and food plants, they either die or disperse to more suitable areas.

Examine the soil for false wireworms before sowing because treatment after sowing is not practicable. The larvae are usually found at the junction of the loose, drier cultivated soil and the undisturbed moister soil below. They have hard, round, smooth, yellow-brown or blackish bodies with pointed upturned tails or a pair of raised spinelike processes on the end segment and are 8–40 mm long when fully grown.

Soil-incorporated insecticides used prior to sowing and seed dressings are commonly used to prevent larval attack. Broad-scale use of insecticides may have a severe impact on non-target organisms.

Post-sowing compaction may improve seedling vigour and germination while blocking the pathways and cracks used by the larvae.

The larvae of bronzed field beetle chew stems of young canola plants at ground level, causing plant death. The larvae are dark brown and grow up to 11 mm long and

Damage to young canola from bronze field beetle larval feeding. Note larvae on soil surface at base of plant.
PHOTO: A. DORE, DAFWA

Larva of vegetable weevil; about 13 mm long when fully grown.
PHOTO: L. TURTON, NSW DPI

Adult vegetable weevil.
PHOTO: SARDI

Brown pasture looper. Length 35–40 mm when fully grown.
PHOTOT: L. TURTON, NSW DPI

2–3 mm wide, with two distinct upturned spines on the last body segment. They are often confused with grey false wireworm. Pupation occurs during August. The adults are up to 11 mm in length and shiny black with a slight bronze appearance. Over the summer and autumn they shelter in crop residues or tufts of grass. They become active after autumn rains and commence egg laying. Approximately 15 adults per m^2 can produce more than 1500 larvae, enough to seriously damage most canola crops. Pupation generally starts in August and extends to the end of October.

Check young canola crops regularly for signs of damage. Larvae actively feed during the night and shelter under clods of soil and stubble during the day. A reduction in larval numbers can be achieved by:

- removing crop residues through cutting, burning or grazing;
- cultivating prior to seeding;
- increasing the sowing rate, which may compensate for damage; and
- applying insecticide surface treatment.

Grey false wireworm has a similar lifecycle to bronzed field beetle. The adults are smaller and browner in appearance. The larvae of both species are similar in appearance, except grey false wireworm larvae are slightly smaller, flatter and faster moving. However, they differ in their feeding damage. Grey false wireworm larvae never feed at the surface, rather, they ringbark the hypocotyl and root of the germinating seedlings below ground level. High larval numbers (50/m^2) can cause major losses to canola seedlings. Once the damage has become obvious, it is too late to treat the crop.

To detect grey false wireworm larvae prior to sowing, do either one of the following:

- bait using oats or canola grain (200–300 g) pre-soaked for 24 hours. The grain is buried (50 mm deep) and randomly placed (5–10 sites) across the paddock. After seven days examine the baits for presence of larvae; or
- carefully look in the top 20 mm of soil in a 30 cm x 30 cm quadrat, randomly placed (5–10 sites) across the paddock. Count and record the number of larvae.

Vegetable weevil (*Listroderes difficilis*)

The larvae and adults feed on the leaves of the seedlings. They usually feed in the evening and at night and shelter by day in the soil near affected plants. Damage can be severe if the larvae or adults are numerous and seedling growth is impaired by adverse weather.

Check emerging crops in the evening or at night for larvae and adults. Infestation is often confined to the edge of the crop so border spraying may be all that is needed. Treat in the evening or at night.

The legless larvae are about 13 mm long when fully grown with curved green, yellow-green or cream bodies and dark heads. Adult weevils are about 8 mm long and dull greyish-brown with prominent snouts.

They have a V-shaped, pale mark near the middle of the back and a small pointed process towards the rear of each wing case.

Bare fallowing of infested paddocks and eliminating weeds and grasses from headlands can control the vegetable weevil in late spring and summer. The oversummering weevils must eat to live and in the absence of shelter and food plants they either die or disperse to more suitable areas.

Lucerne flea.
PHOTO: SARDI

The grey-coloured reticulated slug.
PHOTO: G. BAKER, SARDI

Mandalotus weevils (*Mandalotus* spp.)

A complex of native weevil species in the genus *Mandalotus* has been reported causing serious damage to germinating canola in parts of SA and NSW. They are usually associated with lighter soils.

At time of publication no registered insecticide treatments were available. Consult your local agronomist/consultant for control advice.

Brown pasture looper (*Ciampa arietaria*)

The late-stage caterpillars sometimes move into young crops and severely defoliate the plants. Capeweed is a preferred food plant and infestations are likely to be confined to areas around the edges of crops, or within crops, near patches of this weed. Spot or perimeter spraying is usually all that is required.

The caterpillars, which reach 30–40 mm long when fully grown, crawl with a looping motion. They have yellow-brown heads and are grey to dark brown with a pale stripe down each side of the back and a row of reddish spots along each side of the body.

Lucerne flea (*Sminthurus viridis*)

Lucerne fleas are small (2–4 mm), globular, wingless yellow-green insects, which prefer lucerne and clovers, but can attack annual winter crops including canola. They feed on green leaf tissues, leaving a thin transparent 'window'. The growth of seedling canola can be retarded, and in heavy infestations seedling death can occur. From a distance severely affected crop areas can appear to be bleached. Lucerne fleas are usually associated with heavier soils and prefer cool, moist conditions.

Lucerne fleas hatch from oversummering eggs following the first significant autumn rains. Several generations develop over winter.

Monitor crops frequently at germination and in the following weeks. Working on hands and knees, look for fleas, checking the soil surface where they may shelter and the plants for tell-tale signs of their feeding. Unfortunately, there are no specific thresholds for lucerne flea damage in canola. However, if control appears warranted, spray as early as possible because of the risk of damage retarding crop vigour.

Aphids (as vectors of canola viruses)

The common aphid species of canola are cabbage aphid, green peach aphid and turnip aphid. Cowpea aphid also colonises canola at times.

Aphid densities in canola crops during the vegetative phase are generally insufficient to cause crop loss from feeding damage. The exception may occur in dry winters when aphids can be very abundant. Early colonisation by virus-infected aphids, however, can result in canola yield losses due to viral infection.

Beet western yellows virus (BWYV) is the most common virus in WA canola crops. BWYV is persistently transmitted by green peach aphid. Yield losses of up to 50 per cent from the combination of BWYV and green peach aphid have been recorded in WA with infections very early in the growth of the crop. Viruses present in canola crops in NSW, Victoria and South Australia include BWYV, *Cauliflower mosaic virus* (CaMV) and *Turnip mosaic virus* (TuMV). The green peach and cabbage aphids transmit all these viruses. Turnip aphid transmits CaMV and TuMV. Cowpea aphid transmits BWYV. A seed-applied insecticide treatment is available for canola aphid control.

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

The main slug pests of canola crops in southern Australia are the grey-coloured reticulated slug and the black-keeled slug. Other pest slug species found in canola crops include *Deroceras panormitanum*, *Lehmannia nyctelia* and *Arion intermedius*. These slugs can feed both above and below the ground in the emerging canola crop, damaging leaf margins, fully removing cotyledons and chewing through stems.

Slugs prefer heavier soils, particularly those that form cracks or large clods. Slug damage is more common in high rainfall districts and along road verges or fencelines, where slugs enter from an adjacent pasture or stubble, but extensive damage can also occur in drier areas and in the centre of crops. The less tillage and greater stubble retention of conservation farming are allowing more slugs to survive and breed.

Damage often goes undetected when the crop is emerging and resultant poor establishment is incorrectly attributed to agronomic factors. Baiting is often applied too late and crops need to be resown.

The key to controlling slug infestations in canola is monitoring. Inspect crops closely for signs of seedling destruction as most slug activity occurs at night and failure of seedlings to appear may be mistaken as slow germination. If seedling cotyledons are destroyed, the plants will not recover.

Inspect crops after sunset, and/or set baiting stations along fencelines when the soil surface is visibly moist by applying bait under a hessian bag or pot. If slugs are caught at bait points, baiting of the crop is recommended before, or at seeding. Either bait the affected area, which is often along fencelines from adjoining pasture, or bait the whole crop if the bait stations reveal an extensive problem. Treat borders with higher rates of baits when slug numbers are high. Assessing paddocks for the risk of slug damage in the year before a vulnerable crop such as canola will allow early and precise action.

Slug bait pellets may be effective for about a week so successive applications at a lower rate (5 kg/ha) may be more economical than higher rates, especially if rain is forecast. Broadcast pellets evenly on the surface before the crop emerges, not underground with the seed, where the slugs are less likely to find them. Monitor crops at five to six-day intervals up to fourth true leaf stage and repeat baiting if significant infestations of slugs are detected.

Snails: common white snail (*Cernuella virgata*), white Italian snail (*Theba pisana*), conical snail (*Cochlicella acuta*) and small conical snail (*Cochlicella barbara*)

Four snail species are pests in the southern Australian cropping system. Two species are round (the common white and White Italian snails) and the other two are conical. These species differ in behaviour, the damage they cause and their management tactics. Knowledge of the type of snails present (round or conical), the number of each type and the sizes present is necessary before appropriate management can be implemented.

Following sufficient autumn rains, these snails commence egg laying, which may continue from April to September.

Table 9.1 Snail pests in southern Australia

PHOTOS: SARDI

	Snail species	Distribution	Appearance	Food source	Attacks young canola	Grain contaminant	Oversummer site	Management notes†
	Common white snail	SA, VIC, also WA, NSW, east Tas	Round, open, circular umbilicus.	Dead organic matter (plus green plant material)	Yes	Yes	Up on plants, stubble, posts	
	White Italian snail	Coastal areas of SA, NSW, VIC, WA and east Tas	Round, semi-circular or partly closed umbilicus	Green plant material and dead organic matter	Yes	Yes	Up, plus on weeds.	Brown-out weeds
	Conical snail	Yorke Pen., SA, also other parts of SA, VIC, NSW and WA	Conical (up to 18 mm length)	Dead organic matter	No	Yes	Up, but often near ground	Cabling and exposing rocks important
	Small conical snail	SA, NSW, VIC and WA (mainly higher rainfall areas)	Conical (up to 8–10 mm length)	Dead organic matter and green plant material	No	Yes	Low to ground	Cabling and exposing rocks important

† These are species-specific techniques. Stubble management, burning and baiting are applicable for all four species.

Controlling snails before, or soon after, egg laying commences is essential.

Eggs hatch after about two weeks and round snail hatchlings are up to 1.5 mm in diameter.

Monitoring can help target control to areas of high snail density. Key monitoring times are as follows:

- January/February to assess options for stubble management;
- March/April to assess options for burning and/or baiting;
- May to August to assess options for baiting, particularly along fencelines; and
- three to four weeks prior to harvest to assess the need for header modifications.

Year-round management of snails is required for control of large snail populations. Applying controls before egg laying commences is essential to minimise increases in populations. Monitor live snail numbers per square metre before and after snail control treatments. Use a 30 cm x 30 cm quadrat to estimate numbers per unit area.

Stubble management. Cabling is the most effective treatment when there are surface stones etc. Treatments are most effective at temperatures above 35ºC. Repeating stubble treatments will increase snail mortality but overnight moisture, summer weeds and heavy mulch on the soil surface may reduce it.

Burning. Use burning strategically. It may not be required every year and may increase the erosion risk. Summer weeds and stones will reduce the snail kill. Protect burnt and snail-free areas from re-invasion by strip baiting snails.

Baiting. Use summer stubble treatments to lower snail numbers before baiting. Snails must be active and conditions cool and moist for five to seven days. Distribute bait evenly and complete at least eight weeks before harvest due to risk of bait/residue contamination in grain. In emerging canola crops, five snails/m^2 is the baiting threshold. Baiting is very effective when snail numbers are below 80/m^2. The following guidelines are recommended:

- 5–80 snails/m^2 – apply bait at 5 kg/ha
- more than 80 snails/m^2 – apply bait at 10 kg/ha.

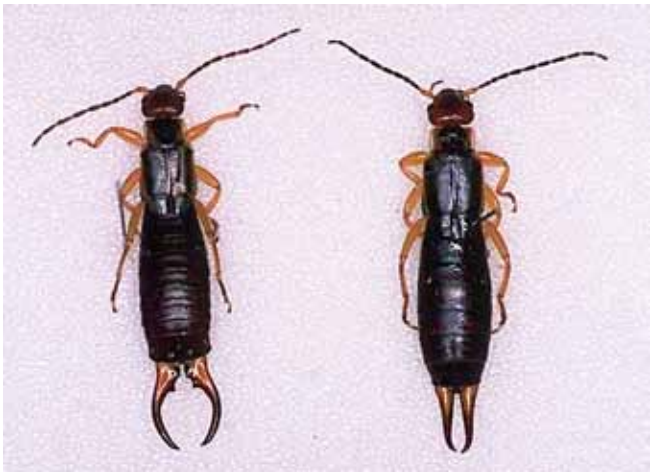
European earwig (*Forficula auricularia*)

European earwig is an introduced pest that continues to extend its distribution across southern Australia. It is more prevalent in cool, higher-rainfall districts and appears to be favoured by the lesser tillage and greater stubble retention of conservation farming. Immature and adult earwigs can occur in high densities in germinating canola where they lop young plants off at ground level, making re-seeding necessary.

European earwigs grow to about 16 mm long. Like other earwigs they have a strong pair of terminal, moveable forceps. They are nocturnal, sheltering under clods of soil, stones and other debris during the day. They feed on a wide range of food types including leaf litter and other organic matter, seedling plants, flowers, fruits and other insects, particularly aphids.

If present in high densities they can also damage mature windrowed canola by feeding on the pods and may contaminate the harvested grain.

No insecticides are registered for the control of European earwigs in canola.



Male (left) and female (right) European earwig. PHOTO: DAFWA

European earwig damage to rosette-stage canola foliage.
PHOTO: A. DORE, DAFWA

Slaters normally feed on decaying organic matter but have been observed feeding on canola seedlings when in very high densities.
PHOTO: A. WEEKS, CESAR CONSULTANTS

Slaters (*Australiodillo bifrons* and *Porcellio scaber*)

Slaters (including the indigenous *Australiodillo bifrons* and the introduced *Porcellio scaber*) primarily feed on decaying and rotting organic matter but at high densities they can damage seedling canola and cereal crops, leading to reduced yields. Adult slaters (also known as woodlice and flood bugs) are light brown, oval shaped, about 10–15 mm long and 6 mm wide with multiple pairs of legs.

A. bifrons feeding causes 'windows' of transparent leaf membrane similar to lucerne flea damage. Damage thought to be caused by *P. scaber* is similar to slug and snail damage, giving leaves a rasped and shredded appearance. Populations of the introduced species *P. scaber* are often initially confined to relatively small areas, having spread from previous accidental introductions via external sources such as pot plants, machinery or hay.

They appear to be favoured by moist soil conditions, and by high stubble residues associated with minimum or zero till. During daytime they usually shelter in damp shaded places under stones etc. and hence may be difficult to find on the seedlings.

Where damage to canola has occurred in WA, it is mostly associated with very high slater populations and where there has been at least 4–5 t/ha of straw. Problems have been known to occur even after burning stubbles.

Foliar sprays, bare-earth chemical treatments and snail/slug pellets have been trialled with varying degrees of success.

Cowpea aphid.
PHOTO: G. BAKER, SARDI

(Top) cabbage aphid, green peach aphid (centre) and turnip aphid (below).
PHOTOS: G. BAKER, SARDI

PESTS AT FLOWERING AND CROP MATURITY

Cabbage aphid (*Brevicoryne brassicae*); turnip aphid (*Lipaphis erysimi*); green peach aphid (*Myzus persicae*) and cowpea aphid (*Aphis craccivora*)

Infestation is most common from flowering to podding. Dense clusters feeding on the upper stems, flower heads and developing seed heads can seriously reduce pod set, pod fill, seed quality and viability. Yield losses of up to 33 per cent have been recorded.

Cabbage aphids typically form dense clusters near the top of the plant. The lady beetle is an aphid predator.
PHOTO: R. COLTON, NSW DPI

Winged aphids migrate into young canola from autumn weeds. Early control of *Brassica* weeds (for example wild radish, wild turnip) on the property can help limit canola colonisation by aphids. Early sowing can enable the crop to begin flowering before aphid densities peak. However, sowing earlier also creates a risk that crops will be vulnerable to autumn aphid flights, which may result in the early establishment of diseases and increased potential for their spread in spring.

Dry weather favours aphids, which develop more rapidly on drought-stressed plants. Cold, wet winter weather retards their increase. Initially only small groups of plants scattered through the crop may be affected. The rate of increase and spread of aphids within the crop varies greatly, but sometimes occurs very rapidly.

Monitor crops at least twice a week during flowering and podding to observe changes in aphid numbers on flower heads. Check at least five scattered sites in the crop and look for aphids on at least 20 plants at each site. If more than 20 per cent of plants are infested and biological control agents (lacewings, ladybirds, hover fly larvae, tiny parasitic wasps and fungal diseases etc) are not very active, consider control measures.

Early-sown crops often escape infestation because they flower before aphid build-up occurs. However, the frequency of seasonal infestation has increased in recent years. Warm, dry conditions are conducive to aphid build-up. In northern areas, milder winter and spring weather may induce early aphid build-up and necessitate more frequent spraying.

Diamondback moth (cabbage moth) (*Plutella xylostella*)

Diamondback moth (DBM) is the main pest of *Brassica* crops worldwide. It is difficult to control with insecticides because it develops rapidly through an ongoing series of overlapping generations and has great ability to evolve resistance to insecticides.

DBM feed on a wide range of *Brassicas*, including vegetable and herb crops, seed crops, fodder crops and weeds. The source of DBM on canola may be local (*Brassica* weeds and volunteer canola), or from other regions.

In canola, the caterpillars make clear, membranous 'windows' and small holes in the leaves and also graze on the stems and pods. Severe defoliation and pod grazing during flowering, pod formation and pod filling reduces seed yield. Sometimes large numbers of caterpillars may develop on the foliage after flowering without causing harm, but then they move to the pods and rapidly cause damage.

The caterpillars are 10–13 mm long when fully grown and have slender, pale-green bodies that taper towards each end. They wriggle violently when disturbed on a plant and may drop to the ground or hang suspended by a silken strand.

Dry warm conditions favour DBM. Rainfall causes direct mortality by dislodging and drowning larvae, and when accompanied by warm temperatures (18–25°C) can induce fungal disease outbreaks that devastate DBM infestations. Drought conditions mobilise nitrogenous compounds in the

Diamondback moth larvae killed by the fungal pathogen *Zoophthora radicans*.
PHOTO: G. BAKER, SARDI

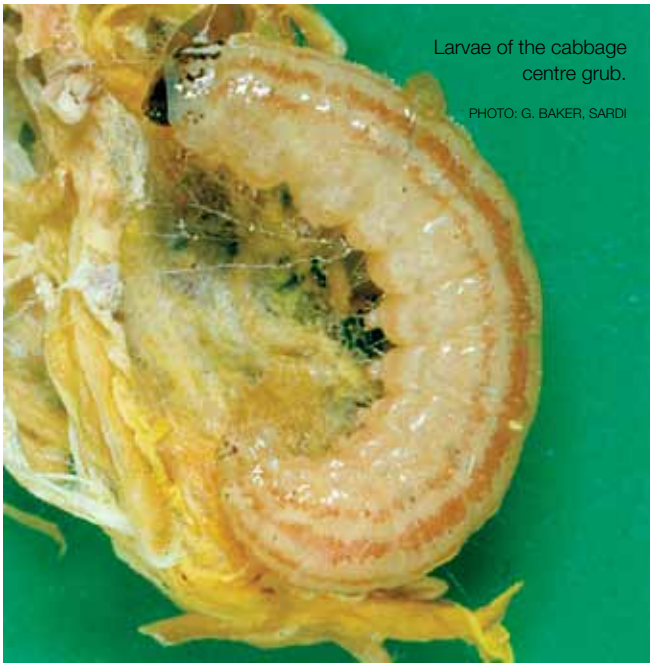
Diamondback moth adult and fourth-instar larvae (above).
PHOTOS: M. KELLER, UNIVERSITY OF ADELAIDE

Damage to flower-head (left) and pods (below) from feeding of diamondback moth larvae.
PHOTOS: G. BAKER, SARDI

plants, which may stimulate DBM growth and development.

Monitor crops regularly from flowering and podding until windrowing for caterpillars and their damage. Check by sweep-netting at 5–10 sites in the crop to determine the severity and extent of the infestation. Sometimes damaging populations can develop very rapidly. If 50 or more caterpillars per 10 sweeps are found, WA entomologists recommend increasing the monitoring to every three days. If, over the next week, the density rapidly increases to 80–100 caterpillars per 10 sweeps, spray. If the density remains about 50–70 caterpillars per 10 sweeps, keep monitoring frequently. In this latter circumstance the DBM infestation often stabilises and declines without the need to spray.

Moderate levels of synthetic pyrethroid resistance have been recorded in many DBM populations collected from canola in recent years (1999–2008). The combination of moderate resistance and the sub-optimal spray coverage that is often achieved in dense stands of canola sprayed at around 100 L/ha, often results in poor control.



Larvae of the cabbage centre grub.

PHOTO: G. BAKER, SARDI

Native budworm moth resting with the forewings slightly parted. The outer margin of the hindwing is uniformly dark. PHOTO: L. TURTON, NSW DPI

Corn earworm moth resting with the forewings slightly parted. The pale patch, or the two spots in the dark outer margin of the hindwing, is exposed.

PHOTO: L. TURTON, NSW DPI

Heliothis caterpillars (family Noctuidae); corn earworm (*Helicoverpa armigera*); native budworm (*H. punctigera)*

Heliothis caterpillars, especially those of the native budworm, can extensively damage canola crops in some seasons. Infestation can occur at any time from flowering and podding until the seedheads have dried off after windrowing, but it is most common during flowering to podding. Caterpillars less than 10 mm long normally feed on the foliage, but larger ones also chew holes in the pods and eat the seeds. Loss of foliage usually does not matter, but heavy damage to the pods severely reduces yield.

Occasionally, heliothis caterpillars are particularly abundant in canola crops during flowering to podding in many areas. This can be due to the combined effect of two or more of the following factors — concurrent drought conditions, concurrent heavy aphid infestation and absence of more attractive nearby crops (for example, grain legumes) to divert the egg-laying moths away from canola.

Heavy aphid infestations and hot dry weather appear to favour heliothis because the egg-laying moths are attracted to the aphid honeydew as a source of food. The aphids also provide an alternative prey for predators that would otherwise feed on heliothis eggs and small caterpillars. The hot dry weather is detrimental to the wasps which parasitise the eggs and young larvae.

Examine crops at regular intervals from flowering to podding for moths and young caterpillars.

Moth activity alone cannot be taken as a guide for spraying. Base spray timing on careful observation of the extent of caterpillar infestation in the crop. Check plants in a large number of sites at random for caterpillars and pod damage. Sweep the borders of dense crops with a butterfly net or shake plants in thinner crops over a white fertiliser

bag or plastic tray.

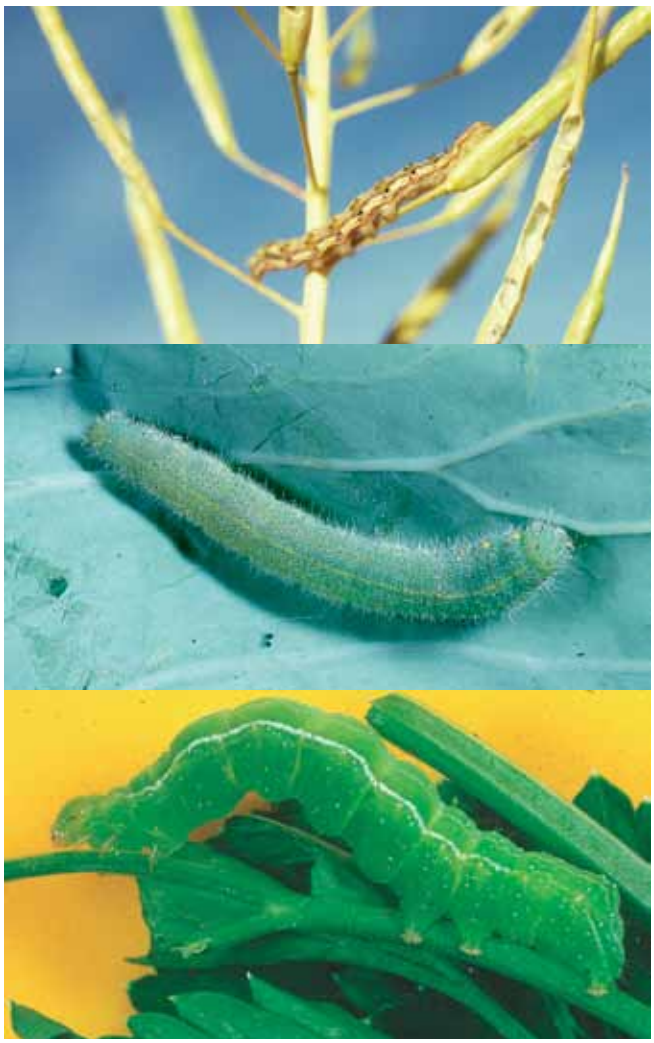
Newly hatched heliothis caterpillars are 1–1.5 mm long with dark heads and dark-spotted, whitish bodies. Young caterpillars are 10–20 mm long and pale yellow, greenish or brownish with dark heads, conspicuous upper body hairs and often have narrow, dark stripes along the back and sides of the body.

The threshold for treatment is five or more 10 mm long pod-feeding caterpillars per square metre.

Egg and six larval instars of native budworm.
PHOTO: G. BAKER, SARDI

(Below) Heliothis caterpillar and pod damage in canola.
PHOTO: R. COLTON, NSW DPI

Cabbage white butterfly (centre) and looper caterpillar (bottom).
PHOTOS: G. BAKER, SARDI



(Below) Rutherglen bugs feed on the pods, reducing the weight and oil content of the seeds.
PHOTO: R. COLTON, NSW DPI

(Above) Rutherglen bug nymphs can cause similar damage to that caused by adults.
PHOTO: R. COLTON, NSW DPI

Cabbage centre grub (*Hellula hydralis*), cabbage white butterfly (*Pieris rapae*), and looper caterpillars (*Chrysodeixis* spp.)

These three caterpillar species may be found in canola crops but generally occur at low, sub-economic densities. Larvae of cabbage centre grub have dark heads and longitudinal reddish-brown stripes. They are usually found on the foliage, especially on the basal leaves, but also attack the young floral parts. Cabbage white butterfly are creamy-white and commonly seen flying in the crop or visiting nearby flowers. Cabbage white butterfly larvae are velvety leaf-green, with a pale-yellow stripe along the middle of the back and each side, and when fully grown are about 3 cm long. They are slow moving and eat ragged holes out of the foliage, but do not attack the floral parts. Looper caterpillars are grass-green, smooth and slender, and move with a characteristic looping action. They feed on foliage and fully grown are about 2.5–3 cm long.

Seed bugs (family Lygaeidae); Rutherglen bug (*Nysius vinitor*) and grey cluster bug (*N. clevelandensis*)

Rutherglen bug is usually the most important pest. It will attack crops at any time from flowering and podding until the seedheads have dried off after windrowing.

The adults and nymphs suck sap from the leaves, stems, flowers and developing and ripening pods and seeds. Heavy or prolonged infestation can severely reduce pod set, pod fill, seed quality and viability.

Regularly check a large number of sites in the crop from the start of flowering until windrowing for adult and nymphal bugs. Infestation is most likely during hot dry weather when damaging populations can build up rapidly. Treatment is warranted if there is an average of 10 or more adults or 20 or more nymphs per plant and the crop is moisture stressed. If necessary, spray before windrowing to prevent damage in windrowed crops.

Adult bugs are about 5 mm long, narrow bodied and grey brown with prominent black eyes. Nymphal bugs are reddish brown, somewhat pear-shaped and wingless.

Plague thrips (*Thrips imaginis*)

The adults and nymphs frequently occur in very large numbers in the flower heads and mainly feed on the stems, flower petals and pollen. They do not affect pollination, pod set or pod fill, but some pods may be distorted.

Adult plague thrips are slender, about 1 mm long and brownish with two pairs of narrow, fringed wings. The nymphs are smaller, yellow or orange-yellow and wingless.

INSECTICIDES

Recommendations change regularly so obtain a copy of your state department's bulletin or chart of current insecticide control recommendations for crop pests.

Canola pods distorted by plague thrips; only the odd plant is affected.
PHOTO: L. TURTON, NSW DPI

Rutherglen bug adult. Length about 5 mm. PHOTO: L. TURTON, NSW DPI