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GRDC GROWNOTES™

GRDC
GRAINS RESEARCH & DEVELOPMENT CORPORATION

SUNFLOWER

SECTION 7

INSECT CONTROL

ESTABLISHMENT PESTS | POST-ESTABLISHMENT PESTS | FALSE WIREWORMS | TRUE WIREWORM | CUTWORMS | BLACK SCARAB BEETLES | THRIPS | THRESHOLDS FOR CONTROL | WINGLESS COCKROACHES | BLACK FIELD EARWIG | FIELD CRICKETS | RUTHERGLEN BUG | HELICOVERPA SPP. | WHITEFLIES | GREENHOUSE WHITEFLY | LOOPERS | GREEN VEGETABLE BUG

Insect control

Sunflowers are attacked by a number of insect pests at various stages of crop development. Most pests are not specific to sunflowers and originate from other crops, weed hosts or plant residues in the soil.

7.1 Establishment pests

Several species of soil-dwelling insects attack seeds and seedlings of sunflowers, causing thinning or complete destruction of plant stands. Sunflowers are more susceptible to seedling damage than other field crops because damaged sunflower seedlings lack the capacity to regrow or tiller. Seedlings are most vulnerable to damage:

- before they develop three or four 'true' leaves
- during periods of moisture stress
- when other factors such as low soil temperature or soil compaction limit plant growth [1]

Establishment pests include false wireworm, true wireworm, wingless cockroaches, field crickets, thrips, black field earwigs, black scarab beetles, cutworms and armyworms (Figure 1). These pests are significant only in central Queensland, except false wireworm larvae, which can affect spring plantings in southern Queensland and northern NSW. [2]

Figure 1: *Armyworms are among the significant establishment pests of sunflowers.*

Photo: Drew Penberthy, Penagcon

1 QDAF (2011) Insect pest management in sunflowers. Department of Agriculture, Fisheries and Forestry Queensland, https://www.daf.qld.gov.au/plants/field-crops-and-pastures/broadacre-field-crops/integrated-pest-management/ipm-information-by-crop/sunflowers#Wireworms

2 Australian Oilseeds Federation (2012), Better Sunflowers Agronomy Training Package (Big Yellow Sunflower Pack), Insect Management https://bettersunflowers.com.au/bysp/surveyinfo.aspx?sid=7

7.2 Post-establishment pests

Once sunflowers have established, several other pests can attack the crop. Post-establishment pests include Rutherglen bug (*Nysius vinitor and N. clevelandensis*), heliothis (*Helicoverpa* spp.) caterpillars, whiteflies, loopers, and green vegetable bug (*Nezara viridula*). [3] However, the major pests requiring monitoring in the period from budding to maturity are the Rutherglen bug and *Helicoverpa* caterpillars. [4]

Bees

Bees play only a small role in sunflower yields, except in seed production blocks, but are often seen foraging in large numbers in sunflower fields (Figure 2). When it is necessary to apply insecticides during flowering, give preference to insecticides with a low residual toxicity and spray in the late afternoon when bees have stopped foraging. [5]

Figure 2: *Bees are often seen foraging in large numbers in sunflowers but only play a small role in yields.*

Photo: Drew Penberthy, Penagcon

Management

Soil-dwelling insects such as false wireworm beetles, cockroaches and black field crickets have the potential to significantly reduce plant stands. Activity is likely to be greatest in retained stubble, but the benefits of stubble retention far outweigh insect damage. However monitoring for, and control of, these insects is relatively simple and inexpensive. [6]

3 QDAF (2011) Insect pest management in sunflowers. Department of Agriculture, Fisheries and Forestry Queensland, http://www.daf.qld.gov.au/plants/field-crops-and-pastures/broadacre-field-crops/integrated-pest-management/ipm-information-by-crop/sunflowers - Wireworms

4 L Serafin, S Belfield (2008) Sunflower production guidelines for the northern grains region—northern NSW and southern Qld. NSW Department of Primary Industries, http://www.dpi.nsw.gov.au/__data/assets/pdf_file/0011/249779/Sunflower-production-guidelines-for-the-northern-grains-region.pdf

5 L Serafin, D McCaffery, S Thompson (2014) Sunflower. Summer crop production guide 2014. pp. 80–92. NSW DPI Management Guide. NSW Department of Primary Industries, http://www.dpi.nsw.gov.au/agriculture/broadacre-crops/guides/summer-crop-production-guide

6 Australian Oilseeds Federation (2012), Better Sunflowers Agronomy Training Package (Big Yellow Sunflower Pack), Insect Management https://bettersunflowers.com.au/bysp/surveyinfo.aspx?sid=7

Check the seedbed before planting and check the crop regularly and thoroughly for insect pests (see Figure 3 for critical inspection times). Spray only when the insect population exceeds the economic threshold and only use registered insecticides. [7]

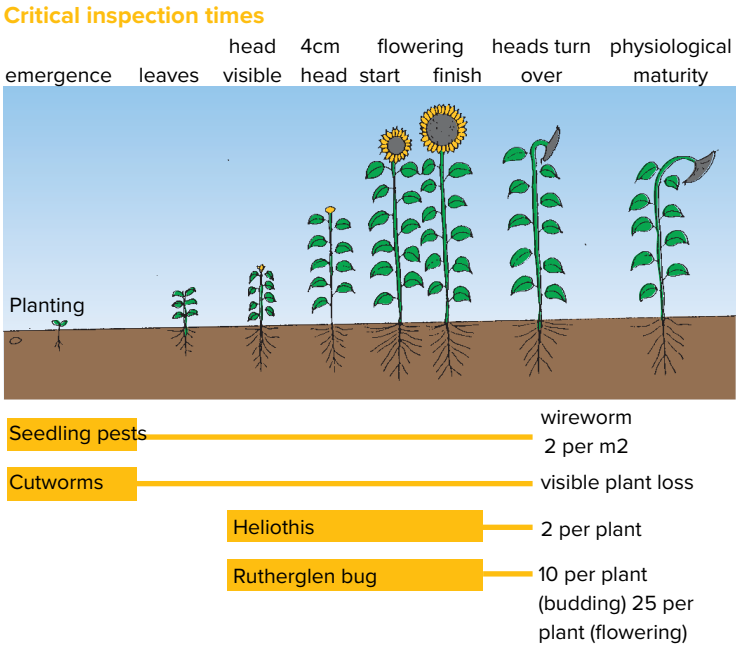

Figure 3: *Critical inspection times for sunflower pests.*

Source: Australian Sunflower Association

Recommended action:

- Check fields for insect activity and bait at planting if the level of activity warrants (see Figure 3 for critical inspection times).
- If baiting is not done at planting, continue to monitor closely during emergence; baiting during emergence can still be effective, either by ground or by air.

Recommended baits:

- Beetle Bait® is a pellet impregnated with chlorpyrifos. The pellet facilitates uniform distribution, and with the insecticide impregnated into the pellet, the product should be more effective over time.
- Bait can be prepared on the farm by mixing 100 mL Lorsban® 500 EC with 125 mL sunflower oil per 2.5 kg cracked wheat or cracked sorghum. [8]

For application rates see: Australian Sunflower Association - The New Big Black Sunflower Pack - Insect Management

MORE INFORMATION

QDAF. How to recognise and monitor soil insects.

QDAF. Chemical control of insects – consideration and choices.

NSW DPI Management Guide. Summer crop production guide. Sunflower.

Australian Pesticides and Veterinary Medicines Authority - Public Chemical Information System Search

Better Sunflower Association – Insect Management Library.

7 L Serafin, D McCaffery, S Thompson (2014) Sunflower. Summer crop production guide 2014. pp. 80–92. NSW DPI Management Guide. NSW Department of Primary Industries, http://www.dpi.nsw.gov.au/agriculture/broadacre-crops/guides/summer-crop-production-guide

8 Australian Oilseeds Federation (2012), Better Sunflowers Agronomy Training Package (Big Yellow Sunflower Pack), Insect Management https://bettersunflowers.com.au/bysp/surveyinfo.aspx?sid=7

7.3 False wireworms

Striate false wireworm (*Pterohelaeus alternatus*), eastern false wireworm (*P. darlingensis*) (Figure 4) and southern false wireworm (*Gonocephalum macleayi*) are minor establishment pests in sunflowers, with frequent small populations. [9]

Adult false wireworms (Figure 5) emerge from the soil during spring and early summer. Eggs are laid singly in moist soil, usually under trash or low-growing weeds. Larvae feed on decaying vegetable matter and newly germinated seeds (e.g. cereals, cotton, soybeans and sunflowers). Both the seeds and growing points are damaged, resulting in patchy stands. [10]

Figure 4: *Eastern false wireworm larva and adult.*

Photo: QDAF

Figure 5: *Small false wireworm larva and adult.*

Photo: QDAF

9 Australian Oilseeds Federation (2012), Better Sunflowers Agronomy Training Package (Big Yellow Sunflower Pack), Insect Management https://bettersunflowers.com.au/bysp/surveyinfo.aspx?sid=7

10 QDAF (2010) Soil insects in Queensland. False wireworm. Department of Agriculture, Fisheries and Forestry Queensland, http://www.daf.qld.gov.au/plants/field-crops-and-pastures/broadacre-field-crops/integrated-pest-management/a-z-insect-pest-list/soil-insects/false-wireworm

7.3.1 Damage

Both adults and larvae attack sunflower, and the damage caused may necessitate replanting. Larvae feed on decaying vegetable and crop residues in the soil. They also feed on newly germinating seed and the growing points of seedlings, which results in patchy stands. Damage is most common in early-planted crops where crop residue has become scarce. During summer, adults may damage young plants by surface feeding or cutting of the plant at or near soil level. Larvae are more damaging in southern Queensland, whereas adults are the most damaging stage in central and northern districts. [11]

The risk from adults is highest in summer. For larvae, the risk is highest for early (September–October) planted crops. Damage may occur if early plant growth is slowed by cool, damp weather allowing larvae to remain in the moist root-zone. As soil dries, larvae retreat below the root-zone. However, if crops are grown into dry seedbeds, damage may be significant. [12]

False wireworm damage is similar to that caused by the wireworm; however, it is more prevalent in dry seedbeds. Wireworms are usually found at the interface between dry and wet soil. [13]

MORE INFORMATION

QDAF. How to recognise and monitor soil insects.

7.3.2 Thresholds for control

Detection of false wireworms can be difficult. The suggested method is either to hand-sift 10 soil samples (30 by 30 cm) or place 10 germinating seed baits (GSBs) monitoring for soil-dwelling insects throughout the paddock. One larva per sample warrants control. [14] [15]

7.3.3 Management

High mortality of false wireworms can be caused by cool, wet weather from autumn to spring.

False wireworm beetles are more damaging to sunflower seedlings where stubble is buried by cultivation than in crops that are directly drilled into the surface-retained stubble. This is because the surface-feeding beetles remain feeding on the stubble and not the crop.

Key points on managing false wireworms: [16]

- Check the seedbed prior to sowing.
- Prepare the ground for even and rapid germination.
- Using press-wheels at planting provides some control. [17]
- Clean cultivation during summer dries out the topsoil and eliminates weeds that provide food for adults.
- Larvae can be controlled by insecticide applications at planting or insecticide-treated seed.

11 QDAF (2011) Insect pest management in sunflowers. Department of Agriculture, Fisheries and Forestry Queensland, http://www.daf.qld.gov.au/plants/field-crops-and-pastures/broadacre-field-crops/integrated-pest-management/ipm-information-by-crop/sunflowers - Wireworms

12 QDAF (2011) Insect pest management in sunflowers. Department of Agriculture, Fisheries and Forestry Queensland, http://www.daf.qld.gov.au/plants/field-crops-and-pastures/broadacre-field-crops/integrated-pest-management/ipm-information-by-crop/sunflowers - Wireworms

13 L Serafin, D McCaffery, S Thompson (2014) Sunflower. Summer crop production guide 2014. pp. 80–92. NSW DPI Management Guide. NSW Department of Primary Industries, http://www.dpi.nsw.gov.au/agriculture/broadacre-crops/guides/summer-crop-production-guide

14 QDAF (2011) Insect pest management in sunflowers. Department of Agriculture, Fisheries and Forestry Queensland, http://www.daf.qld.gov.au/plants/field-crops-and-pastures/broadacre-field-crops/integrated-pest-management/ipm-information-by-crop/sunflowers - Wireworms

15 Australian Oilseeds Federation (2012), Better Sunflowers Agronomy Training Package (Big Yellow Sunflower Pack), Insect Management https://bettersunflowers.com.au/bysp/surveyinfo.aspx?sid=7

16 QDAF (2011) Insect pest management in sunflowers. Department of Agriculture, Fisheries and Forestry Queensland, http://www.daf.qld.gov.au/plants/field-crops-and-pastures/broadacre-field-crops/integrated-pest-management/ipm-information-by-crop/sunflowers - Wireworms

17 Australian Oilseeds Federation (2012), Better Sunflowers Agronomy Training Package (Big Yellow Sunflower Pack), Insect Management https://bettersunflowers.com.au/bysp/surveyinfo.aspx?sid=7

- Control of adults is obtained by baiting with insecticide-treated, cracked grain broadcast evenly over the surface at or immediately after planting.
- Where broadcasting is not possible, the bait may be laid in trials spaced no more than 2 m apart.
- Natural enemies provide little control.

See Table 1 below for further description of the species, damage caused, and management and control strategies.

Table 1: *False wireworm description and management summary.* [18]

Scientific name	*Pterohelaeus* spp., *Gonocephalum* spp.
Description	Larvae are up to 30 mm long, shiny and cream, yellow or tan with three pairs of legs just behind the head. They are hard-bodied, cylindrical and segmented with a rounded head. Adult beetles of *Pterohelaeus* spp. are 20 mm long and dark grey–black with a distinctive 'pie-dish' shape formed by flanges around the outline of the beetle. Adult beetles of *Gonocephalum* spp. are 9 mm long, dark grey–black, and often covered in soil. There are flanges around the outline of the thorax (behind the head).
Similar species	Several species of false wireworms may occur in any particular crop, depending on locality, soil type, organic matter and tillage practices: *Pterohelaeus* spp.—eastern false wireworm, striate false wireworm *Gonocephalum* spp.—small false wireworm, southern false wireworm, northern false wireworm
Life-cycle	Larvae feed on decaying vegetable matter and crop residues in the soil, as well as on newly germinated seed. They usually have a single generation per year.
Risk period	Larvae cause most damage to germinating crops during spring, whereas adults are most troublesome in summer.
Damage	Larvae feed on germinating seed and chew on seedling roots and shoots, resulting in patchy stands. Adults chew on seedlings at or above ground level, ring-barking or completely cutting the stem.
Monitoring	Use germinating seed baits (GSBs) or digging and sieving to detect larvae prior to planting.
Action level	Treatment is required if >25 wireworm larvae are found in 20 GSBs. For adults, apply bait to the whole field if the soil insect rating (SIR) is >6.
Control	**Chemical control.** For larvae, use seed dressings or in-furrow sprays. For adults, use cracked grain baits. See Pest Genie or APVMA for current chemical options. **Cultural control.** The false wireworm is mainly a pest in areas having heavy, black soils. It prefers cultivated soils rather than no-till. Use press-wheels at sowing, set at 2–4 kg per cm width after planting rain or 4–8 kg per cm in dry soil.
Pest status	Minor, widespread, regular.

MORE INFORMATION

NSW DPI Management guide.
Summer crop production guide.
Insecticide seed dressings table

7.4 True wireworm

True wireworms (*Agrypnus* spp.), whose adults are also known as click-beetles, are an establishment pest named for the supposed wire-like appearance of their larvae (Figure 6). True wireworm adults are elongated beetles that jump and click when disturbed (Figure 7). Larvae are similar to false wireworm larvae. They may also be mistaken for predatory larvae of other beetles. [19] See Table 2 for a more detailed description of true wireworms.

18 QDAF (2010) Soil insects in Queensland. False wireworm. Department of Agriculture, Fisheries and Forestry Queensland, http://www.daf.qld.gov.au/plants/field-crops-and-pastures/broadacre-field-crops/integrated-pest-management/a-z-insect-pest-list/soil-insects/false-wireworm

19 QDAF (2011) Insect pest management in sunflowers. Department of Agriculture, Fisheries and Forestry Queensland, http://www.daf.qld.gov.au/plants/field-crops-and-pastures/broadacre-field-crops/integrated-pest-management/ipm-information-by-crop/sunflowers - Wireworms

Figure 6: *True wireworm larva showing dark, flattened head.*

Photo: QDAF

Figure 7: *True wireworm adult.*

Photo: QDAF

MORE INFORMATION

QDAF. How to recognise and monitor soil insects.

7.4.1 Damage

Larvae bore into germinating seed and chew on seedling roots and shoots, resulting in reduced vigour or seedling death. [20]

7.4.2 Thresholds for control

Use the GSB [21] technique or soil sampling to detect larvae prior to sowing. Monitor crops after sowing until establishment. Treatment is required if >25 wireworm larvae are found in 20 GSBs (Table 2). [22]

7.4.3 Management

Seed dressings, in-furrow sprays and granular insecticides offer some control. For current chemical control options see Pest Genie or APVMA. [23]

Table 2: *True wireworm description and management summary.* [24]

Scientific name	*Agrypnus* spp.
Description	Eggs are ovoid, 0.6 by 0.5 mm. Larvae grow to 35 mm long, are shiny and cream, yellow or tan, with three pairs of legs behind the head. Unlike false wireworms, they are soft-bodied, and flatter in cross-section with a flattened head. Adult beetles are 25 mm long, grey to brown and are known as click beetles.
Similar species	Larvae are similar to false wireworm larvae.
Crops attacked	All field crops. True wireworms are omnivorous. They originally inhabited native grasslands but have adapted to feeding on cultivated crops including field crops and pastures. They are also predatory, feeding on soil invertebrates.
Life-cycle	Most individuals complete a single generation in a year, but a small number complete two generations in a year. In Queensland, adults emerge between late October and early February, with most emerging between November and early December. Adults shelter in refuges for several weeks, then move into the soil, where they may be found to a depth of 7 cm. Females lay eggs 3–4 weeks after emergence, either singly on the soil surface or in batches of 10–15 eggs in crevices to 5 cm deep in the soil. There are eight larval instars with a total average larval duration of 315 days; the last instar, the most damaging, occupies 48% of this time. Larvae pupate in cells in the soil during October–January. Adults emerge after 14 days. Adult females live for a maximum of 7 weeks in the field. Unlike several species of click beetles, sugarcane wireworm adults do not fly to lights. Adults and larvae feed in the soil on vegetation, including roots. Larvae may also feed on soil and invertebrates.
Risk period	Immediately after sowing and early seedling growth, especially if germination is delayed by cold, wet weather.
Damage	Larvae bore into germinating seed and chew on seedling roots and shoots, resulting in reduced vigour or seedling death.
Monitoring and action level	Use germinating seed baits (GSBs) or soil sampling to detect larvae prior to sowing. Monitor crops after sowing until establishment. Treatment is required if >25 wireworm larvae are found in 20 GSBs.
Chemical control	Seed dressings, in-furrow sprays and granular insecticides offer some control. For current chemical control options see Pest Genie or APVMA.
Natural enemies	Common brown earwig.

20 QDAF (2010) Soil insects in Queensland. True wireworm, click beetle or sugar-cane wireworm. Department of Agriculture, Fisheries and Forestry Queensland, http://www.daf.qld.gov.au/plants/field-crops-and-pastures/broadacre-field-crops/integrated-pest-management/a-z-insect-pest-list/soil-insects/true-wireworm

21 QDAF (2011) How to recognise and monitor soil insects. Department of Agriculture, Fisheries and Forestry Queensland, http://www.daf.qld.gov.au/plants/field-crops-and-pastures/broadacre-field-crops/integrated-pest-management/help-pages/recognising-and-monitoring-soil-insects

22 QDAF (2010) Soil insects in Queensland. True wireworm, click beetle or sugar-cane wireworm. Department of Agriculture, Fisheries and Forestry Queensland, http://www.daf.qld.gov.au/plants/field-crops-and-pastures/broadacre-field-crops/integrated-pest-management/a-z-insect-pest-list/soil-insects/true-wireworm

23 QDAF (2010) Soil insects in Queensland. True wireworm, click beetle or sugar-cane wireworm. Department of Agriculture, Fisheries and Forestry Queensland, http://www.daf.qld.gov.au/plants/field-crops-and-pastures/broadacre-field-crops/integrated-pest-management/a-z-insect-pest-list/soil-insects/true-wireworm

24 QDAF (2010) Soil insects in Queensland. True wireworm, click beetle or sugar-cane wireworm. Department of Agriculture, Fisheries and Forestry Queensland, http://www.daf.qld.gov.au/plants/field-crops-and-pastures/broadacre-field-crops/integrated-pest-management/a-z-insect-pest-list/soil-insects/true-wireworm

7.5 Cutworms

Cutworm (*Agrotis* spp.) is an establishment pest in sunflowers. The common name of cutworms is derived from the larval habit of severing the stems of young seedlings at or near ground level, causing the collapse of the plant (Figure 8).

Several species of cutworms, including *Agrotis munda* (brown cutworm), *A. infusa* (Bogong moth) and *A. ipsilon* (black cutworm) and *A. prophyricollis* (variable cutworm) attack a wide range of crops in Queensland. [25]

Figure 8: *Cutworm larvae on the soil.*

Photo: QDAF/J Wessels

7.5.1 Damage

Cutworms can severely damage crops during establishment (Table 3). [26] Crop areas attacked by cutworms tend to be patchy, and the destruction of seedlings in one area may cause cutworms to migrate to adjacent fields. [27]

Cutworms feed at night or on dull, overcast days. Cutworms seek shelter under the soil surface during the day. Large cutworms cut the stem off at ground level, and smaller cutworms eat the leaves. [28] Sometimes the young plant is partially dragged into the soil where the larvae feed on it. Larvae may also climb plants and browse on or cut off leaves.

The risk period is summer and spring—one generation per crop. [29]

7.5.2 Thresholds for control

There are no established threshold numbers in sunflower. NSW Department of Primary Industry recommends treatment at the first sign of damage. [30] Department of Agriculture, Fisheries and Forestry Queensland suggests treating seedlings when there is a rapidly increasing area or proportion of crop damage (>10% seedling loss) and treating older plants if >90% of plants are infested or >50% of plants have ≥75 leaf tissue loss. [31]

25 QDAF (2010) Soil insects in Queensland. Cutworm. Department of Agriculture, Fisheries and Forestry Queensland, http://www.daf.qld.gov.au/plants/field-crops-and-pastures/broadacre-field-crops/integrated-pest-management/a-z-insect-pest-list/soil-insects/cutworm

26 L Serafin, D McCaffery, S Thompson (2014) Sunflower. Summer crop production guide 2014. pp. 80–92. NSW DPI Management Guide. NSW Department of Primary Industries, http://www.dpi.nsw.gov.au/agriculture/broadacre-crops/guides/summer-crop-production-guide

27 QDAF (2011) Insect pest management in sunflowers. Department of Agriculture, Fisheries and Forestry Queensland, http://www.daf.qld.gov.au/plants/field-crops-and-pastures/broadacre-field-crops/integrated-pest-management/ipm-information-by-crop/sunflowers - Wireworms

28 L Serafin, D McCaffery, S Thompson (2014) Sunflower. Summer crop production guide 2014. pp. 80–92. NSW DPI Management Guide. NSW Department of Primary Industries, http://www.dpi.nsw.gov.au/agriculture/broadacre-crops/guides/summer-crop-production-guide

29 QDAF (2011) Insect pest management in sunflowers. Department of Agriculture, Fisheries and Forestry Queensland, http://www.daf.qld.gov.au/plants/field-crops-and-pastures/broadacre-field-crops/integrated-pest-management/ipm-information-by-crop/sunflowers - Wireworms

30 L Serafin, D McCaffery, S Thompson (2014) Sunflower. Summer crop production guide 2014. pp. 80–92. NSW DPI Management Guide. NSW Department of Primary Industries, http://www.dpi.nsw.gov.au/agriculture/broadacre-crops/guides/summer-crop-production-guide

31 QDAF (2011) Insect pest management in sunflowers. Department of Agriculture, Fisheries and Forestry Queensland, http://www.daf.qld.gov.au/plants/field-crops-and-pastures/broadacre-field-crops/integrated-pest-management/ipm-information-by-crop/sunflowers - Wireworms

7.5.3 Management

Check crops late in the afternoon or evening and control if damage is obvious (Table 3). Control at an early stage is recommended because sunflowers do not have a compensatory mechanism such as tillering to recover from any stand losses. [32]

Chemical control may be cost-effective. Spot spraying of identified patches may suffice. Spray in the late afternoon, close to feeding time, for best results.

Controlling weeds prior to planting will reduce cutworm infestations.

Cutworms are attacked by a range of natural enemies including common brown earwigs, orange caterpillar parasite, two-tones caterpillar parasite, orchid dupe, spiders and Bt (*Bacillus thuringiensis*) bacteria. [33]

Table 3: *Cutworm description and management summary.* [34]

Scientific name	*Agrotis* spp.
Description	Larvae are up to 50 mm long, hairless with dark heads and usually darkish coloured bodies, often with longitudinal lines and/or dark spots. Larvae curl up and remain motionless if picked up. Moths are a dull brown–black colour.
Similar species	May be confused with armyworms and Helicoverpa larvae.
Crops attacked	All field crops. Crops are at most risk during seedling and early vegetative stages.
Damage	Young caterpillars climb plants and skeletonise the leaves or eat small holes. The older larvae may also climb to browse or cut off leaves, but commonly cut through stems at ground level and feed on the top growth of felled plants. Caterpillars that are almost fully grown often remain underground and chew into plants at or below ground level. They usually feed in the late afternoon or at night. By day, they hide under debris or in the soil.
Monitoring and action level	Inspect crop twice weekly in seedling and early vegetative stage. Larvae feed late afternoons and evenings. Chemical control is warranted when there is a rapidly increasing area or proportion of crop damage.
Life-cycle	Usually a single generation during early vegetative stages. Moths prefer to lay their eggs in soil in lightly vegetated (e.g. a weedy fallow) or bare areas. Early autumn egg-laying results in most damage to young cereals. Larvae hatch and feed on host plants right through to maturity. Mature larvae pupate in the soil. Under favourable conditions, the duration from egg-lay to adult emergence is 8–11 weeks, depending on the species.
Control	**Chemical control.** Insecticide application is cost-effective. The whole crop may not need to be sprayed if distribution is patchy; spot spraying may suffice. See Pest Genie or APVMA for current control options. **Cultural control.** Control weeds 3–4 weeks prior to sowing. **Natural enemies.** Cutworms are attacked by a number of predators, parasites and diseases.
Pest status	Minor, widespread, irregular.

MORE INFORMATION

QDAF. Insect pest management in sunflowers.

32 L Serafin, D McCaffery, S Thompson (2014) Sunflower. Summer crop production guide 2014. pp. 80–92. NSW DPI Management Guide. NSW Department of Primary Industries, http://www.dpi.nsw.gov.au/agriculture/broadacre-crops/guides/summer-crop-production-guide

33 QDAF (2011) Insect pest management in sunflowers. Department of Agriculture, Fisheries and Forestry Queensland, http://www.daf.qld.gov.au/plants/field-crops-and-pastures/broadacre-field-crops/integrated-pest-management/ipm-information-by-crop/sunflowers - Wireworms

34 QDAF (2010) Soil insects in Queensland. Cutworm. Department of Agriculture, Fisheries and Forestry Queensland, http://www.daf.qld.gov.au/plants/field-crops-and-pastures/broadacre-field-crops/integrated-pest-management/a-z-insect-pest-list/soil-insects/cutworm

7.6 Black scarab beetles

At least two species of black scarab beetles, or black sunflower scarab, (*Pseudoheteronyx* spp.), are known to attack sunflowers (Figures 9 and 10). Black scarab beetles are an establishment pest and the life-cycle on sunflowers is one generation per year, with the adults damaging the crops in summer. [35]

Figure 9: *Black scarab beetle adults.*

Photo: QDAF

Figure 10: *Seedling damage caused by the adult black scarab beetle.*

Photo: QDAF

7.6.1 Damage

Black scarab beetle larvae feed on taproots, causing wilting and death of seedlings, whereas adult beetles can defoliate and kill plants up to 40 cm tall (Table 4). Adults often feed in a line across the field. Beetles hide in the soil during the day and emerge late afternoon to feed. [36]

35 QDAF (2011) Insect pest management in sunflowers. Department of Agriculture, Fisheries and Forestry Queensland, http://www.daf.qld.gov.au/plants/field-crops-and-pastures/broadacre-field-crops/integrated-pest-management/ipm-information-by-crop/sunflowers - Wireworms

36 QDAF (2011) Insect pest management in sunflowers. Department of Agriculture, Fisheries and Forestry Queensland, http://www.daf.qld.gov.au/plants/field-crops-and-pastures/broadacre-field-crops/integrated-pest-management/ipm-information-by-crop/sunflowers - Wireworms

7.6.2 Thresholds for control

Monitor the soil by digging and sieving for the presence of larvae prior to planting, and at all stages for adults. Look for feeding beetles just before sunset (Table 4). Four beetles per square metre can cause severe losses to young seedlings and may warrant control. [37]

7.6.3 Management

Limited control can be achieved by spraying, with registered chemicals, either side of the feeding line. Spray when beetles are active on the soil surface. Beetles can also be controlled by application of pelleted baits (lucerne or similar meal) at planting. Cracked grain baits do not control beetles.

Damage is most prevalent where sunflowers follow wheat, sorghum or grass pasture.

Removal of the host parthenium weed is advised.

Table 4: *Black scarab beetle description and management summary.* [38]

Scientific name	*Pseudoheteronyx basicollis*
Description	Larvae are creamy white with a grey rear end, brown head capsule and up to 25 mm long. They are C-shaped grubs with wrinkly bodies. Adult beetles are 13 mm long, shiny and black.
Similar species	White grubs/peanut scarabs
Distribution	Queensland
Crops attacked	Sunflower. Parthenium weed is a favoured host but the larvae can develop on the roots of numerous grasses and weeds.
Life-cycle	One generation per year, with adults damaging sunflower crops in summer.
Damage	Larvae feed on taproots, causing wilting and death of plants up to 400 mm high. Damage is most prevalent where sunflowers follow wheat, sorghum or grass pasture. Adult beetles feed on foliage, often in a line across the field.
Monitoring and action level	Check in the soil by digging and sieving for the presence of larvae prior to planting, and at all stages for adults. Particularly look for feeding beetles just before sunset. Four beetles per square metre can cause severe losses to young seedlings.
Control	**Chemical control.** Chemicals are registered but are of limited effectiveness. For current chemical control options see Pest Genie or APVMA. **Cultural control.** Removal of the host parthenium weed is advised. Damage is most prevalent where sunflowers follow wheat, sorghum or grass pasture.
Conservation of natural enemies	No effective natural enemies have been identified.

MORE INFORMATION

Australian Pesticides and Veterinary Medicines Authority - Public Chemical Information System Search

37 QDAF (2011) Insect pest management in sunflowers. Department of Agriculture, Fisheries and Forestry Queensland, http://www.daf.qld.gov.au/plants/field-crops-and-pastures/broadacre-field-crops/integrated-pest-management/ipm-information-by-crop/sunflowers - Wireworms

38 QDAF (2010) Soil insects in Queensland. Black sunflower scarab. Department of Agriculture, Fisheries and Forestry Queensland, http://www.daf.qld.gov.au/plants/field-crops-and-pastures/broadacre-field-crops/integrated-pest-management/a-z-insect-pest-list/black-sunflower-scarab

7.7 Thrips

Several different species of thrips act as an establishment pest on sunflowers; these include onion thrips (*Thrips tabaci*; Figure 11, Table 5), tomato thrips (*Frankliniella schultzei*; Figure 12) and plague thrips (*Thrips imaginis*) (Table 6), and western flower thrips (*Frankliniella occidentalis*; Table 7). [39]

For many field crops (apart from beans), thrips are a significant pest only at the seedling stage. They infest the underside of cotyledons, young leaves and growing points. Adults and nymphs pierce the leaf and suck out sap. Affected areas are silvery-white, and younger leaves become distorted in shape and growing points can die. Damage is more significant if seedlings are not actively growing.

Flower thrips feed inside navy bean and mungbean flowers, causing flower abortion and pod distortion. Deformed pods may be difficult to thresh, resulting in further yield losses. [40]

Thrips are most abundant during a hot, dry spring following a mild dry winter. [41]

7.7.1 Onion thrips

Figure 11: *Onion thrips showing winged adults and nymphs.*

Photo: D Ironside, QDAF

39 QDAF (2011) Insect pest management in sunflowers. Department of Agriculture, Fisheries and Forestry Queensland, http://www.daf.qld.gov.au/plants/field-crops-and-pastures/broadacre-field-crops/integrated-pest-management/ipm-information-by-crop/sunflowers - Wireworms

40 QDAF (2010) Managing insect pests in field crops. Thrips in field crops. Department of Agriculture, Fisheries and Forestry Queensland, http://www.daf.qld.gov.au/plants/field-crops-and-pastures/broadacre-field-crops/integrated-pest-management/a-z-insect-pest-list/thrips-overview

41 QDAF (2011) Insect pest management in sunflowers. Department of Agriculture, Fisheries and Forestry Queensland, http://www.daf.qld.gov.au/plants/field-crops-and-pastures/broadacre-field-crops/integrated-pest-management/ipm-information-by-crop/sunflowers - Wireworms

Table 5: *Onion thrips description and management summary.* [42]

Scientific name	*Thrips tabaci*. Also known as cotton seedling thrips or tobacco thrips.
Description	Adult thrips are 2 mm long and are dark, cigar-shaped and have narrow wings folded along their back. Nymphs are smaller, lack wings and are pale. Thrips species can only be determined microscopically.
Distribution	Recorded in all Australian states.
Crops attacked	Cotton, navy bean, mungbean, cereals. sunflowers
Life-cycle	Adult thrips can infest a seedling's growing point as soon as it emerges from the ground. In cracking soils, seedlings may be infested before they emerge. Nymphs feed inside vegetative terminals. Populations typically peak within 4 weeks of plant emergence. Spring-planted crops are at greatest risk, especially those close to maturing cereal crops.
Damage	For many field crops (apart from beans), thrips are only a significant pest at the seedling stage. They infest the underside of cotyledons, young leaves and growing points. Adults and nymphs pierce the leaf and suck out sap. Affected areas are silvery-white, and younger leaves become distorted in shape and growing points can die. Damage is more significant if seedlings are not actively growing.
Monitoring and action level	Open and microscopically examine the plant's growing points; they can also be dunked in alcohol to dislodge thrips. There are no action level thresholds for seedling thrips.
Chemical control	For current chemical control options see Pest Genie or APVMA.
Cultural control	
Conservation of natural enemies	If a decision is made to control thrips, apply a narrow band spray over the seedlings to preserve predators such as spiders in the inter-row.

42 QDAF (2010) Thrips in field crops. Onion or cotton seedling thrips. Department of Agriculture, Fisheries and Forestry Queensland, http://www.daf.qld.gov.au/plants/field-crops-and-pastures/broadacre-field-crops/integrated-pest-management/a-z-insect-pest-list/thrips-overview/onion-or-cotton-seedling-thrips

7.7.2 Tomato thrips

Figure 12: *Adult tomato thrips.*

Photo: QDAF

Table 6: *Tomato and plague thrips description and management summary.* [43]

Scientific name	Tomato thrips, *Frankliniella schultzei* Plague thrips, *Thrips imaginis* (both in the flower thrips family).
Description	Adults are 2 mm long, cigar-shaped and range in colour from yellow–orange to grey–black. They have narrow wings folded along their back. Nymphs are similar in shape, pale yellow to orange–yellow, wingless and smaller.
Similar species	Other thrips species; differentiation is difficult in the field.
Distribution	Present in all Australian states.
Crops attacked	Flower thrips are common in the flowers of all summer pulses, as well as other crops, ornamentals and weeds.
Life-cycle	Flower thrips feed and breed inside the flowers. Crops are at greatest risk during flowering and podset.
Damage	Nymphs and adults feed in growing points and inside flowers. Thrips damage can result in flower abortion and pod distortion. Deformed pods may be difficult to thresh, resulting in further yield losses. Thrips may also vector (via pollen transfer) the damaging exotic Tobacco streak virus reported in mungbeans and sunflowers at Emerald in central Queensland.
Monitoring and action levels	Open and examine flowers for the presence of thrips. If flowers cannot be assessed immediately, store in 70% alcohol to dislodge thrips and prevent escape. Control thrips if >4–6 are found per flower.
Control	**Chemical control.** Except for western flower thrips, flower thrips are easily controlled with current systemic pesticides registered in pulses. For current chemical control options see Pest Genie or APVMA. **Cultural control.** Vigorously growing crops can usually compensate for flower abortion.
Conservation of natural enemies	Pirate bugs, lacewing larvae and ladybird beetles prey on thrips.

43 QDAF (2012) Thrips in field crops. Tomato and plague thrips. Department of Agriculture, Fisheries and Forestry Queensland, http://www.daf.qld.gov.au/plants/field-crops-and-pastures/broadacre-field-crops/integrated-pest-management/a-z-insect-pest-list/thrips-overview/tomato-thrips,-plague-thrips

7.7.3 Western flower thrips

Table 7: *Western flower thrips description and management summary.* [44]

Scientific name	*Frankliniella occidentalis*
Description	Adults are 2 mm long, cigar-shaped and range from yellow–orange to grey–black. They have tiny, narrow wings carried over the back. Nymphs are similar in shape, pale yellow to orange–yellow, wingless and smaller.
Similar species	Thrips species can only be determined microscopically. Thrips damage is distinguished from spider mite damage by the appearance of liquid faecal deposits, which cause dark green speckling, whereas spider mites produce black granules.
Distribution	A cosmopolitan species that has recently established and spread throughout Australia.
Crops attacked	Cotton, navy bean, mungbean, sunflower, canola and peanuts.
Life-cycle and risk period	Eggs are laid in slits made in leaves and growing points. There are two larval stages as well as a pre-pupal and pupal stage. Nymphs and adults feed in growing points and inside flowers. Pupation occurs in the soil. The life-cycle can be completed in as little as 10 days at 20°C. Populations decline at temperatures >30°C. Crops can be infested during the early vegetative stage but severe symptoms may not occur until much later in the crop's development. The earlier the thrips attack, the greater is the risk of damage.
Damage	Symptoms of the western flower thrips feeding include discoloration and indentation of the leaf surface. Damage to buds and flowers can result in deformed pods.
Monitoring and action level	Check seedling crops. Monitor flowering bean crops by peeling open the flower to look inside for thrips. Very few western flower thrips, which are resistant to most insecticides, are required to spread Tomato spotted wilt virus.
Control	**Chemical control.** Unlikely to be cost-effective. For current chemical control options see Pest Genie or APVMA. **Cultural control.** Late peanut plantings may help avoid western flower thrips damage.
Conservation of natural enemies	Using soft pesticides against other pests may conserve other thrips species, which, by competing with western flower thrips, may slow its population growth.

7.7.4 Damage

Both adults and nymphs feed on the leaves by rasping the surface tissues and sucking the exuded juices. Damage is normally insignificant; however, when there are high populations of thrips on seedlings, they cause distortion and browning of the cotyledons and leaves. Under these conditions seedlings can become stunted and die.

Thrips are an important vector for the pathogen Tobacco streak virus (TSV). [45]

7.8 Thresholds for control

For tomato thrips, control if 4–6 thrips are found per flower. [46] There are no action level thresholds for thrips on seedlings. [47]

44 QDAF (2012) Thrips in field crops. Western flower thrips. Department of Agriculture, Fisheries and Forestry Queensland, http://www.daf.qld.gov.au/plants/field-crops-and-pastures/broadacre-field-crops/integrated-pest-management/a-z-insect-pest-list/thrips-overview/western-flower-thrips

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46 QDAF (2012) Thrips in field crops. Western flower thrips. Department of Agriculture, Fisheries and Forestry Queensland, http://www.daf.qld.gov.au/plants/field-crops-and-pastures/broadacre-field-crops/integrated-pest-management/a-z-insect-pest-list/thrips-overview/western-flower-thrips

47 QDAF (2010) Thrips in field crops. Onion or cotton seedling thrips. Department of Agriculture, Fisheries and Forestry Queensland, http://www.daf.qld.gov.au/plants/field-crops-and-pastures/broadacre-field-crops/integrated-pest-management/a-z-insect-pest-list/thrips-overview/onion-or-cotton-seedling-thrips

7.8.1 Management

Insecticides can be used if needed (see APVMA for listed insecticides). Thrips may require control in areas of known TSV outbreaks. If a decision is made to control thrips, apply a narrow band spray over the seedlings to preserve predators such as spiders in the inter-row. [48]

7.9 Wingless cockroaches

Wingless cockroaches (*Calolampra* spp.) are an establishment pest that eats seedlings of all field crops (Figures 13 and 14). Other native cockroaches are minor pests. [49] Wingless cockroach adults are large, shiny brown with yellow stripes and margins (Table 8). They are nocturnal, feeding at night and sheltering by day under trash. [50]

Figure 13: *Wingless cockroach adult. Adult males may be winged.*

Photo: D Ironside, QDAF

48 QDAF (2011) Insect pest management in sunflowers. Department of Agriculture, Fisheries and Forestry Queensland, http://www.daf.qld.gov.au/plants/field-crops-and-pastures/broadacre-field-crops/integrated-pest-management/ipm-information-by-crop/sunflowers - Wireworms

49 QDAF (2011) Insect pest management in sunflowers. Department of Agriculture, Fisheries and Forestry Queensland, http://www.daf.qld.gov.au/plants/field-crops-and-pastures/broadacre-field-crops/integrated-pest-management/ipm-information-by-crop/sunflowers - Wireworms

50 QDAF (2010) Soil insects in Queensland. Wingless cockroaches. Department of Agriculture, Fisheries and Forestry Queensland, http://www.daf.qld.gov.au/plants/field-crops-and-pastures/broadacre-field-crops/integrated-pest-management/a-z-insect-pest-list/soil-insects/wingless-cockroach

Figure 14: *Leaf damage caused by wingless cockroaches. Aboveground parts of seedlings are chewed and sometimes cut off.*

Photo: QDAF

MORE INFORMATION

QDAF. How to recognise and monitor soil insects.

7.9.1 Damage

Cockroaches are mainly a problem where seedlings are present in late summer and autumn. On small seedlings, they feed on cotyledons and stems, often severing the stem. On larger seedlings, they feed on the leaves and growing points. [51]

7.9.2 Thresholds for control

The use of GSBs is recommended, with the threshold for control being when at least one cockroach is present per two GSBs. [52]

7.9.3 Management

Nymphs and adults are found under stubble but congregate around volunteer plants in bare fallows. If the soil surface dries, they tend to move down to the moist soil layer. They feed at night and shelter under trash by day. They pose the highest risk where seedlings are present (Table 8).

Populations reach the highest densities under no tillage with stubble retained. Determine numbers with GSB. Take action when the threshold is reached (≥1 cockroach per two GSBs). Use insecticide-treated seed. See APVMA for chemical control options.

No effective natural enemies have been identified. A parasitic fly has been recorded parasitising nymphs. but parasitism percentages are low (<5%). [53]

51 QDAF (2010) Soil insects in Queensland. Wingless cockroaches. Department of Agriculture, Fisheries and Forestry Queensland, http://www.daf.qld.gov.au/plants/field-crops-and-pastures/broadacre-field-crops/integrated-pest-management/a-z-insect-pest-list/soil-insects/wingless-cockroach

52 QDAF (2010) Soil insects in Queensland. Wingless cockroaches. Department of Agriculture, Fisheries and Forestry Queensland, http://www.daf.qld.gov.au/plants/field-crops-and-pastures/broadacre-field-crops/integrated-pest-management/a-z-insect-pest-list/soil-insects/wingless-cockroach

53 QDAF (2010) Soil insects in Queensland. Wingless cockroaches. Department of Agriculture, Fisheries and Forestry Queensland, http://www.daf.qld.gov.au/plants/field-crops-and-pastures/broadacre-field-crops/integrated-pest-management/a-z-insect-pest-list/soil-insects/wingless-cockroach

Table 8: *Wingless cockroach description and management summary.* [54]

Scientific name	*Calolampra elegans* and *C. solida*
Description	Adult males and females of *C. elegans* are large (25–35 mm long) and shiny brown with yellow stripes and margins. The male of *C. solida* is fully winged, whereas the females are wingless. Nymphs are initially greyish-brown or tan, developing yellow markings when about half of adult size. Both species are Australian natives.
Similar species	House cockroach.
Pest status	Major, recorded as pests in Queensland's Central Highlands, irregular. Other native cockroaches, recorded as minor pests, are *Cosmozosteria* sp. and *Platyzosteria* sp.
Crops attacked	Omnivorous; food includes seedlings of all field crops.
Risk period	When seedlings are present.
Damage	On small seedlings, they feed on cotyledons and stems, often severing the stem. On larger seedlings, they feed on the leaves and growing points.
Monitoring and action level	Use germinating seed baits. Take action when there are one or more cockroaches per two germinating seed baits.
Control	**Chemical control**. Baiting with insecticide-treated cracked grain baits. For current chemical control options see Pest Genie or APVMA. **Cultural control**. Wingless cockroach populations reach highest densities under no tillage with stubble retained. **Conservation of natural enemies**. No effective natural enemies have been identified.

7.10 Black field earwig

Several earwig species are omnivorous. Their plant-feeding behaviour may result in plant damage but their predatory behaviour may also effectively control other crop pests. Black field earwigs (*Nala lividipes*) are a sporadic establishment pest of sunflowers (Figures 15 and 16, Table 9). [55]

Figure 15: *Three sizes of black field earwig.*

Photo: QDAF

54 QDAF (2010) Soil insects in Queensland. Wingless cockroaches. Department of Agriculture, Fisheries and Forestry Queensland, http://www.daf.qld.gov.au/plants/field-crops-and-pastures/broadacre-field-crops/integrated-pest-management/a-z-insect-pest-list/soil-insects/wingless-cockroach

55 QDAF (2010) Soil insects in Queensland. Black field earwig. Department of Agriculture, Fisheries and Forestry Queensland, http://www.daf.qld.gov.au/plants/field-crops-and-pastures/broadacre-field-crops/integrated-pest-management/a-z-insect-pest-list/soil-insects/black-field-earwig

Figure 16: *Black field earwig damage to germinating seed and young seedlings (in maize).*

Photo: QDAF

MORE INFORMATION

QDAF. How to recognise and monitor soil insects.

7.10.1 Damage

Black field earwigs eat newly sown and germinating seed and the roots of crops below ground, resulting in poor establishment (Table 9). Black field earwigs also chew the stems of newly emerged seedlings above ground.

7.10.2 Thresholds for control

The use of GSB, or digging and sieving, to detect adults and nymphs prior to planting is recommended. Crops should be monitored after planting until establishment. Controls should be implemented if >50 earwigs are found in 20 GSBs. [56]

7.10.3 Management

Grain baits containing insecticide applied at sowing offer the best protection from black field earwigs. Insecticide seed dressings provide some protection. In-furrow sprays are not effective in protecting against dense populations.

The black field earwig is mainly a pest in areas having heavy, black soils. Earwigs prefer cultivated soils rather than undisturbed soil (no-till).

Use press-wheels at sowing. [57]

56 QDAF (2011) Insect pest management in sunflowers. Department of Agriculture, Fisheries and Forestry Queensland, http://www.daf.qld.gov.au/plants/field-crops-and-pastures/broadacre-field-crops/integrated-pest-management/ipm-information-by-crop/sunflowers - Wireworms

57 QDAF (2011) Insect pest management in sunflowers. Department of Agriculture, Fisheries and Forestry Queensland, http://www.daf.qld.gov.au/plants/field-crops-and-pastures/broadacre-field-crops/integrated-pest-management/ipm-information-by-crop/sunflowers - Wireworms

Table 9: *Black field earwig description and management summary.* [58]

Scientific name	*Nala lividipes*
Description	Adults are 15 mm long, shiny black with a flattened body and a pair of curved pincers at the end of the body. Nymphs resemble adults but are wingless and paler.
Similar species	The common brown earwig (*Labidura truncata*), which grows to a larger size (24 mm) and is lighter in colour than the black field earwig.
Crops attacked	Wheat, sorghum, maize and sunflowers are the preferred hosts, but seedlings of most field crops are susceptible.
Life-cycle	The black field earwig normally feeds on decaying stubble in cultivation, with all stages (adults and immature stages) present during warmer months. In common with several earwig species, female black field earwigs lay eggs in a burrow in the soil and remain to care for the eggs and nymphs. Eggs hatch in 6–7 days at 29°C. The developmental time for five nymphal instars is about 7 weeks in clay soils, longer in sandy soils. Nymphs develop into adult females or major or minor males. Longevity is about 20 weeks.
Damage	The black field earwig eats newly sown and germinating seed and the roots of crops, resulting in poor establishment. Feeding on secondary roots may cause the plants to fall over as they get larger.
Monitoring	Use germinating seed baits or digging and sieving to detect adults and nymphs prior to planting. Monitor crops after planting until establishment.
Action level	Control if >50 earwigs in 20 germinating seed baits or if one earwig is found in 20 spade samples.
Control	**Chemical control**. Grain baits containing insecticide applied at sowing offer best protection. Insecticide seed dressings provide some protection. In-furrow sprays are not effective in protecting against dense populations. See Pest Genie or APVMA for current control options. **Cultural control.** The black field earwig is mainly a pest in areas with heavy, black soils. Earwigs prefer cultivated soils rather than undisturbed soil (no-till). Use press-wheels at sowing, set at 2–4 kg per cm width after planting rain, or 4–8 kg per cm in dry soil.
Distribution	Widespread in Australia, southern Europe, Asia, Africa and Hawaii.

7.11 Field crickets

Black field crickets (*Teleogryllus* spp.; Figure 17, Table 10) and brown field crickets (*Lepidogryllus* spp.) are minor, widespread and irregular establishment pests of sunflowers. [59]

Adult and nymph black field crickets feed on the leaves and stems of seedlings and may reduce a stand to the extent that replanting is necessary. They may damage cotton when present in plague numbers.

Both adults and immature stages shelter during the day in cracks in the soil or under trash. They come out at night and feed on weeds, grasses or crops. In sunflowers, the cricket feeds on the seedlings, on the back of the flower heads and on the maturing seeds on the face of the flower. [60]

58 QDAF (2010) Soil insects in Queensland. Black field earwig. Department of Agriculture, Fisheries and Forestry Queensland, http://www.daf.qld.gov.au/plants/field-crops-and-pastures/broadacre-field-crops/integrated-pest-management/a-z-insect-pest-list/soil-insects/black-field-earwig

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60 QDAF (2010) Soil insects in Queensland. Black field cricket. Department of Agriculture, Fisheries and Forestry Queensland, http://www.daf.qld.gov.au/plants/field-crops-and-pastures/broadacre-field-crops/integrated-pest-management/a-z-insect-pest-list/soil-insects/black-field-cricket

Figure 17: *Black field crickets, adults and nymphs.*

Photo: D Ironside, QDAF

7.11.1 Damage

Black field crickets feed on the leaves and stems of seedlings, sometimes severing the stem at or above ground level. They may also attack more mature plants, feeding on the back of flower heads and on the maturing seed on the face of the head. [61]

7.11.2 Thresholds for control

Because crickets feed at night, it is suggested to inspect crops at dusk when they are most active (Table 10). Activity of black field cricket can be monitored with light traps. Use GSB to determine cricket numbers. One cricket (or more) per two GSBs requires control. [62]

7.11.3 Management

Field crickets are controlled using insecticide-treated, cracked grain baits. Control can be achieved with insecticide-treated grain baits. Weedy cultivation prior to planting may encourage crickets.

Natural controls such as disease, parasitic insects and predators (e.g. birds) have little impact on crickets. Nematodes are common parasites of brown field crickets in Central Queensland.

Cricket populations are regulated by weather conditions. [63]

MORE INFORMATION

QDAF. How to recognise and monitor soil insects.

61 QDAF (2011) Insect pest management in sunflowers. Department of Agriculture, Fisheries and Forestry Queensland, http://www.daf.qld.gov.au/plants/field-crops-and-pastures/broadacre-field-crops/integrated-pest-management/ipm-information-by-crop/sunflowers - Wireworms

62 QDAF (2011) Insect pest management in sunflowers. Department of Agriculture, Fisheries and Forestry Queensland, http://www.daf.qld.gov.au/plants/field-crops-and-pastures/broadacre-field-crops/integrated-pest-management/ipm-information-by-crop/sunflowers - Wireworms

63 QDAF (2011) Insect pest management in sunflowers. Department of Agriculture, Fisheries and Forestry Queensland, http://www.daf.qld.gov.au/plants/field-crops-and-pastures/broadacre-field-crops/integrated-pest-management/ipm-information-by-crop/sunflowers - Wireworms

Table 10: *Black field cricket description and management summary.* [64]

Scientific name	*Teleogryllus commodus*
Description	Adults are up to 30 mm long, winged, black or brown and have the head and mouthparts inclined downwards. The hind legs are large and modified for jumping, like grasshoppers. Nymphs are similar in shape but are smaller, paler and wingless. Small nymphs can have a white band across their back.
Distribution	Widespread in Australia, common in cracking soils.
Crops attacked	Many field crops, including most pulses.
Risk conditions	Crops can be attacked at any stage. Crops in heavier soils are at greatest risk. Most damage is caused by crickets already in the area at planting or by adults flying into crops.
Damage	Significant damage may be caused by adults and nymphs feeding on leaves, stems and pods. When black field crickets are present in plague numbers, seedling crops can be thinned to the point where replanting is necessary. At podding, adults chew into pods to reach the seeds.
Monitoring and action level	Crickets feed at night, so inspect crops at dusk when crickets are most active. Black field cricket activity can be monitored with light traps. Take action if significant cricket populations are present.
Control	**Chemical control**. Field crickets are controlled using insecticide-treated cracked-grain baits. For current chemical control options see Pest Genie or APVMA. **Cultural control.** Weedy cultivation prior to planting may encourage crickets.
Natural enemies	Natural control agents, including diseases, parasitic insects, and predatory birds and insects, appear to have little effect.

7.12 Rutherglen bug

The Rutherglen bug (RGB) (*Nysius vinitor*) is a major, widespread pest of crops throughout Australia (Figures 18 and 19). Grey cluster bug (*Nysius clevelandensis)* is a minor pest of sunflowers in Queensland and northern NSW. [65] These species are considered together as they are difficult to distinguish, are both establishment pests that cause similar symptoms, and have similar potential to reduce yield. In large populations, both have the capacity to reduce sunflower yield and oil contents dramatically. [66] RGB is the most likely and most damaging insect pest on sunflower. [67] [68]

The RGB and grey cluster bug are native species that can migrate into crops in very large numbers in favourable seasons. [69] Bugs can often appear in large numbers in a very short time and only in occasional seasons. Their invasion can occur in a very short time and be highly unpredictable, because they can migrate 200–300 km in a single night. [70]

MORE INFORMATION

Better Sunflowers Newsletter, March 2013
Feature Article: Is Weed Management the Key to Controlling Rutherglen Bug Pressure?

64 QDAF (2010) Soil insects in Queensland. Black field cricket. Department of Agriculture, Fisheries and Forestry Queensland, http://www.daf.qld.gov.au/plants/field-crops-and-pastures/broadacre-field-crops/integrated-pest-management/a-z-insect-pest-list/soil-insects/black-field-cricket

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66 L Serafin, D McCaffery, S Thompson (2014) Sunflower. Summer crop production guide 2014. pp. 80–92. NSW DPI Management Guide. NSW Department of Primary Industries, http://www.dpi.nsw.gov.au/agriculture/broadacre-crops/guides/summer-crop-production-guide

67 QDAF (2011) Insect pest management in sunflowers. Department of Agriculture, Fisheries and Forestry Queensland, http://www.daf.qld.gov.au/plants/field-crops-and-pastures/broadacre-field-crops/integrated-pest-management/ipm-information-by-crop/sunflowers - Wireworms

68 Australian Oilseeds Federation (2012), Better Sunflowers Agronomy Training Package (Big Yellow Sunflower Pack), Insect Management https://bettersunflowers.com.au/bysp/surveyinfo.aspx?sid=7

69 QDAF (2010) Managing insect pests in field crops. Rutherglen bug, grey cluster bug. Department of Agriculture, Fisheries and Forestry Queensland, http://www.daf.qld.gov.au/plants/field-crops-and-pastures/broadacre-field-crops/integrated-pest-management/a-z-insect-pest-list/rutherglen-bug,-grey-cluster-bug

70 QDAF (2011) Insect pest management in sunflowers. Department of Agriculture, Fisheries and Forestry Queensland, http://www.daf.qld.gov.au/plants/field-crops-and-pastures/broadacre-field-crops/integrated-pest-management/ipm-information-by-crop/sunflowers - Wireworms

Populations of RGB in cropping areas will breed on weeds, moving to available crops or weeds when hosts die off. Adults fly into crops, and flightless nymphs move by walking.

In seasons when RGB is a major pest, the population is dominated by migrants from outside the local cropping areas that are carried from inland breeding sites to eastern cropping regions. Depending on the time of planting, adults may be present during budding and flowering, and nymphs post-flowering. During summer, several overlapping generations develop and all stages may be present. [71]

Both species breed on a wide range of native and weed hosts, building up to large numbers in inland areas when winter and spring rainfall allows the growth of native herbs and weeds. In spring, as the hosts start to dry off, large numbers of adult bugs will move into the eastern cropping areas, migrating on the winds associated with storm fronts. [72] Winter and spring conditions that favour prolific weed growth, followed by a dry late spring, will force bugs off their host plants onto crops. [73]

Figure 18: *Rutherglen bug nymphs and adults.*

Photo: QDAF

Figure 19: *Rutherglen bug damaging sunflower plants.*

Photo: Drew Penberthy, Penagcon

71 QDAF (2011) Insect pest management in sunflowers. Department of Agriculture, Fisheries and Forestry Queensland, http://www.daf.qld.gov.au/plants/field-crops-and-pastures/broadacre-field-crops/integrated-pest-management/ipm-information-by-crop/sunflowers - Wireworms

72 QDAF (2010) Managing insect pests in field crops. Rutherglen bug, grey cluster bug. Department of Agriculture, Fisheries and Forestry Queensland, http://www.daf.qld.gov.au/plants/field-crops-and-pastures/broadacre-field-crops/integrated-pest-management/a-z-insect-pest-list/rutherglen-bug,-grey-cluster-bug

73 QDAF (2011) Insect pest management in sunflowers. Department of Agriculture, Fisheries and Forestry Queensland, http://www.daf.qld.gov.au/plants/field-crops-and-pastures/broadacre-field-crops/integrated-pest-management/ipm-information-by-crop/sunflowers - Wireworms

7.12.1 Damage

Adults congregate on the upper stems during budding and cause the head to wilt, become malformed or die. [74] After flowering, adults lay eggs in flower heads, in between individual flowers, with nymphs emerging in about 7 days to feed. [75] Both adults and nymphs feed on the seed, reducing grain yield, oil content, oil quality and seed germination. Damage is higher in moisture-stressed crops. Damage can occur until harvest depending on seed hardness. [76]

7.12.2 Monitoring

Weekly trap catch data for *H. punctigera* and *H. armigera* from locations across all states can now be viewed online. The adjustable bar below the map allows selection of a time period (1 wk, 2 wks, 1 mth, etc). https://jamesmaino.shinyapps.io/MothTrapVis/

7.12.3 Thresholds for control

The critical times to monitor for RGB are at budding and seed-fill. To monitor for bug numbers, count adults on buds and heads at weekly intervals. During budding, bugs congregate on the upper stem and bud. During flowering, eggs are laid between individual flowers with nymphs emerging after about 7 days to feed on the young seeds.

Monitor and manage insect pests, especially RGB, which reduces sunflower yield and oil content by sucking the developing seed, reducing seed weight and changing oil composition. RGB damage is exacerbated in moisture-stressed crops; hence, dryland crops are more vulnerable than irrigated crops. [77] [78]

Table 11: Nysius *spp. thresholds (number of adult bugs per plant) in sunflowers.* [79]

Growth stage	Early-plant sunflowers (August–December)	Late-plant sunflowers (January–April)
Budding	10–15	20–25
Seed fill	20–25	50
Confectionery[A]	5	5

A The threshold is lower for confectionary sunflower due to the need to meet human consumption specifications. Brown marks on the seed from piercing make confectionary seed visually unattractive.

The thresholds (Table 11) are designed to prevent adults breeding in the crop; hence, thresholds are higher in late crops than in early crops, because higher prevailing temperatures promote more rapid RGB development. The thresholds proposed are based on field experience and knowledge that the adults will not lay eggs until the start of seed-fill. [80]

74 QDAF (2011) Insect pest management in sunflowers. Department of Agriculture, Fisheries and Forestry Queensland, http://www.daf.qld.gov.au/plants/field-crops-and-pastures/broadacre-field-crops/integrated-pest-management/ipm-information-by-crop/sunflowers - Wireworms

75 Australian Oilseeds Federation (2012), Better Sunflowers Agronomy Training Package (Big Yellow Sunflower Pack), Insect Management https://bettersunflowers.com.au/bysp/surveyinfo.aspx?sid=7

76 QDAF (2011) Insect pest management in sunflowers. Department of Agriculture, Fisheries and Forestry Queensland, http://www.daf.qld.gov.au/plants/field-crops-and-pastures/broadacre-field-crops/integrated-pest-management/ipm-information-by-crop/sunflowers - Wireworms

77 L Serafin, S Belfield (2008) Sunflower production guidelines for the northern grains region—northern NSW and southern Qld. NSW Department of Primary Industries, http://www.dpi.nsw.gov.au/__data/assets/pdf_file/0011/249779/Sunflower-production-guidelines-for-the-northern-grains-region.pdf

78 Australian Oilseeds Federation (2012), Better Sunflowers Agronomy Training Package (Big Yellow Sunflower Pack), Insect Management https://bettersunflowers.com.au/bysp/surveyinfo.aspx?sid=7

79 QDAF (2011) Insect pest management in sunflowers. Department of Agriculture, Fisheries and Forestry Queensland, http://www.daf.qld.gov.au/plants/field-crops-and-pastures/broadacre-field-crops/integrated-pest-management/ipm-information-by-crop/sunflowers - Wireworms

80 L Serafin, D McCaffery, S Thompson (2014) Sunflower. Summer crop production guide 2014. pp. 80–92. NSW DPI Management Guide. NSW Department of Primary Industries, http://www.dpi.nsw.gov.au/agriculture/broadacre-crops/guides/summer-crop-production-guide

7.12.4 Management

Weed management

Remove host weeds and by ploughing a deep furrow around the crop, to prevent wingless bugs from migrating from weeds. Migration of RGB nymphs out of harvested canola crops and devastating sunflower and cotton crops is a significant problem.

Insecticide use

Understanding the life-cycle of the RGB when making spray decisions is helpful (Table 12). The aim is to prevent adults breeding; otherwise, population explosions will occur. Adults will not start breeding until a protein source is available, i.e. developing sunflower seed. Adults stop breeding in late February. [81]

If crops require spraying, best results are achieved before heads turn down toward the ground. Several synthetic pyrethroids are registered and they are the most effective pesticide for control. [82] However, they have limited residual effect and severely disrupt natural predator populations. As adults are winged, re-infestation can occur rapidly after treatment. [83] Multiple treatments are sometimes required. Sprays are best applied from budding onwards if the populations are high enough. This timing will normally prevent subsequent nymphal populations developing. Spray late in the afternoon when bees are less active. [84]

The 2008 project 'Sunflowers in Northern NSW and Southern Qld—Tools for Success' included benchmarking of 134 commercial crops across these regions supported by strategic replicated trials. This benchmarking study indicated a high degree of variability in insecticide application across the regions. Southern Queensland consistently recorded a lower proportion of insecticide applications, whereas in Gunnedah, ≥50% of crops were consistently sprayed. In the Moree region, application was seasonal-dependent. [85]

Insecticides were primarily targeted at controlling RGB. Secondary pests targeted include *Helicoverpa* spp. Insecticide use was dominated by synthetic pyrethroids. Trials carried out by Queensland Department of Primary Industries and Fisheries have shown pyrethroids to be the most effective chemicals in controlling RGB in sunflowers. [86]

Natural enemies

Egg parasitoids *(Telenomus spp.)* are sometimes important in hindering or preventing nymph infestations and reducing bug populations. Their potential contribution to population control will be limited in seasons when there are large influxes of adults. More than one species of egg parasitoid has been found. Parasitism of eggs is generally low, with the maximum recorded at 33.3%. Predation has rarely been recorded, but spiders may play a role. [87]

81 L Serafin, S Belfield (2008) Sunflower production guidelines for the northern grains region—northern NSW and southern Qld. NSW Department of Primary Industries, http://www.dpi.nsw.gov.au/__data/assets/pdf_file/0011/249779/Sunflower-production-guidelines-for-the-northern-grains-region.pdf

82 L Serafin, D McCaffery, S Thompson (2014) Sunflower. Summer crop production guide 2014. pp. 80–92. NSW DPI Management Guide. NSW Department of Primary Industries, http://www.dpi.nsw.gov.au/agriculture/broadacre-crops/guides/summer-crop-production-guide

83 L Serafin, S Belfield (2008) Sunflower production guidelines for the northern grains region—northern NSW and southern Qld. NSW Department of Primary Industries, http://www.dpi.nsw.gov.au/__data/assets/pdf_file/0011/249779/Sunflower-production-guidelines-for-the-northern-grains-region.pdf

84 QDAF (2011) Insect pest management in sunflowers. Department of Agriculture, Fisheries and Forestry Queensland, http://www.daf.qld.gov.au/plants/field-crops-and-pastures/broadacre-field-crops/integrated-pest-management/ipm-information-by-crop/sunflowers - Wireworms

85 L Serafin, S Belfield (2008) Sunflower production guidelines for the northern grains region—northern NSW and southern Qld. NSW Department of Primary Industries, http://www.dpi.nsw.gov.au/__data/assets/pdf_file/0011/249779/Sunflower-production-guidelines-for-the-northern-grains-region.pdf

86 L Serafin, S Belfield (2008) Sunflower production guidelines for the northern grains region—northern NSW and southern Qld.. NSW Department of Primary Industries, http://www.dpi.nsw.gov.au/__data/assets/pdf_file/0011/249779/Sunflower-production-guidelines-for-the-northern-grains-region.pdf

87 QDAF (2011) Insect pest management in sunflowers. Department of Agriculture, Fisheries and Forestry Queensland, http://www.daf.qld.gov.au/plants/field-crops-and-pastures/broadacre-field-crops/integrated-pest-management/ipm-information-by-crop/sunflowers - Wireworms

Table 12: *Rutherglen bug and grey cluster bug description and management summary.* [88] [89] [90]

Scientific name	*Nysius vinitor*—Rutherglen bug (RGB), *Nysius clevelandensis*—grey cluster bug
Description	Adults are 3–4 mm long, mottled grey–brown–black, and have clear wings folded flat over the back. Nymphs are wingless, with a reddish-brown, pear-shaped body. *Nysius clevelandensis* and *N. vinitor* can be distinguished from each other with a hand lens or microscope; *N. vinitor* looks smooth, while *N. clevelandensis* is hairy.
Similar species	Brown mirid and brokenbacked bug. Nymphs are often confused with aphids.
Distribution	RGB is common in NSW, Queensland, South Australia, Victoria and southern Western Australia. Grey cluster bug is common in northern NSW and Queensland.
Crops attacked	Sunflower, sorghum, canola and safflower.
Life-cycle	RGB has 8 generations a year. In spring and summer, development from egg to adult takes 3–4 weeks. Adults will live up to 4 weeks, and females will lay up to 400 eggs in this period (which will hatch ~1 week after laying). The nymphs are wingless, with a pear-shaped body and reddish brown in colour. Nymphs develop over 3 weeks, before gaining wings, changing their shape and size, and becoming adults. They have rapid breeding capabilities, which mean 40 adults per plant at flowering can breed up into 1200 nymphs by harvest. [89] Females use the developing sunflower seed as a protein source to initiate egg laying. Eggs are laid between the seeds and dead florets up to 2 weeks post flowering. This means a second generation could be mature enough to lay a third generation by the time the crop reaches physiological maturity. Damage can continue until harvest depending on seed hardness. [90] Populations of RGB in cropping areas will breed on weeds, moving to available crops or weeds when hosts die off. Adults will overwinter, moving to available weeds and crops in spring and starting to breed. In seasons when RGB is a major pest, the population is dominated by migrants from outside the local cropping areas which are carried from inland breeding sites to eastern cropping regions.
Damage	In sunflowers, infestation during grain set and grain fill will reduce yield, oil content and oil quality. In seed crops, RGB will reduce germination of seed. Heavy infestations during budding may cause heads to distort. Impact is greater in moisture-stressed crops.
Monitoring	Sunflower and other oilseeds: from budding onwards.
Control	**Chemical control.** Repeated influxes of migrating adults can make repeat applications necessary, particularly in spring-sown sunflower. See Pest Genie or APVMA for current control options. **Cultural control**. Local management will have little impact on RGB in seasons when there are major influxes of bugs from outside the cropping region in spring. Managing weeds in and around paddocks prior to sowing can reduce the likelihood of bugs moving from dying weeds onto emerging seedlings.
Conservation of natural enemies	Egg parasitoids are the most commonly recorded natural enemy of RGB. Their potential contribution to population control will be limited in seasons when there are large influxes of adults. Predation has rarely been recorded, but spiders may play a role.

MORE INFORMATION

www.apvma.gov.au

7.13 *Helicoverpa* spp.

Two species of *Helicoverpa* are serious post-establishment pests of sunflowers in the northern grains region of Australia: the native budworm, *Helicoverpa punctigera,* and the corn earworm, *H. armigera* (Figures 20–24).

88 QDAF (2010) Managing insect pests in field crops. Rutherglen bug, grey cluster bug. Department of Agriculture, Fisheries and Forestry Queensland, http://www.daf.qld.gov.au/plants/field-crops-and-pastures/broadacre-field-crops/integrated-pest-management/a-z-insect-pest-list/rutherglen-bug,-grey-cluster-bug

89 L Serafin, S Belfield (2008) Sunflower production guidelines for the northern grains region—northern NSW and southern Qld. NSW Department of Primary Industries, http://www.dpi.nsw.gov.au/__data/assets/pdf_file/0011/249779/Sunflower-production-guidelines-for-the-northern-grains-region.pdf

90 L Serafin, S Belfield (2008) Sunflower production guidelines for the northern grains region—northern NSW and southern Qld. NSW Department of Primary Industries, http://www.dpi.nsw.gov.au/__data/assets/pdf_file/0011/249779/Sunflower-production-guidelines-for-the-northern-grains-region.pdf

Figure 20: Helicoverpa armigera*: male (left), female (right).*

Photo: Drew Penberthy, Penagcon

Helicoverpa armigera is generally regarded as the more serious pest because of its greater capacity to develop resistance to insecticides, broader host range, and persistence in cropping areas from year to year. [91] They usually occur from late budding until late seed fill. [92] [93]

The proportion of each species found on sunflowers depends on the time of planting in any particular year, and the population of *H. punctigera* in cropping regions fluctuates from year to year based on breeding conditions in inland breeding areas. [94] [95]

91 QDAF (2012) Managing insect pests in field crops. *Helicoverpa* species. Department of Agriculture, Fisheries and Forestry Queensland, http://www.daf.qld.gov.au/plants/field-crops-and-pastures/broadacre-field-crops/integrated-pest-management/a-z-insect-pest-list/helicoverpa/helicoverpa-species

92 QDAF (2011) Insect pest management in sunflowers. Department of Agriculture, Fisheries and Forestry Queensland, http://www.daf.qld.gov.au/plants/field-crops-and-pastures/broadacre-field-crops/integrated-pest-management/ipm-information-by-crop/sunflowers - Wireworms

93 L Serafin, S Belfield (2008) Sunflower production guidelines for the northern grains region—northern NSW and southern Qld. NSW Department of Primary Industries, http://www.dpi.nsw.gov.au/__data/assets/pdf_file/0011/249779/Sunflower-production-guidelines-for-the-northern-grains-region.pdf

94 QDAF (2011) Insect pest management in sunflowers. Department of Agriculture, Fisheries and Forestry Queensland, http://www.daf.qld.gov.au/plants/field-crops-and-pastures/broadacre-field-crops/integrated-pest-management/ipm-information-by-crop/sunflowers - Wireworms

95 QDAF (2012) Managing insect pests in field crops. *Helicoverpa* species. Department of Agriculture, Fisheries and Forestry Queensland, http://www.daf.qld.gov.au/plants/field-crops-and-pastures/broadacre-field-crops/integrated-pest-management/a-z-insect-pest-list/helicoverpa/helicoverpa-species

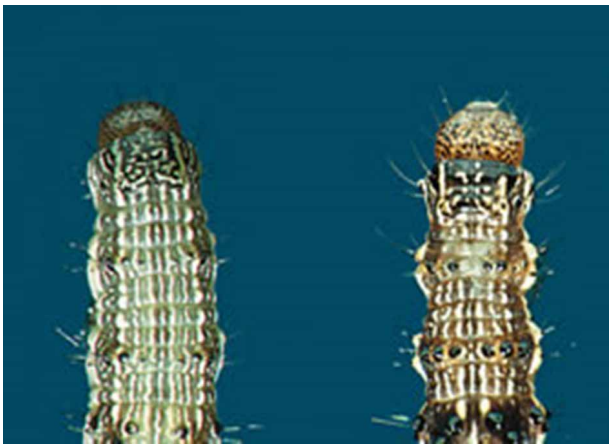

Figure 21: *Image showing key differences between* Helicoverpa punctigera *and* H. armigera *larva.*

Photo: QDAF

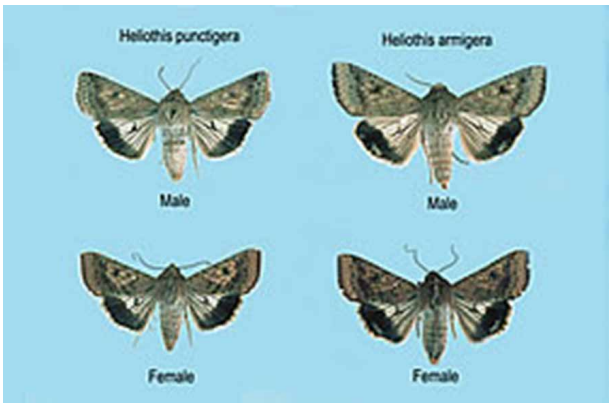

Figure 22: *Image distinguishing between adult moths of* Helicoverpa punctigera *and* H. armigera.

Photo: QDAF

Figure 23: *A row of* Helicoverpa *spp. coloured larvae in lucerne.*

Photo: QDAF

Figure 24: *Normal* Helicoverpa *egg on left, black parasitised egg on right.*

Photo: QDAF

7.13.1 Damage

Although damage from *Helicoverpa* is obvious and appears serious, they are not considered of major economic importance in sunflowers, because the plant is able to tolerate large infestations of *Helicoverpa* caterpillars and still produce a worthwhile yield. [96]

Caterpillars feed on the leaves, buds and petals or on the small green bracts surrounding the head. Damage to the developing seed is of little consequence unless infestations are very heavy. Heavy infestations during bud stage can result in severe damage.

Larval feeding can cause deformation of the seed head and sometimes loss of the head by larvae chewing into its connection with the stem. [97] Larvae are difficult to control when feeding on the sunflower face and under bracts, especially once the head turns over.

Feeding on the back of the head can predispose the crop to secondary head rots such as Rhizopus head rot [98] as well as quality downgrades.

7.13.2 Thresholds for control

Budding is the most vulnerable stage, because the whole bud can be eaten. Earlier recommendations were that populations of one medium or two small larvae per plant warranted control. [99] [100] However, natural mortality rates of 30% for larvae <5 mm in length should be taken into account. Therefore, by including expected mortality, the threshold for larvae in the size range 1–5 mm is six larvae per head. [101] [102]

From flowering to grainfill stage, the plant is able to tolerate larger populations. Damage to the back of the head may predispose the head to rot, but this is rarely

96 QDAF (2011) Insect pest management in sunflowers. Department of Agriculture, Fisheries and Forestry Queensland, http://www.daf.qld.gov.au/plants/field-crops-and-pastures/broadacre-field-crops/integrated-pest-management/ipm-information-by-crop/sunflowers - Wireworms

97 QDAF (2011) Insect pest management in sunflowers. Department of Agriculture, Fisheries and Forestry Queensland, http://www.daf.qld.gov.au/plants/field-crops-and-pastures/broadacre-field-crops/integrated-pest-management/ipm-information-by-crop/sunflowers - Wireworms

98 L Serafin, D McCaffery, S Thompson (2014) Sunflower. Summer crop production guide 2014. pp. 80–92. NSW DPI Management Guide. NSW Department of Primary Industries, http://www.dpi.nsw.gov.au/agriculture/broadacre-crops/guides/summer-crop-production-guide

99 Australian Oilseeds Federation (2012), Better Sunflowers Agronomy Training Package (Big Yellow Sunflower Pack), Insect Management https://bettersunflowers.com.au/bysp/surveyinfo.aspx?sid=7

100 QDAF (2011) Insect pest management in sunflowers. Department of Agriculture, Fisheries and Forestry Queensland, http://www.daf.qld.gov.au/plants/field-crops-and-pastures/broadacre-field-crops/integrated-pest-management/ipm-information-by-crop/sunflowers - Wireworms

101 L Serafin, D McCaffery, S Thompson (2014) Sunflower. Summer crop production guide 2014. pp. 80–92. NSW DPI Management Guide. NSW Department of Primary Industries, http://www.dpi.nsw.gov.au/agriculture/broadacre-crops/guides/summer-crop-production-guide

102 L Serafin, S Belfield (2008) Sunflower production guidelines for the northern grains region—northern NSW and southern Qld. NSW Department of Primary Industries. http://www.dpi.nsw.gov.au/__data/assets/pdf_file/0011/249779/Sunflower-production-guidelines-for-the-northern-grains-region.pdf

an economic reason to control *Helicoverpa*, as there are many other causal insects. [103] [104]

7.13.3 Management

At the bud stage, the caterpillars are concealed within the bud bracts and are difficult to control with insecticides.

When spraying is necessary, it is best to wait until the buds are just beginning to open and the yellow petals are becoming visible. Spraying earlier may result in poor control, and spraying later can affect pollination by bees. [105]

Helicoverpa armigera larvae are best targeted when <5–7 mm. Larvae are difficult to control when they are feeding on the sunflower face and under bracts [106]; therefore, insecticide applications are normally effective only until the heads turn to face the ground. [107]

The requirement for insecticide treatment in the post-flowering stage for the control of larvae in sunflower remains problematic. Trial results suggest that an initial population averaging 17 larvae per plant during the post-flowering stage of crop development caused no significant reduction in yield in the absence of secondary head rots. Insecticide spraying is unlikely to reduce head rots. [108]

The chemical to be used and the effectiveness of control will depend on the species of *Helicoverpa* present (Table 13). Therefore, consult an agronomist for a spray recommendation. [109] Select control options that are compatible with the insecticide-resistance management strategy for your region. [110] Avoid spraying when bees are active, and if bees are present, spray late afternoon. [111]

Helicoverpa have a large number of natural enemies such as egg and larval parasitoids, predators and various diseases. Parasitism can at times be >30%. [112]

103 Australian Oilseeds Federation (2012), Better Sunflowers Agronomy Training Package (Big Yellow Sunflower Pack), Insect Management https://bettersunflowers.com.au/bysp/surveyinfo.aspx?sid=7

104 QDAF (2011) Insect pest management in sunflowers. Department of Agriculture, Fisheries and Forestry Queensland, http://www.daf.qld.gov.au/plants/field-crops-and-pastures/broadacre-field-crops/integrated-pest-management/ipm-information-by-crop/sunflowers - Wireworms

105 QDAF (2011) Insect pest management in sunflowers. Department of Agriculture, Fisheries and Forestry Queensland, http://www.daf.qld.gov.au/plants/field-crops-and-pastures/broadacre-field-crops/integrated-pest-management/ipm-information-by-crop/sunflowers - Wireworms

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107 L Serafin, D McCaffery, S Thompson (2014) Sunflower. Summer crop production guide 2014. pp. 80–92. NSW DPI Management Guide. NSW Department of Primary Industries, http://www.dpi.nsw.gov.au/agriculture/broadacre-crops/guides/summer-crop-production-guide

108 QDAF (2011) Insect pest management in sunflowers. Department of Agriculture, Fisheries and Forestry Queensland, http://www.daf.qld.gov.au/plants/field-crops-and-pastures/broadacre-field-crops/integrated-pest-management/ipm-information-by-crop/sunflowers - Wireworms

109 Australian Oilseeds Federation (2012), Better Sunflowers Agronomy Training Package (Big Yellow Sunflower Pack), Insect Management https://bettersunflowers.com.au/bysp/surveyinfo.aspx?sid=7

110 L Serafin, S Belfield (2008) Sunflower production guidelines for the northern grains region—northern NSW and southern Qld. NSW Department of Primary Industries, http://www.dpi.nsw.gov.au/__data/assets/pdf_file/0011/249779/Sunflower-production-guidelines-for-the-northern-grains-region.pdf

111 Australian Oilseeds Federation (2012), Better Sunflowers Agronomy Training Package (Big Yellow Sunflower Pack), Insect Management https://bettersunflowers.com.au/bysp/surveyinfo.aspx?sid=7

112 L Serafin, S Belfield (2008) Sunflower production guidelines for the northern grains region—northern NSW and southern Qld. NSW Department of Primary Industries, http://www.dpi.nsw.gov.au/__data/assets/pdf_file/0011/249779/Sunflower-production-guidelines-for-the-northern-grains-region.pdf

Table 13: *Helicoverpa spp. description and management summary.* [113]

Scientific name	*Helicoverpa armigera*—cotton bollworm or corn earworm *Helicoverpa punctigera*—native budworm
Identification	Eggs are 0.5 mm in diameter and change from white to brown to a black head stage before hatching. Newly hatched larvae are light in colour with tiny dark spots and dark heads. As larvae develop, they become darker and the darker spots become more obvious. Both species look the same at the egg and small larvae stages. Medium larvae develop lines and bands running the length of the body and are variable in colour; *H. armigera* larvae have a saddle of darker pigment on the fourth segment and at the back of the head and dark-coloured legs, whereas *H. punctigera* larvae have no saddle and light-coloured legs. Large larvae of *H. armigera* have white hairs around the head; *H. punctigera* have black hairs around the head. Pupae are found in soil underneath the crop. Healthy pupae wriggle violently when touched; *H. armigera* pupal tail spines are more widely spaced than those of *H. punctigera.* Moths are a dull light brown with dark markings and are 35 mm long. Moths of *H. armigera* have a small light or pale patch in the dark section of the hindwing, whereas the dark section is uniform in *H. punctigera*. Forewings are brown in the female and cream in the male.
Similar species	Commonly confused species include armyworms and loopers. *Helicoverpa* larvae have a group of four pairs of 'legs' in the back half of the body, whereas loopers can have a group of 2, 3 or 4 pairs of legs at the rear and loop when walking. Armyworms also have 4 pairs of prolegs, but are smoother and fatter, with more coloured bands than *Helicoverpa*.
Life-cycle	Both *H. armigera* and *H. punctigera* take ~4–6 weeks to develop from egg to adult in summer, and 8–12 weeks in spring or autumn. Moths live for ~10 days, during which females lay 1000 eggs. Read more about Helicoverpa life-cycle and behaviour.
Crops attacked	The two *Helicoverpa* species prefer different hosts: *Helicoverpa punctigera* attacks broadleaf species (e.g. cotton, chickpeas, sunflowers, soybean, mungbean, navy bean, lucerne, canola, peanut, faba bean, safflower, linseed and azuki bean). It is not found on grass or cereal crops such as wheat, barley, sorghum or maize. *Helicoverpa armigera* will attack all field crops, but is less common in wheat and barley. Larvae feed on leaves but are most damaging when feeding on growing terminals, buds or squares, flowers, pods, seed and/or fruit. This includes direct losses through shedding and reduced quality. For more information see IPM in specific crops or visit The Beat Sheet blog.
Monitoring	*Helicoverpa* can be present in crops from the vegetative stage onwards. Very susceptible crops (e.g. cotton) need to be closely monitored from emergence to maturity for eggs and larvae; however, most field crops need to be monitored closely only from budding–flowering through to maturity. Eggs are most commonly laid on the top third of the plant and growing points.
Management	To manage *H. armigera* and *H. punctigera* well, it is important to understand the basic differences between the two species. Integrated pest management (IPM) strategies incorporating chemical, cultural and biological methods aim to restrict populations to below damaging levels. *Helicoverpa armigera* has developed resistance to a wide range of insecticides; however, a number of products are now registered for both species that have reduced impacts on natural enemies in the crop. Larvae are best targeted when <7 mm. Read more about key principles of helicoverpa management.
Natural enemies	All stages of the *Helicoverpa* life-cycle are attacked by a wide range of predators, parasitoids and pathogens, and conserving these in the crop through the avoidance of broad-spectrum insecticides can help to prevent or minimise the need for insecticide treatments. Read more about Helicoverpa's natural enemies.

MORE INFORMATION

QDAF. Integrated pest management – Helicoverpa.

7.14 Whiteflies

The four types of whitefly found in Australia are:

- the greenhouse whitefly (GHW), *Trialeurodes vaporariorum*
- the silverleaf whitefly (SLW), or B biotype, *Bemisia tabaci* species complex

113 QDAF (2012) Managing insect pests in field crops. *Helicoverpa* species. Department of Agriculture, Fisheries and Forestry Queensland, http://www.daf.qld.gov.au/plants/field-crops-and-pastures/broadacre-field-crops/integrated-pest-management/a-z-insect-pest-list/helicoverpa/helicoverpa-species

- the Australian native (AN) biotype of the *Bemisia tabaci* species complex, also known as the cotton whitefly.

The main distinguishing feature is the way they hold their wings. GHW has overlapping wings that form a heart shape. The *Bemisia* species hold their powdery wings more like the roof of a house that does not quite meet at the apex.

The SLW poses a greater pest threat than other whitefly because of their greater host range, quicker reproductive rate, and ability to rapidly develop resistance to insecticides. Under hot conditions, SLW can multiply on an area-wide scale to a point where management with insecticides is difficult. It is not possible to separate the two *B. tabaci* biotypes in the field.

7.15 Greenhouse whitefly

Greenhouse whitefly (Figures 25, 26) is a sporadic, post-establishment pest of sunflowers. [114] GHW adults are larger than *B. tabaci* (SLW) and have overlapping wings, which obscure the body when viewed from the top. [115]

Figure 25: *Image showing adult greenhouse whitefly with white powdery wings and the pale yellow–green, scale-like nymphs.*

Photo: QDAF

Figure 26: *Greenhouse whitefly nymph.*

Photo: QDAF

114 QDAF (2011) Insect pest management in sunflowers. Department of Agriculture, Fisheries and Forestry Queensland, http://www.daf.qld.gov.au/plants/field-crops-and-pastures/broadacre-field-crops/integrated-pest-management/ipm-information-by-crop/sunflowers - Wireworms

115 QDAF (2010) Managing insect pests in field crops. Greenhouse whitefly. Department of Agriculture, Fisheries and Forestry Queensland, http://www.daf.qld.gov.au/plants/field-crops-and-pastures/broadacre-field-crops/integrated-pest-management/a-z-insect-pest-list/whitefly-overview/greenhouse-whitefly

7.15.1 Damage

Severe infestations of GHW can cause significant yield loss. Severe wilting and the appearance of a sticky, sooty, honeydew exudate on the leaves are common symptoms (Table 14). Crops may be killed but this is very rare; however, sunflower crops can also support large numbers of GHW with little effect. [116]

Nymphs and adults suck sap and excrete honeydew. A secondary infection develops when a black sooty mould fungus grows on the sticky honeydew. There are no visible damage symptoms with low numbers of GHW. Under very heavy infestations, plants lose vigour and damage is manifested under severe moisture stress, causing leaf wilting and failure to set seed. [117]

7.15.2 Thresholds for control

There are no established threshold numbers in sunflowers. [118]

7.15.3 Management

There are no insecticides registered for the control of whiteflies on sunflowers. Chemicals targeting other pests can affect parasitic wasps that provide effective control of whitefly. An introduced parasitoid is widespread in Australia and commonly attacks whitefly nymphs. [119]

Natural predators can effectively regulate whitefly populations. Whitefly populations can occur as mixed species, so aim to retain natural predator populations for as long as possible.

Table 14: *Greenhouse whitefly description and management summary.* [120]

Scientific name	*Trialeurodes vaporariorum*
Description	Adults are ~1.5 mm long and hold their white powdery wings flat, almost parallel to and obscuring the body when viewed from above. Nymphs are pale yellow–green, scale-like insects with long hairs protruding all over the body. Most nymph stages are immobile.
Similar species	Silverleaf whitefly.
Distribution	A pest in crops in Australia, Europe, Asia, Africa and the United States.
Crops attacked	Cotton, sunflower, soybean and navy bean.
Life-cycle	The greenhouse whitefly breeds throughout the warm months with a life-cycle of ~5–7 weeks. It can have up to 3 generations on a sunflower crop and 7 generations per year. Summer and autumn are the risk periods, with outbreaks favoured by warm weather and host availability.
Damage	Adults and nymphs suck on sap and excrete honeydew, which interferes with photosynthesis and discolours the lint in cotton. A secondary infection develops when a sooty black mould fungus grows on the sticky honeydew. Under very heavy infestations, plants lose vigour, causing leaf-wilting and failure to set seed.
Monitoring and action level	Usually found on the lower leaf surface. Affects all crop stages.
Control methods	**Chemical control.** None available. **Cultural control.** Removal of alternative weed hosts may be helpful, but weed-free environments may hinder the survival of natural enemies.
Conservation of natural enemies	Parasitic wasps (*Encarsia formosa*) commonly provide effective biological control.

MORE INFORMATION

QDAF. Chemical control of insects – consideration and choices.

116 L Serafin, D McCaffery, S Thompson (2014) Sunflower. Summer crop production guide 2014. pp. 80–92. NSW DPI Management Guide. NSW Department of Primary Industries, http://www.dpi.nsw.gov.au/agriculture/broadacre-crops/guides/summer-crop-production-guide

117 QDAF (2011) Insect pest management in sunflowers. Department of Agriculture, Fisheries and Forestry Queensland, http://www.daf.qld.gov.au/plants/field-crops-and-pastures/broadacre-field-crops/integrated-pest-management/ipm-information-by-crop/sunflowers - Wireworms

118 L Serafin, D McCaffery, S Thompson (2014) Sunflower. Summer crop production guide 2014. pp. 80–92. NSW DPI Management Guide. NSW Department of Primary Industries, http://www.dpi.nsw.gov.au/agriculture/broadacre-crops/guides/summer-crop-production-guide

119 QDAF (2011) Insect pest management in sunflowers. Department of Agriculture, Fisheries and Forestry Queensland, http://www.daf.qld.gov.au/plants/field-crops-and-pastures/broadacre-field-crops/integrated-pest-management/ipm-information-by-crop/sunflowers - Wireworms

120 QDAF (2010) Managing insect pests in field crops. Greenhouse whitefly. Department of Agriculture, Fisheries and Forestry Queensland, http://www.daf.qld.gov.au/plants/field-crops-and-pastures/broadacre-field-crops/integrated-pest-management/a-z-insect-pest-list/whitefly-overview/greenhouse-whitefly

7.15.4 *Bemisia tabaci* whitefly complex

The *Bemisia tabaci* species complex is represented in Australia by three distinct biotypes: Australian Native (AN), SLW (or B biotype), and Q biotype (a recently identified biotype of SLW).

The AN biotype is quite common but causes no problems. SLW was first discovered in Australia in 1994. It is a pesticide-resistant strain from overseas (most likely the United States). The Q biotype was reported in Queensland and north-western NSW in 2009. [121] The *B. tabaci* biotypes in Australia are morphologically indistinguishable and can only be differentiated using chemical (enzyme) or DNA techniques.

Hosts of SLW and Q biotypes include at least 500 crops and ornamental plants worldwide and it is a pest on many of these.

During the 2001–02 season, large populations of SLW (Figures 27 and 28) were found on sunflowers in Central Queensland. However, infested sunflower crops suffered little damage. [122]

Figure 27: *Adult silverleaf whitefly (*Bemisia tabaci*) viewed from above; note the gap between the wings.*

Photo: B Scholz, QDAF

121 L Serafin, D McCaffery, S Thompson (2014) Sunflower. Summer crop production guide 2014. pp. 80–92. NSW DPI Management Guide. NSW Department of Primary Industries, http://www.dpi.nsw.gov.au/agriculture/broadacre-crops/guides/summer-crop-production-guide

122 QDAF (2011) Managing insect pests in field crops. *Bemisia tabaci* species complex—Silverleaf whitefly (SLW) or B biotype and Australian native (AN) biotype. Department of Agriculture, Fisheries and Forestry Queensland, http://www.daf.qld.gov.au/plants/field-crops-and-pastures/broadacre-field-crops/integrated-pest-management/a-z-insect-pest-list/whitefly-overview/silverleaf-whitefly-biotype-b-and-native

Figure 28: *Silverleaf whitefly (*Bemisia tabaci*) nymph.*

Photo: P de Barro, QDAF

7.15.5 Damage

Silverleaf whitefly poses a greater threat than GHW to broadacre crops. SLW has a very wide host range, a high reproductive capacity and an ability to develop resistance to insecticides within 2–3 generations (Table 15). Hence, the further north it occurs, the shorter the timespan between generations and the greater the number of generations possible each season. SLW caused significant damage to a wide range of broadleaf crops including sunflower, mungbean, soybean, peanut and cotton in the 2001–02 season in the Emerald Irrigation Area. [123]

SLW is usually found on the lower leaf surface and affects all crop stages. SLW has a high reproduction rate and a short generation time, and the large numbers generated can retard plants simply by feeding. The insect secretes large quantities of honeydew, which interferes with photosynthesis and can reduce plant vigour. [124]

7.15.6 Management

There are no registered insecticides for SLW in sunflowers.

Cultural control options include:

- breaks in the cropping cycle
- elimination of alternative hosts
- conservation of natural enemies [125]

Natural enemies can provide good control of SLW and stabilise populations as long as they are not disrupted by the overuse of non-selective insecticides. [126] Immature SLW are susceptible to attack by several predatory wasp species. Parasitic wasps commonly provide some level of biological control, with other beneficial species including big-eyed bugs, green lacewing larvae, brown lacewing larvae, spiders and ladybird beetles. Maintaining beneficial insects in sunflowers can therefore play an important role in reducing the number of SLW. Maintenance of clean fallows and consideration of nearby host crops also play a role in managing SLW. [127]

123 L Serafin, D McCaffery, S Thompson (2014) Sunflower. Summer crop production guide 2014. pp. 80–92. NSW DPI Management Guide. NSW Department of Primary Industries, http://www.dpi.nsw.gov.au/agriculture/broadacre-crops/guides/summer-crop-production-guide

124 QDAF (2011) Insect pest management in sunflowers. Department of Agriculture, Fisheries and Forestry Queensland, http://www.daf.qld.gov.au/plants/field-crops-and-pastures/broadacre-field-crops/integrated-pest-management/ipm-information-by-crop/sunflowers - Wireworms

125 QDAF (2011) Insect pest management in sunflowers. Department of Agriculture, Fisheries and Forestry Queensland, http://www.daf.qld.gov.au/plants/field-crops-and-pastures/broadacre-field-crops/integrated-pest-management/ipm-information-by-crop/sunflowers - Wireworms

126 QDAF (2011) Insect pest management in sunflowers. Department of Agriculture, Fisheries and Forestry Queensland, http://www.daf.qld.gov.au/plants/field-crops-and-pastures/broadacre-field-crops/integrated-pest-management/ipm-information-by-crop/sunflowers - Wireworms

127 L Serafin, D McCaffery, S Thompson (2014) Sunflower. Summer crop production guide 2014. pp. 80–92. NSW DPI Management Guide. NSW Department of Primary Industries, http://www.dpi.nsw.gov.au/agriculture/broadacre-crops/guides/summer-crop-production-guide

Table 15: Bemisia tabaci *species complex description and management summary.* [128]

Scientific name	*Bemisia tabaci* species complex, B biotype—silverleaf white fly (SLW) *Bemisia tabaci* species complex, AN biotype—cotton whitefly
Description	Adults of both biotypes are both 1.5 mm long and cannot be separated visually. Adults hold their white powdery wings like the roof of a house that does not quite join at the apex, so when viewed from above, the body can be seen between the wings. Nymphs are pale yellow–green and flat, scale-like insects that attach to the underside of the leaves of their host plant. Most nymph stages are immobile. Once SLW becomes established in a location it tends to displace the AN biotype.
Similar species	Greenhouse whitefly, *Trialeurodes vaporariorum*; other biotypes of the *Bemisia tabaci* species complex.
Distribution	SLW is a pest of crops in Australia, Europe, Asia, Africa and the United States. SLW has been recorded in cotton crops from all areas in eastern Australia and from Katherine in the Northern Territory. Only in central Queensland has it reached levels regularly requiring the use of insecticides, and occasional insecticide control is required in the Darling Downs, Byee and St George areas.
Crops attacked	Cotton, soybean, peanut and many broadleaf weeds.
Life-cycle	SLW eggs are laid haphazardly on the underside of leaves. The eggs are yellow–green, changing to dark tan as they are about to hatch. Leaves with high populations of eggs often have a dark patch on the underside. The life-cycle from egg to adult can be as little as 18 days in summer, but longer in cooler weather.
Damage	SLW can cause damage in several ways. With a high reproduction rate and a short generation time, the large numbers generated can retard plants simply by feeding. The insect secretes large quantities of honeydew. This interferes with photosynthesis and causes problems with cotton fibre processing. SLW is a carrier of viruses such as Cotton leaf curl virus in Pakistan and the United States. These viruses are not known in Australia but should they enter the country, SLW is now available to spread them.
Monitoring and action level	Proper identification and regular estimates of the number of adults and nymphs are important. SLW is usually found on the lower leaf surface and it affects all crop stages.
Control	**Chemical control** By permit only. A significant problem in the management of SLW is its ability to develop resistance very quickly to many insecticides when used repeatedly. There is variation for resistance in cotton varieties, and breeding for host-plant resistance is under way in other countries. For current chemical control options see Pest Genie or Australian Pesticides and Veterinary Medicines Authority (APVMA). **Cultural control** SLW management in Queensland cotton will be based on a number of integrated controls such as: breaks in the cropping cycle and elimination of alternative hosts use of economic thresholds to determine whether control action with an insecticide is necessary use of appropriate insecticides such as insect growth regulators (IGRs) as required conservation of natural enemies an insecticide management to conserve susceptibility
Conservation of natural enemies	Parasitic wasps (*Encarsia* spp. and *Eretmocerus* spp.) commonly provide some level of biological control. Predators include bigeyed bugs , lacewing larvae and ladybirds. A management strategy needs to preserve and promote the activity of predators and parasites. Avoid early-season use of broad-spectrum insecticides, particularly pyrethroids and organophosphates.

128 QDAF (2011) Managing insect pests in field crops. *Bemisia tabaci* species complex—Silverleaf whitefly (SLW) or B biotype and Australian native (AN) biotype. Department of Agriculture, Fisheries and Forestry Queensland, http://www.daf.qld.gov.au/plants/field-crops-and-pastures/broadacre-field-crops/integrated-pest-management/a-z-insect-pest-list/whitefly-overview/silverleaf-whitefly-biotype-b-and-native

7.16 Loopers

Tobacco looper (*Chrysodeixis argentifera; Table 16*), vegetable looper (*Chrysodeixis eriosoma; Table 17*) and soybean looper (*Thysanoplusia orichalcea; Figures 29 and 30; Table 18*) are an occasional post-establishment pest of sunflower.

Loopers have attracted a lot of interest and concern with regard to sunflower crops in 2012. Primarily, the looper involved in defoliating sunflower crops has been soybean looper caterpillars (*T. orichalcea*). [129]

Loopers can be distinguished from *Helicoverpa* by:

- their 'looping' action when walking
- their body, which tapers towards the head
- their two pairs of hind legs, as opposed to four for *Helicoverpa* [130]

Larvae are green with white and/or dark stripes and can reach 50 mm in length. Soybean looper larvae are more prominently striped than the vegetable and tobacco loopers. The eggs are similar in shape to *Helicoverpa* eggs but are more flattened and are a pale, yellow–green. *Thysanoplusia* (soybean looper) moths are brown with large golden markings on their forewings. *Chrysodeixis* spp. (tobacco and vegetable loopers) moths are brown with small silver markings on the forewings. [131]

MORE INFORMATION

QDAF. Managing insect pests in field crops. Loopers in field crops.

7.16.1 Tobacco looper

Table 16: *Tobacco looper description and management summary.* [132]

Scientific name	*Chrysodeixis argentifera*
Description	Eggs are pale yellow–green, ribbed and are flatter than *Helicoverpa* eggs. Larvae move with a distinctive looping action and have only two pairs of ventral prolegs. Their body tapers towards the head. Very small larvae are pale green all over; larger larvae are green with white stripes. Tobacco loopers have a darker green line along the middle of their back, flanked by two white stripes. Their sides have parallel white lines and sometimes a row of black spots. Larvae can reach 40 mm in length. Larvae usually pupate under leaves in a thin silken cocoon. Pupae are dark above and pale underneath. The moth's forewings are dark brown with small silver 'figure-8' markings. On tobacco looper, these markings are fused, whereas on the vegetable looper they are separated. Tobacco looper also has a small, silver, S-shaped mark above the figure-8 on each forewing.
Similar species	Tobacco loopers may be confused with soybean loopers but are not as prominently striped.
Distribution	The tobacco looper is common throughout mainland Australia and Tasmania.
Crops attacked	Tobacco loopers damage flowers and pods of mungbeans, navy beans, azuki bean and the leaves of soybeans.
Life-cycle	Looper eggs hatch in 3–6 days. There are six larval stages. Larvae take 2–3 weeks to develop before pupating under leaves in a loose silken cocoon.
Risk period	Crops can be attacked at any stage but are at greatest risk during flowering and podding. Summer legumes are least tolerant of defoliation at these stages, and in some crops, flowers and young pods are at direct risk of looper attack. In subtropical regions, crops are at greatest risk from mid–late summer. However, in the tropics winter-planted 'summer legumes' may also be at risk.

129 AOF (2012) The Better Sunflower e-Newsletter. May 2012. Australian Oilseeds Federation, Australian Sunflower Association, Grains Research and Development Corporation, http://www.australianoilseeds.com/__data/assets/pdf_file/0010/8875/Better_Sunflowers_-_Issue_1_May_2012.pdf

130 QDAF (2011) Insect pest management in sunflowers. Department of Agriculture, Fisheries and Forestry Queensland, http://www.daf.qld.gov.au/plants/field-crops-and-pastures/broadacre-field-crops/integrated-pest-management/ipm-information-by-crop/sunflowers - Wireworms

131 QDAF (2010) Managing insect pests in field crops. Loopers in field crops. Department of Agriculture, Fisheries and Forestry Queensland, http://www.daf.qld.gov.au/plants/field-crops-and-pastures/broadacre-field-crops/integrated-pest-management/a-z-insect-pest-list/loopers

132 QDAF (2010) Managing insect pests in field crops. Tobacco looper. Department of Agriculture, Fisheries and Forestry Queensland, http://www.daf.qld.gov.au/plants/field-crops-and-pastures/broadacre-field-crops/integrated-pest-management/a-z-insect-pest-list/loopers/tobacco-looper

Damage	Small larvae feed on only one side of the leaf, leaving translucent 'feeding windows'. As larvae develop, they chew holes in the leaf and then feed from the leaf margin. Larvae are primarily foliage feeders in soybeans but will attack the flowers and developing pods in azuki beans, mungbeans and navy beans. Looper damage is different from *Helicoverpa* damage, with the feeding holes being angular rather than rounded.
Monitoring and action level	**Monitoring.** Inspect crops weekly during the vegetative stage and twice weekly from very early budding onwards, until crops are no longer susceptible to attack (late podding). Beat-sheet sampling is the preferred sampling method for looper larvae. Crops should be scouted for looper eggs and moths to pinpoint the start of infestations and to increase the chance of success of biopesticides such as *Bacillus thuringiensis* (Bt). **Action level.** In pre-flowering crops, looper control is warranted if defoliation exceeds (or is likely to exceed) 33%). Tolerable defoliation drops to 15–20% once flowering and podding commences. In azuki beans, mungbeans and navy beans, where flowers and pods are attacked the threshold is set at three looper larvae per square metre.
Control	**Chemical control.** Loopers can be controlled with most pesticides targeting *Helicoverpa*, but are not controlled by products containing the naturally occurring biopesticide NPV (nucleopolyhedrovirus). Small loopers (<12 mm long) can be controlled with Bt; more than one application may be required. For current chemical control options, see Pest Genie or APVMA. **Cultural control.** Vigorously growing plants will be better able to compensate for flower and pod damage, and damaged leaves will be replaced more quickly. **Conservation of natural enemies.** Loopers in summer pulses are attacked by numerous predators and parasites. The use of Bt for looper control will help preserve beneficial insects and reduce the risk of subsequent whitefly and mite attack.

7.16.2 Vegetable looper

Table 17: *Vegetable looper description and management summary.* [133]

Scientific name	*Chrysodeixis eriosoma*
Description	Eggs are pale yellow–green and ribbed and are flatter than *Helicoverpa* eggs. Larvae move with a distinctive looping action and have only two pairs of ventral prolegs. Their body tapers towards the head. Larval colour can vary considerably. Very small larvae are pale green all over; larger larvae are green with white stripes. Larvae can reach 40 mm in length. These looper larvae usually pupate under leaves in a thin silken cocoon. Pupae are dark above and pale underneath. The moth's forewings are dark brown with small silver figure-8 markings. Male vegetable loopers have long, orange, hair-like scales on either side of the abdomen.
Similar species	*Chrysodeixis* species (vegetable and tobacco loopers) may be confused with soybean loopers but are not as prominently striped.
Distribution	*Chrysodeixis eriosoma* (vegetable looper) occurs throughout northern and eastern Australia, and as far south as central NSW.
Crops attacked	The vegetable looper damages flowers and pods of azuki beans, mungbeans and navy beans, as well as soybean leaves.
Life-cycle	Looper eggs hatch in 3–6 days. There are six larval stages. Larvae take 2–3 weeks to develop before pupating under leaves in a loose silken cocoon.
Risk period	Crops can be attacked at any stage but are at greatest risk during flowering and podding. Summer legumes are least tolerant of defoliation at these stages, and in some crops, flowers and young pods are at direct risk of looper attack. In subtropical regions, crops are at greatest risk from mid to late summer; however, in the tropics winter-planted 'summer legumes' may also be at risk.
Damage	Small larvae feed on only one side of the leaf, leaving translucent 'feeding windows'. As larvae develop, they chew holes in the leaf and then feed from the leaf margin. Larvae are primarily foliage feeders in soybeans but will attack the flowers and developing pods in azuki beans, mungbeans and navy beans. Looper damage is different from *Helicoverpa* damage, with the feeding holes being angular rather than rounded.

133 QDAF (2010) Managing insect pests in field crops. Vegetable looper. Department of Agriculture, Fisheries and Forestry Queensland, http://www.daf.qld.gov.au/plants/field-crops-and-pastures/broadacre-field-crops/integrated-pest-management/a-z-insect-pest-list/loopers/vegetable-looper

Monitoring and action level	**Monitoring**. Inspect crops weekly during the vegetative stage and twice weekly from very early budding onwards, until crops are no longer susceptible to attack (late podding). Beat-sheet sampling is the preferred sampling method for looper larvae. Crops should be scouted for looper eggs and moths to pinpoint the start of infestations and to increase the chance of success of biopesticides such as *Bacillus thuringiensis* (Bt). **Action level.** In pre-flowering crops, looper control is warranted if defoliation exceeds (or is likely to exceed) 33%. Tolerable defoliation drops to 15–20% once flowering and podding commences. In azuki beans, mungbeans and navy beans, where flowers and pods are attacked, the threshold is set at three looper larvae per square metre.
Control	**Chemical control**. Loopers can be controlled with most pesticides targeting *Helicoverpa*, but are not controlled by products containing the naturally occurring biopesticide NPV (nucleopolyhedrovirus). Small loopers (<12 mm long) can be controlled with Bt; however, more than one application may be required. For current chemical control options, see Pest Genie or APVMA. **Cultural control.** Vigorously growing plants will be better able to compensate for flower and pod damage, and damaged leaves will be replaced more quickly. **Conservation of natural enemies**. Loopers in summer pulses are attacked by numerous predators and parasites. The use of Bt for looper control will help preserve beneficial insects and reduce the risk of subsequent whitefly and mite attack.

7.16.3 Soybean looper

Figure 29: *Soybean looper, light phase.*

Photo: Better Sunflowers Newsletter

Figure 30: *Soybean looper, dark phase.*

Photo: Better Sunflowers Newsletter

Table 18: *Soybean looper description and management summary.* [134]

Scientific name	*Thysanoplusia orichalcea*
Description	Eggs are pale yellow-green, ribbed and are flatter than *Helicoverpa* eggs. Larvae move with a distinctive looping action and have only two pairs of ventral prolegs. Their body tapers towards the head. Larval colour can vary considerably. Very small larvae are green all over but medium larvae usually have prominent dark and white striping. Large larvae are usually green with white stripes. Larvae can reach 45 mm in length. Soybean looper larvae usually pupate under leaves in a thin silken cocoon. Pupae are dark above and pale underneath. The moth's forewings are very distinctive: brown with a large, bright gold patch. The hind wings are fawn-coloured, darkening towards the outer margins.
Similar species	Soybean loopers may be confused with vegetable and tobacco loopers (*Chrysodeixis* spp.) but are more prominently striped.
Distribution	Africa, Asia, Papua New Guinea and Australia. First reported in Queensland in 1976, now recorded in NSW and Tasmania but most likely more widespread.
Crops attacked	Soybeans, mungbeans, navy beans, azuki bean, sunflowers.
Life-cycle	Looper eggs hatch in 3–6 days. There are six larval stages. Larvae take 2–3 weeks to develop before pupating under leaves in a loose silken cocoon.
Risk period	Crops can be attacked at any stage but are at greatest risk during flowering and podding. Summer legumes are least tolerant of defoliation at these stages, and in some crops, flowers and young pods are at direct risk of looper attack. In subtropical regions, crops are at greatest risk from mid to late summer. However, in the tropics winter-planted 'summer legumes' may also be at risk.
Damage	Soybean looper is a more serious pest in mungbeans and navy beans than soybeans. Small larvae feed on only one side of the leaf, leaving translucent 'feeding windows'. As larvae develop, they chew holes in the leaf, and then feed from the leaf margin. Larvae are primarily foliage feeders in soybeans, but will attack the flowers and developing pods in azuki beans, mungbeans and navy beans. Looper damage is different to *Helicoverpa* damage, with the feeding holes being angular rather than rounded.

134 QDAF (2010) Managing insect pests in field crops. Soybean looper. Department of Agriculture, Fisheries and Forestry Queensland, http://www.daf.qld.gov.au/plants/field-crops-and-pastures/broadacre-field-crops/integrated-pest-management/a-z-insect-pest-list/loopers/soybean-looper

Monitoring and action level	**Monitoring.** Inspect crops weekly during the vegetative stage and twice weekly from very early budding onwards, until crops are no longer susceptible to attack (late podding). Beat-sheet sampling is the preferred sampling method for looper larvae. Crops should be scouted for looper eggs and moths to pinpoint the start of infestations and to increase the chance of success of biopesticides such as *Bacillus thuringiensis* (Bt). **Action level.** In pre-flowering crops, looper control is warranted if defoliation exceeds (or is likely to exceed) 33%. Tolerable defoliation drops to 15–20% once flowering and podding commences. In azuki beans, mungbeans, and navy beans, where flowers and pods are attacked the threshold is set at three looper larvae per square metre.
Control	**Chemical control.** Soybean loopers can be controlled with most pesticides targeting *Helicoverpa*, but are not controlled by products containing the naturally occurring biopesticide NPV (nucleopolyhedrovirus). Small loopers (<12 mm long) can be controlled with Bt; more than one application may be required. For current chemical control options, see Pest Genie or APVMA. **Cultural control.** Vigorously growing plants will be better able to compensate for flower and pod damage, and damaged leaves will be replaced more quickly. **Conservation of natural enemies.** Soybean loopers in summer pulses are attacked by numerous predators and parasites. The use of Bt for looper control will help preserve beneficial insects and reduce the risk of subsequent whitefly and mite attack.

7.16.4 Damage

Larvae feed on leaves. Tissue damage is insignificant when larvae are small, but increases with larger loopers. Large, irregular shaped holes in the leaves usually coincide with the appearance of large larvae (Figure 31). Severe defoliation is uncommon. [135]

The following points are useful in making decisions to control loopers:

- Yield loss will occur if the top third of leaves is not retained through budding and grainfill (based on leaf loss from powdery mildew data).
- Loopers will consume 80% of their total food intake in the final two instars before pupating. Consequently, the rate of defoliation will speed up as larvae reach maturity.
- Loopers do not usually feed on the buds or developing heads in sunflowers.
- Large larvae (25–40 mm) will be close to maturity and likely to stop feeding and pupate within a few days. [136]

135 QDAF (2011) Insect pest management in sunflowers. Department of Agriculture, Fisheries and Forestry Queensland, http://www.daf.qld.gov.au/plants/field-crops-and-pastures/broadacre-field-crops/integrated-pest-management/ipm-information-by-crop/sunflowers - Wireworms

136 AOF (2012) The Better Sunflower e-Newsletter. May 2012. Australian Oilseeds Federation, Australian Sunflower Association, Grains Research and Development Corporation, http://www.australianoilseeds.com/__data/assets/pdf_file/0010/8875/Better_Sunflowers_-_Issue_1_May_2012.pdf

Figure 31: *Pre-flowering defoliation by loopers.*

Photo: J Wessels, QDAF

7.16.5 Thresholds for control

Although loopers can occur anytime throughout the growing season, they normally feed almost exclusively on leaves and do not usually warrant control. Under some conditions, populations can flare to damaging levels as high as 150 per square metre. Control should be considered if leaf loss is likely to be >33% in the vegetative stage, or 20% from flowering onwards. [137]

No local trial data are available because severe looper infestations in sunflowers occur so rarely. In the US, looper control in sunflowers is recommended if defoliation reaches 25% of leaf area, and larvae are still small and the crop is flowering or grain is filling. When defoliation was >50%, yield losses were incurred. [138] Damage on the Liverpool plains has been measured by local consultants at 25% under high pressure.

7.16.6 Management

Looper infestations are often controlled by parasitoids, predators and diseases before they cause too much damage.

Control is usually unwarranted, but caterpillars causing severe damage late in crop development can be controlled with insecticides if warranted. Crops should be scouted for looper eggs and moths to pinpoint the start of infestations and to increase the chance of success of biopesticides such as *Bacillus thuringiensis* (Bt). [139]

Loopers appear susceptible to all insecticides used for Helicoverpa control, with the exception of Gemstar® and Vivus® (NPVs), which only act against *Helicoverpa*. Dipel (Bt) is far more effective against loopers than against *Helicoverpa* but thorough coverage is required for best results. [140]

137 QDAF (2010) Managing insect pests in field crops. Loopers in field crops. Department of Agriculture, Fisheries and Forestry Queensland, http://www.daf.qld.gov.au/plants/field-crops-and-pastures/broadacre-field-crops/integrated-pest-management/a-z-insect-pest-list/loopers

138 AOF (2012) The Better Sunflower e-Newsletter. May 2012. Australian Oilseeds Federation, Australian Sunflower Association, Grains Research and Development Corporation, http://www.australianoilseeds.com/__data/assets/pdf_file/0010/8875/Better_Sunflowers_-_Issue_1_May_2012.pdf

139 QDAF (2011) Insect pest management in sunflowers. Department of Agriculture, Fisheries and Forestry Queensland, http://www.daf.qld.gov.au/plants/field-crops-and-pastures/broadacre-field-crops/integrated-pest-management/ipm-information-by-crop/sunflowers - Wireworms

140 QDAF (2010) Managing insect pests in field crops. Loopers in field crops. Department of Agriculture, Fisheries and Forestry Queensland, http://www.daf.qld.gov.au/plants/field-crops-and-pastures/broadacre-field-crops/integrated-pest-management/a-z-insect-pest-list/loopers

7.17 Green vegetable bug

Green vegetable bugs (GVBs) (*Nezara viridula*) are a minor post-establishment pest of sunflowers. Adult life spans vary from several weeks to 4 months, with summer reducing their longevity.

7.17.1 Damage

Green vegetable bugs have a wide host range and cause damage by sucking sap. GVBs tend to feed on the upper stems and heads and when present in large numbers, cause shrivelling, wilting and deformed heads. If they gather around the peduncle, water and nutrient supply to the developing head will be reduced. GVB are occasionally known to feed on developing seed. [141]

7.17.2 Thresholds for control

The current threshold is one mature bug or fifth instar nymph per plant. Females lay 30–130 eggs in a raft on the leaf surface, and these hatch in 5–21 days. It takes 30 days to progress through the five nymphal instars. [142]

7.17.3 Management

Chemical control is warranted if large populations of GVB are present.

There are several natural enemies of GVB. GVB eggs are frequently parasitised by a tiny introduced wasp, *Trissolcus basalis* (green vegetable bug egg parasite). Parasitised eggs are easily recognised because they turn black. Parasitised GVB eggs may be confused with eggs of the predatory shield bugs but lack the spines that ring the top of the eggs of these species.

GVB nymphs are attacked by ants, spiders and predatory bugs. Final (fifth) instar and adult GVB are parasitised by the recently introduced tachinid fly, the green vegetable bug parasitic fly (*Trichopoda giacomellii*). [143]

141 QDAF (2011) Insect pest management in sunflowers. Department of Agriculture, Fisheries and Forestry Queensland, http://www.daf.qld.gov.au/plants/field-crops-and-pastures/broadacre-field-crops/integrated-pest-management/ipm-information-by-crop/sunflowers - Wireworms

142 L Serafin, S Belfield (2008) Sunflower production guidelines for the northern grains region—northern NSW and southern Qld. NSW Department of Primary Industries, http://www.dpi.nsw.gov.au/__data/assets/pdf_file/0011/249779/Sunflower-production-guidelines-for-the-northern-grains-region.pdf

143 QDAF (2011) Insect pest management in sunflowers. Department of Agriculture, Fisheries and Forestry Queensland, http://www.daf.qld.gov.au/plants/field-crops-and-pastures/broadacre-field-crops/integrated-pest-management/ipm-information-by-crop/sunflowers - Wireworms