Queensland Government

Sunflower insect pest management

Northern grains region

Compiled by Kate Charleston, March 2013

Department of **Agriculture, Fisheries and Forestry**

This publication has been compiled by Kate Charleston of Crop and Food Science, Queensland Department of Agriculture, Fisheries and Forestry, and draws on previous publications and original research by Bernie Franzman, Dave Murray, Melina Miles and other Entomologists. DAFF and GRDC funding for the IPM Workshops project (DAQ00179) has assisted the preparation of this publication.

Front cover photo by Melina Miles, DAFF Queensland

Contents

Overview of insect pest management in sunflower

When are sunflowers at greatest risk?

Identifying when sunflowers crops are susceptible to pests is the first step in good pest management. Sunflower growers throughout Australia contend with a number of insect pests at various stages of crop development. Most of these pests are not specific to sunflowers and feed and breed on other crops and weeds but infest sunflowers at a particular growth stage.

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. Economic damage is most likely to occur during establishment and from flowering until maturity. Major pests are in **bold.**

	Crop stage/				
Pest	**Emergence**	**Vegetative**	**Budding**	**Flowering**	**Grainfill**
Establishment pests: False wireworm True wireworm Cutworm Thrips Black scarab Cockroaches Earwigs					
Black field cricket					
Loopers					
Helicoverpa					
Whitefly greenhouse silverleaf					
Rutherglen bug					
Green vegetable bug					

Establishment

Establishment or seedling pests are insects that injure the sunflower plant before it develops four to five true leaves. These pests can reduce plant establishment and thus plant populations and subsequent yield potential.

- Larvae of **false wireworms** and **true wireworms** feed on newly germinating seed and growing points of seedlings. In summer, false wireworm adults can damage young plants by surface feeding or cutting of the plant at or near soil level.
- **Cutworm** larvae sever stems at ground level but can also climb plants and eat leaves.
- The larvae of **black scarab beetles** feed on taproots causing wilting or plant death. Adults feed on foliage.

- Both adults and nymphs of **thrip** feed on leaves with high populations causing distortion and browning of cotyledons which can lead to seedling death. Thrip can also attack sunflowers in the post establishment stage.
- **Wingless cockroaches** feed on cotyledons, growing points and stems often severing the latter.
- **Field crickets** feed on cotyledons, growing points and stems often severing the latter.
- **Black field earwigs** eat germinating seeds, roots and stems of emerged seedlings.

Growth

Insect pests that attack sunflowers during the growing phase generally damage leaves and stems and reduce the plants' photosynthetic capacity. This can lead to stunting and reduced yields.

- ***Bemisia tabaci* whitefly** can affect all crop stages and in large numbers can retard plants. Secretion of large quantities of honeydew interferes with photosynthesis and reduces plant vigour.
- **Greenhouse whitefly** nymphs and adults suck sap and excrete honeydew. Under very heavy infestations, plants lose vigour.
- Larvae of **soybean loopers** feed on leaves but severe defoliation is uncommon.
- **Helicoverpa spp.** which feed on the leaves

Budding and flowering

Insect pests at budding, flowering and seed filling stages can reduce yields and oil content. Damage at this stage can also affect oil quality and seed storage capacity, damage to heads and seed can lead to greater susceptibility to fungal attack.

- **Rutherglen bug** is the most serious pest of sunflower. Feeding during budding can cause the head to wilt, become malformed or die. After flowering, adults and nymphs reduce yields and oil content by sucking the developing seed, reducing seed weight, changing oil composition and reducing seed germination.
- The larvae of **budworms** (helicoverpa) feed on leaves, buds, petals and the green bracts surrounding the head. Feeding on the back of the head can predispose the crop to secondary head rots.
- **Field crickets** often feed on stems and leaves of seedlings and can sever stems at ground level. They may also attack mature plants where they feed on the back of the heads or on maturing seeds but are rarely seen in sunflowers.
- **Green vegetable bugs** feed on the upper stems and heads and when present in large numbers, cause shrivelling, wilting and deformed heads.

Sunflowers can be attacked by a range of other minor pests. These generally do not cause crop loss. Some minor pests that have been found on sunflower include: cotton seed bugs, leaf hoppers, aphids, cotton stainer bugs, mirids, cotton thrip and sorghum head caterpillars.

Green mirids and brokenback bugs are commonly found on sunflowers yet they do not damage crops and require no control

Establishment pests

False wireworms

- Striate false wireworm *Pterohelaeus alternatus*
- Eastern false wireworm *Pterohelaeus darlingensis*
- Southern false wireworm *Gonocephalum macleayi*

Adult false wireworms emerge from the soil during spring and early summer. Eggs are laid singly in moist soil, usually under trash or low-growing weeds. Larvae are found from about two months later until the next spring.

Identification

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 fine soil particles. There are flanges around the outline of the thorax (behind the head). The eggs are laid in the soil and hatch into shiny, wire-like ‘worms’. Larvae are pale to reddish brown in colour with darker brown heads.

Adult and larva of *Pterohelaeus* spp.

Adult and larva of *Gonocephalum* spp.

Damage

Both adults and larvae attack sunflower.

- 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.
- Damage by both larvae and adults may necessitate re-planting.
- Larvae are more damaging in southern Qld, whereas adults are the most damaging stage in central and northern districts.

The risk of damage from adults is highest in summer. For larvae, the risk is highest for early 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 the soil dries, they retreat below the root zone. However, if crops are grown into dry seedbeds, damage may be significant.

Monitoring and thresholds

Detection can be difficult. For larvae, hand sift 10 soil samples (30 x 30 cm) or place 10 germinating seed baits throughout the paddock. The use of germinating seed baits is an effective method of detecting both adults and larvae.

One larvae per sample warrants control.

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.

Cultural control

- Prepare ground for even and rapid germination.
- Use of press wheels at planting provides some control.
- Clean cultivation during summer dries out topsoil and eliminates weeds that provide food for adults.

Chemical control

- Larvae can be controlled by insecticide applications at planting or insecticide treated seed.
- 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 rows spaced no more than 2 metres apart.

Natural enemies provide little control.

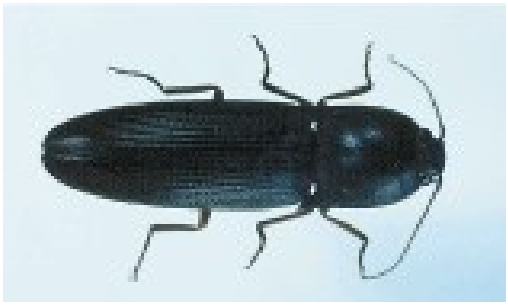
True wireworms

Wireworms are named for the supposed wire-like appearance of their larvae. True wireworm adults (*Agrypnus* spp.) are elongated beetles that jump and click when disturbed.

Identification

Eggs are ovoid, 0.6 × 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.

Larvae are similar to false wireworm larvae. They may also be mistaken for predatory larvae of carabid beetles and rove beetles.



Click beetle

Larva of the true wireworm

Lifecycle

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.

Three to four weeks after emergence, females lay eggs 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 which is the most damaging, occupies 48% of this time.

Larvae pupate in cells in the soil during October to January. Adults emerge after 14 days. Adult females live for a maximum of seven weeks in the field. Adults and larvae feed in the soil on vegetation, including roots. Larvae may also feed on soil and invertebrates.

Damage

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

Monitoring and thresholds

Use germinating seed baits (GSB) or soil sampling to detect larvae prior to sowing. Monitor crops after sowing until establishment.

Treatment is required if more than 25 wireworm larvae are found in 20 GSB.

Management

Seed dressings, in-furrow sprays and granular insecticides offer some control.

Cutworms

- Brown cutworm *Agrotis munda*
- Bogong moth *Agrotis infusa*
- Black cutworm *Agrotis ipsilon*
- Variable cutworm *Agrotis prophyricollis*

Cutworm adult – Bogong moth

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

Cutworm larvae and damage

Identification

Larvae are up to 50 mm long, hairless with dark heads and usually darkish coloured bodies, often with longitudinal lines and/or dark spots. Larvae curl up into a C-shape and remain still if picked up. Moths are a dull brown-black colour.

Cutworms may be confused with armyworms and helicoverpa larvae. Visit the DAFF IPM website for identification information (http://www.daff.qld.gov.au/26_3510.htm).

Damage

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

Monitoring and thresholds

Inspect emerging seedlings twice per week and plants up to budding stage once per week. Check 1 m of row at a number of locations. Check along the plant row, at the base of seedlings under the soil surface and stubble. Placement of a hessian bag on the soil surface may draw cutworms to the surface. Check for their presence in the morning.

Treat seedlings when there is a rapidly increasing area or proportion of crop damage. Treat older plants if 90% (9 out of 10) checks have cutworm present, or if defoliation exceeds 75%.

Management

- Controlling weeds prior to planting will reduce cutworm infestations.
- A late-afternoon spray, close to the time when feeding commences, gives best results.
- Spot spraying of infested patches may suffice.
- Cutworms are killed by a number of natural enemies such as parasitoids, predators and diseases.

Black scarab beetles

At least two species of black scarabs (*Pseudoheteronyx* spp.) attack sunflowers. Their lifecycle on sunflowers is one generation per year with the adults damaging the crops in summer.

Larvae and adults of the black scarab beetle

Identification

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.

Damage

- Larvae feed on taproots causing wilting and death of seedlings.
- Adult beetles can defoliate and kill plants up to 40 cm tall.
- Adults often feed in a front across the field.
- Beetles hide in the soil during the day and emerge in late afternoon to feed.

Monitoring and thresholds

Check in 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.

Four beetles per square metre can cause severe losses to young seedlings.

Feeding damage caused by black scarab beetles

Management

- Removal of their preferred host, parthenium weed, is advised.
- Control can be achieved by spraying either side of the feeding front.
- Spray when beetles are active on the soil surface.
- Chemicals are registered but are of limited effectiveness against larvae feeding below the soil surface.
- Beetles can also be controlled by application of pelleted baits (alfalfa or similar meal) at planting. Cracked grain baits do not control beetles.
- Damage is most prevalent where sunflowers follow wheat, sorghum or grass pasture.

No effective natural enemies have been identified.

White fringed weevil

White fringed weevil (*Naupactus leucoloma*) is predominantly a pest of legumes but has been known to attack sunflowers, particularly where sunflower crops have followed a legume crop.

Adult (top) and larvae (in peanut root) of white fringed weevil

Identification

Larvae are up to 12 mm long, are white to grey with a brown head, legless, have a slightly curved body and are soil dwelling. Adult weevils are 12 mm long, are grey-brown with a white band along the side of their body and have a short snout. Adult weevils cannot fly and emerge from the soil in summer.

This species has a one-year life cycle in northern Australia. Eggs are laid in sticky clumps in plant debris at the base of plants. Hatching larvae burrow downwards in the soil where they attack the roots.

Damage

The larvae burrow into the root system of seedlings, chewing and girdling the tap or lateral roots. Adult weevils may feed on the seedling foliage but appear to cause little harm.

Monitoring and thresholds

In young crops, look for leaf damage. If significant leaf damage is observed, check for adults at the base of plants. If seedling deaths occur, look for larvae under plants in the soil.

Take action if significant adult activity is observed in seedling crops.

Management

The white fringed weevil appears to breed up in legume crops.

- It is recommended that where a potential threat exists, a cereal crop is planted following legumes rather than sunflowers.
- Remove volunteer peanuts from other crops such as maize to reduce carry-over of larvae in the soil.
- Crops close to lucerne are at risk from weevils walking from that crop.

Thrips

- Onion thrips *Thrips tabaci*
- Tomato thrips *Frankliniella schultzei*
- Broadwinged thrips *Desmothrips tenuicornis*
- Plague thrips *Thrips imaginis*

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

For many field crops, 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.

Thrips (top) and their damage symptoms on mungbeans

Identification

The life cycle of thrips is very rapid with a new generation every 3-5 weeks.

Eggs are laid in leaf tissue and the creamy yellow nymphs that emerge will feed on the leaves.

Adult thrips are 2 mm long and are dark, cigar-shaped and have narrow wings folded along their back. Nymphs are similar in shape but are smaller, lack wings and are pale.

Thrips species can only be determined microscopically.

Damage

- Both adults and nymphs feed on the leaves by rasping the surface tissues and sucking the exuded juices.
- Plants generally recover well from damage at the seedling stage. However, when there are high populations of thrips on seedlings, they will cause distortion and browning of the cotyledons and leaves.
- When seedling growth is slowed by dry, cool, or wet conditions, heavy thrip infestations can stunt plants or occasionally kill seedlings.
- Thrips are an important vector for the pathogen tobacco streak virus (TSV).

Monitoring and thresholds

Examine growing points with a hand lens or microscope to see thrips. Thrips can be ‘washed’ off seedlings for later examination by agitating plants in a bottle of alcohol or methylated spirits.

There are no action level thresholds for seedling thrips.

Tobacco streak virus

Tobacco streak virus (TSV) was first diagnosed in sunflowers in central Queensland in 2004. Once it infects the plant, TSV reproduces and causes the death of plant tissue in the vicinity of the infection. It spreads throughout the plant along the vascular tissue and can cause wilting and death of other plant parts including leaves and seed heads.

The extent of plant damage depends on the growth stage of the plant at the time of infection. At the seedling stage, the whole plant may be killed. In mid-stages of plant growth, infection may result in leaf death and deformation/reduction in size of seed heads. Late infections cause only minor visual symptoms, with little effect on plant growth or yield.

The major method of transmission is by infected pollen, which can be spread by wind or carried by thrips. Thrips are the only known insect vector of TSV. Thrips do not become infected with the virus, but transport the infected pollen on their bodies. Transmission of TSV to plants relies on the virus from the infected pollen entering plant cells through the feeding injury caused by thrips.


TSV symptoms in sunflower

Management

- If needed insecticides can be used.
- 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.
- Thrips may require control in areas of known TSV outbreaks.

Wingless cockroaches

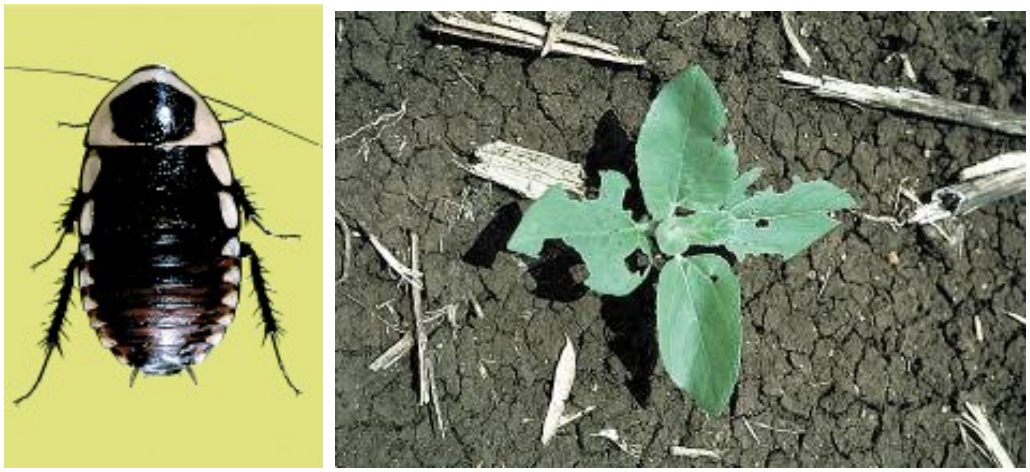
- *Calolampra elegans*
- *Calolampra solida*

These two species of cockroaches are major pests in sunflowers areas of central Queensland. Other native cockroaches are minor pests. Wingless cockroaches eat seedlings of all field crops.

Identification

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 adult size. Both species are Australian natives. Cockroaches have one generation per year on sunflowers.



Wingless cockroach and the damage caused on sunflower seedlings

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.

Monitoring and thresholds

- 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.
- Populations reach the highest densities under no tillage with stubble retained.
- Determine numbers with germinating seed baits.

Take action when there are one or more cockroaches per two germinating seed baits.

Management

- Use insecticide treated seed.
- There are no effective natural enemies. A tachinid fly, *Chlorotachina froggattii* has been recorded parasitizing nymphs but parasitism percentages are low and mostly <5%.

Black field earwig

Black field earwigs (*Nala lividipes*) are a sporadic pest of sunflowers.

Identification

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.

The common brown earwig (*Labidura truncata*) grows to a larger size (24 mm) and is lighter in colour than the black field earwig.

Black field earwig adults and nymph

Life cycle

The black field earwig normally feeds on decaying stubble in cultivation with all stages (adults and immatures) present during warmer months. 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 seven weeks in clay soils, longer in sandy soils. Nymphs develop into adult females or major or minor males. Longevity is about 20 weeks.

Damage

- Eats newly sown and germinating seed and the roots of crops below ground, resulting in poor establishment.
- Feeding on secondary roots may cause the plants to fall over as they get larger.
- Chew the stems of newly emerged seedlings above ground.

Monitoring and thresholds

- Use germinating seed baits or digging and sieving to detect adults and nymphs prior to planting.
- Monitor crops after planting until establishment.
- The black field earwig is mainly a pest in areas having heavy, black soils.
- Earwigs prefer cultivated soils rather than undisturbed soil (zero til).

Control if more than 50 earwigs in 20 germinating seed baits.

Management

- Use press wheels at sowing
- In-furrow sprays are not effective in protecting against dense populations
- Grain baits containing insecticide applied at sowing offer best protection.
- Insecticide seed dressings provide some protection, but may not prevent seedling loss under high pest pressure.

Making control decisions for soil dwelling insects

The commonly used methods for controlling seedling pests include seed treatment, in-furrow spraying and insecticidal grain baits.

Using sunflower seed treated with insecticides such as imidacloprid and fiprinol will provide protection against soil insects such as wireworms, black scarabs, wingless cockroaches and, to some extent earwigs.

However, if treated seed is not used, other methods of chemical control can be achieved with in-furrow sprays to control wireworm and false wireworms. Specific sprays may be required for cutworms and black scarab beetles. Refer to the insecticide table for registered chemicals.

Another method of controlling soil insects is with insecticide treated grain baits. Baits can be made up by growers or agronomists or ready to use baits can also be obtained from your local agribusiness. The chemical registered for use in insecticide grain baits is chlorpyrifos.

Insecticide treated grain baits will control wireworms and field crickets

Making insecticide treated grain baits

- 100 mL chlorpyrifos (500 g/L) EC
- 125 mL crop or vegetable oil
- 2.5 kg of cracked wheat, sorghum or standard pellets.

Once mixed, the bait can be applied with a fertiliser spreader or through fertiliser tubes, dropping onto the soil surface. Using the 2.5 kg/ha of cracked grain gives between 20-30 grains/m^2 which is satisfactory for effective control.

Post establishment pests

Field crickets

- Black field crickets *Teleogryllus commodus* and *Teleogryllus oceanicus*
- Brown field crickets *Lepidogryllus parvulus* and *Lepidogryllus comparatus*

Crickets are minor, widespread and irregular pests of sunflowers.

Identification

Adults are up to 30 mm long, winged, black or brown and have the head and mouthparts inclined downwards. The hindlegs 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.

Damage

- Feed on the leaves and stems of seedlings
- Sometimes sever 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.

Monitoring and thresholds

- Crickets feed at night - inspect crops at dusk when crickets are most active.
- Black field cricket activity can be monitored with light traps.
- Use germinating seed baits to determine cricket numbers.
- One or more crickets per two germinating seed baits require control.

Management

- Field crickets are controlled using insecticide-treated cracked-grain baits.
- Weedy cultivation prior to planting may encourage crickets.

Cricket populations are regulated by weather conditions. Natural control like disease, parasitic insects and predators such as birds and insects has little impact on crickets. However, nematodes are common parasites of brown field crickets in CQ.

Whitefly

- Greenhouse Whitefly (*Trialeurodes vaporariorum*) - GHW
- Silverleaf Whitefly complex (*Bemisia tabaci* B type, native *Bemisia*) - SLW

Sunflower is a good host for whitefly, but unless numbers are extreme, on seedling plants, crop loss does not occur. In regions where whitefly are common (SLW in Central Qld, GHW in more southern regions), small numbers will be present in most seasons, with high populations in warmer than average seasons. Sunflower may act as a source of whitefly for nearby susceptible crops (eg horticulture, cotton, soybeans).

Identification

Nymphs are the best lifestage with which to identify which species is present. GHW and SLW nymphs are quite distinct.

GHW Nymphs are pale yellow-green scale-like insects with long hairs protruding all over the body. Most nymph stages are immobile.

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 B biotype becomes established in a location, it tends to displace the Australian native whitefly.

Adult whitefly are around 1.5 mm long. Greenhouse whitefly adults are larger than SLW and have overlapping wings which obscure the body when viewed from the top. SLW adults hold their white powdery wings more 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.

GHW nymphs are oval-shaped with filaments around margin. Adults are flat, with overlapping wings

SLW nymphs are tear-shaped with no filaments. Adults have tent-shaped wings with a gap

Life cycle

GHW breeds throughout the warm months with a life cycle of about 5-7 weeks. It can have up to three generations on a sunflower crop and seven generations per year. Summer and autumn are the risk periods, with outbreaks favoured by warm weather and host availability.

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 whitefly eggs often have a dark patch on the underside. The life cycle from egg to adult can be as short as 18 days in the summer, but longer in cooler weather.

Damage

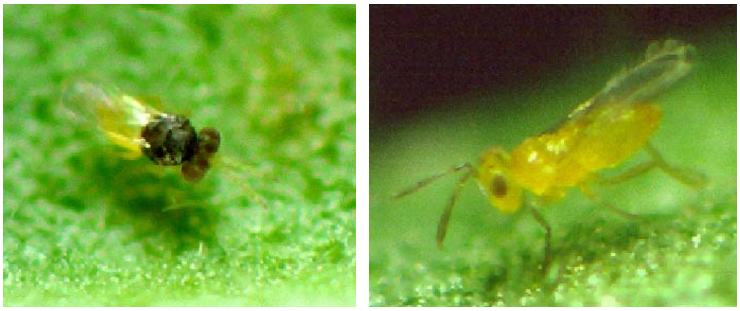
Nymphs and adults suck sap and excrete honeydew. Black sooty mould fungus grows on the sticky honeydew and can interfere with photosynthesis if severe.

Under very heavy infestations, plants vigour may be affected and in situations of severe moisture stress, leaf wilting may occur. In very rare instances, yield may be affected.

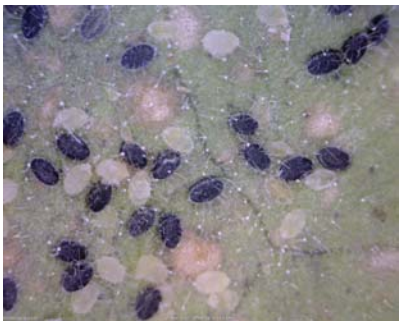
Management

Whitefly control is generally not warranted in sunflower. There are no insecticides registered for the control of whiteflies on sunflower.

The parasitic wasps *Encarsia* spp. and *Eretmocerus* spp. are common in most cropping regions where whitefly persist, and can provide high levels of biological control. Predators include big-eyed bugs, lacewing larvae and ladybirds. These natural enemies can provide good control of whitefly and suppress populations to low levels. The major drivers of whitefly outbreaks are the use of non-selective insecticides to control other pests (e.g. Rutherglen bug, helicoverpa), and above average temperatures.



Whitefly parasitoids - *Encarsia* sp. (left) and *Eretmocerus* sp.



Parasitized greenhouse whitefly nymphs

Loopers

- Tobacco looper *Chrysodeixis argentifera*
- Vegetable looper *Chrysodeixis eriosome*
- Soybean looper *Thysanoplusia orichalcea*

Loopers are an occasional pest of sunflower. Loopers can be distinguished from helicoverpa by:

- their 'looping' action when walking - visit the Beatsheet on YouTube to see looper and helicoverpa larvae movements (http://www.youtube.com/user/TheBeatsheet)
- by their body, which tapers to the head
- they have only two pairs of hind legs, as opposed to four for helicoverpa.

Tobacco looper moth (top) and larva

Identification

Eggs are pale yellow-green, ribbed and are flatter than helicoverpa eggs. Looper eggs hatch in 3-6 days. There are six larval stages. Larvae take 2-3 weeks to develop. Larval colour can vary considerably. Large larvae are usually green with white stripes. Larvae can reach 50 mm in length. Looper larvae usually pupate under leaves in a thin silken cocoon. Pupae are dark above and pale underneath.

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.

Damage

- Larvae feed on leaves.
- 80% of defoliation is done by medium-large larvae.
- Large irregular shaped holes in the leaves usually coincide with the appearance of large larvae.
- Although uncommon, if severe defoliation (>50% total leaf area) occurs during budding and flowering (R1-R7), loss of yield and oil content will result

Monitoring and thresholds

Scout crops for small larvae and evidence of defoliation (holes in leaves). In the past, severe outbreaks have occurred in March-April.

BT is effective against small-medium larvae

A preliminary action threshold of 50% defoliation from R1-R7 is proposed (DAFFQ, 2013). A larval density threshold is under development.

Plants with looper defoliation level below threshold (left) and above threshold (right).

Management

Looper infestations are often controlled by parasitoids, predators and diseases before they cause too much damage. Control is usually unwarranted except when caterpillars cause severe damage in the early reproductive stages. They 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).

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.

Natural enemies

Soybean looper eggs and larvae are attacked by a number of parasitoids, predators, and diseases – many of which also attack helicoverpa. Parasitism by *Litomastix* is a common and distinctive sight.

Loopers can be killed by NPV when densities are high. Note: this is not the same strain at that is used commercially to control helicoverpa.

Soybean looper killed by NPV

Soybean looper parasitised by *Litomastix*. Hundreds of *Litomastix* larvae and pupae are visible under the skin.

***Litomastix* adults emerged from the parasitised soybean looper in the previous picture.**

Rutherglen bug

- Rutherglen bug *Nysius vinitor*
- Grey cluster bug *Nysius clevelandensis*

Rutherglen bug on budding sunflower

The Rutherglen bug (RGB) is a major, widespread pest of crops throughout Australia and is the most damaging insect pest on sunflower Grey cluster bug is a minor pest of sunflowers in Queensland and northern NSW.

Bugs can often appear in large numbers in a very short time period and only in occasional seasons. Their invasion is unpredictable as they can migrate 200-300 km in a single night.

Identification

Adults are small, 6 mm long, mottled grey-brown-black, and have clear silvery grey 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. The forewings of RGB are smooth, while that of the grey cluster bug is fringed with small hairs.

Rutherglen bug adults (left) and nymphs (right)

Brown mirid, broken-backed bug are similar in appearance to RGB. RGB nymphs may be confused with aphids, but are orange and more mobile. Visit the DAFF IPM website for identification information (http://www.daff.qld.gov.au/26_3510.htm).

Life cycle

The RGB and grey cluster bug have about eight generations per year. In spring and summer, development from egg to adult takes 3-4 weeks. On sunflowers, there is one generation per crop. Adults will live up to four weeks, and females will lay up to 400 eggs in this period. The female deposits her small, cream, sausage shaped eggs between the seeds and the dead flowers, usually within 2 weeks after completion of flowering. The small wingless nymphs emerge about 7 days later. After about 3 weeks of feeding, the mature winged adult stage is reached.

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


RGB weed hosts cudweed (left) and caustic creeper

RGB on sowthistle bud

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. Depending on the time of planting, adults may be present during budding and flowering and nymphs, post flowering (see Figure 1). During summer, several overlapping generations develop in which all stages may be present.

Damage

Adults congregate on the stems during budding and cause the head to either wilt, become malformed or die. After flowering, adults lay eggs in flower heads and both adults and nymphs feed on the seed, reduce grain yield, oil content, oil quality and reduce seed germination. Damage is higher in moisture stressed crops. Damage can occur until harvest, depending on seed hardness.

Winter and spring conditions that favour prolific weed growth followed by a dry late spring will force bugs off their host plants onto crops.


Rutherglen bug on sunflower, and sunflower head wilts after RGB infestations at budding (right)

Monitoring and thresholds

The critical time to monitor for RGB are at budding through to seed fill. To monitor for bug numbers - count adults on buds and heads at weekly intervals. Beat buds or heads into a bucket.

- Budding – bugs congregate on the upper stem and bud
- Flowering – eggs are laid between individual flowers with nymphs emerging after about 7 days to feed on the young seeds.

Growth stage	Thresholds (adult bugs per plant)	
	August to December	**January to April**
Budding	10-15	20-25
Seed fill	20-25	50
Confectionary*	5	5

*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. Source: Dr. B Franzman

Understanding the lifecycle of RGB is helpful when making spray decisions. The aim with RGB control is to prevent adults from breeding as population explosions will then occur. Adults will not start breeding until a protein source is available – i.e. developing sunflower seed. Adults generally stop breeding in late February in response to declining temperatures and day length. Although there are no further egg-laying adults, developing nymphs may still be present in the crop.

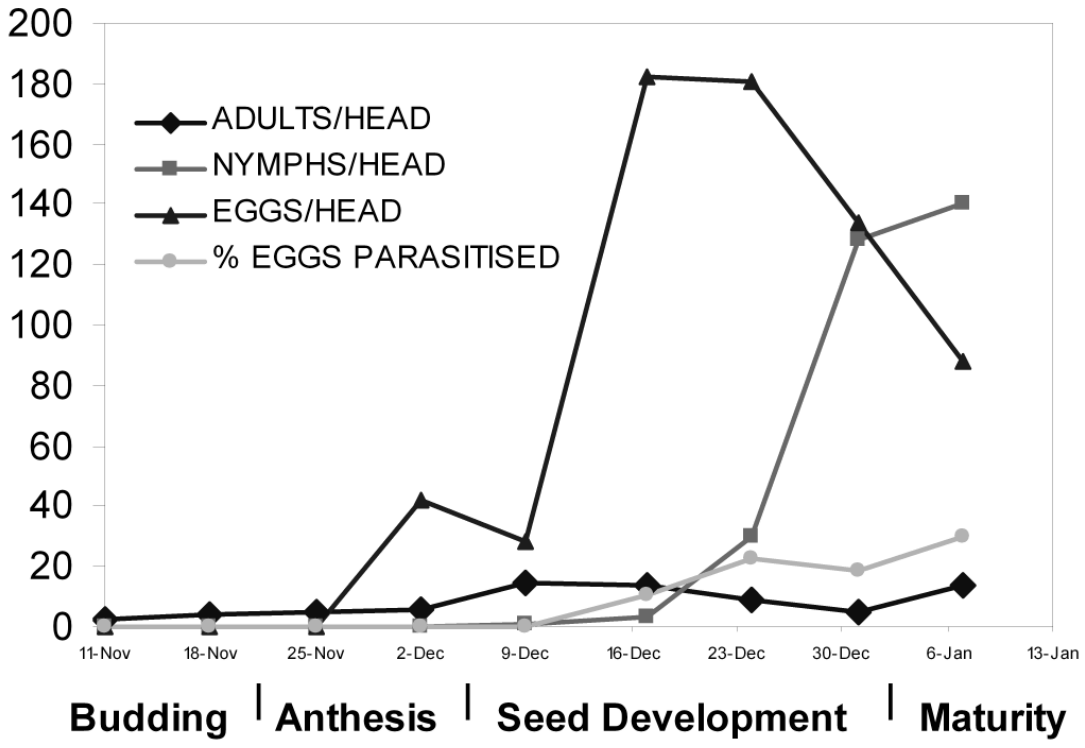


Figure 1 ***Nysius*** **phenology on sunflower.**

Management

- Ploughing a deep furrow around the crop may prevent nymphs from migrating from weeds into seedling crops.
- The most effective pesticides have limited residual effect and severely disrupt parasitoid and predator populations.
- As adults are winged migrants, re-infestation can occur rapidly after treatment. Multiple treatments are sometimes required. In outbreak seasons, migrations can continue for several weeks.
- Aim to apply necessary sprays at the end of flowering (petal fall) before adults begin to lay eggs. This timing will normally prevent subsequent nymphal populations developing.
- Spray late afternoon when bees are less active.

Natural enemies

Egg parasitoids *(Telenomus* spp.) are sometimes important in suppressing nymph infestations and reducing overall bug populations. 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. Several species of egg parasitoid have been found, but parasitism of eggs is generally low.

Making control decisions for Rutherglen bug

Rutherglen bug invasion is unpredictable and bugs can often appear in large numbers in a very short time period. Rutherglen bug can cause crop loss from budding onwards. Adults must feed on sunflower seed as a protein source before they can start breeding. Delaying necessary treatment until petal drop will minimise the risk of large numbers of eggs and nymphs in turned-down heads where they are difficult to control.

Figure 1 illustrates the timing of egg laying (from flowering) and the resultant appearance of large numbers of nymphs in late grain fill. This highlights the importance of preventing egg lay.

Some points to consider when managing Rutherglen bug:

- Most of the chemicals used to control Rutherglen bug have limited residual activity and re-infestation can occur rapidly after treatment.
- The use of pyrethroids can flare helicoverpa and silverleaf whitefly by killing off predators and parasitoids.
- Effectiveness of insecticide application is significantly reduced once heads turn down, and nymphs start to emerge from them.
- Spray during late afternoon when bees are less active.
- A number of insecticides are registered for use on both Rutherglen bug and helicoverpa in sunflowers. The repeated application of synthetic pyrethroids for RGB control (in a high pressure season) will exert selection pressure on *H armigera* present.
- Be aware of withholding periods (WHP) as some registered chemicals have long WHP (up to 28 days).

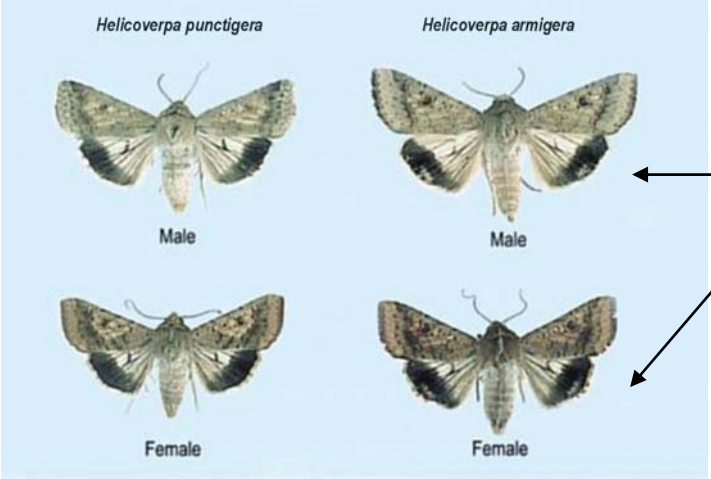
Helicoverpa

- native budworm *Helicoverpa punctigera*
- corn earworm *Helicoverpa armigera*

Helicoverpa larvae infest sunflower from vegetative until late seed fill. The proportion of each species found in crops will vary from year to year.

Helicoverpa species identification

It is possible to visually distinguish between helicoverpa species for medium and large larvae, pupae and adults.



H. punctigera* and *H. armigera* moths are distinguished by the presence of a pale patch in the hindwing of *H. armigera.

Large *Helicoverpa punctigera* (left) and *H. armigera* (right) larvae showing the distinguishing dark and pale hairs behind their heads.

Identification

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.

Medium larvae develop lines and bands running the length of the body and are variable in colour.

Large larvae of *H. armigera* have white hairs around the head; medium larvae have a saddle of darker pigment on the fourth segment and at the back of the head and dark- coloured legs. Large *H. punctigera* larvae have black hairs around the head; medium larvae have no saddle and light-coloured legs.

A distinguishing feature of both species of helicoverpa larvae are a group of four pairs of ´legs´ in the back half of the body (loopers can have a group of two, three or four pairs of legs at the rear and loop when walking).

Moths are a dull light brown with dark markings and are 35 mm long. *Helicoverpa armigera* has a small light or pale patch in the dark section of the hind wing while the dark section is uniform in *H. punctigera*.

Eggs of both species are 0.5 mm in diameter and take 2-5 days to hatch and change from white to brown to a black head stage before hatching.

Helicoverpa larvae occur in a range of colours.

Helicoverpa larval size categories and actual sizes

Actual larval size	Larval length (mm)	Size category
–	1-3	Very small
	4-7	Small
	8-23	Medium
	24-30+	Large

Size categories of helicoverpa larvae, from egg to large larvae

Severe damage at budding.

Medium helicoverpa larva feeding on bracts.

Damage

Although damage from budworms is obvious, budworms are not considered of major economic importance in sunflowers as the plant is able to tolerate large infestations.

- 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.
- Feeding on the back of the head can predispose the crop to secondary head rots.
- Stressed dryland crops are more prone to head rots than unstressed irrigated crops.
- Heavy infestations during bud stage can result in severe damage. Severe damage to the bud can occur when medium-large larvae move onto buds having developed on vegetative plants or weeds in the crop.
- Feeding on the stem close to the bud and on the developing bud can result in the loss or deformation of the head.

Monitoring and thresholds

Budding is the most vulnerable stage as the whole bud can be deformed or destroyed. **One medium larvae/plant at budding warrants control.**

Mortality (death) of small larvae is around 30%. Adjusting for mortality, the threshold for small larvae (<7 mm) would be 3 small larvae/head.

Helicoverpa feeding on the back of sunflower heads can lead to secondary head rot infections.

At flowering to grain fill stage, the plant is able to tolerate larger populations. Damage to the back of the head may predispose the head to rots but this is rarely an economic reason to control helicoverpa.

Management

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 larval population averaging 17 larvae/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 as the incidence of head rots is difficult to predict.

Natural enemies are very effective in the control of helicoverpa. Egg parasitism of around 90% is not uncommon in field crops with many other beneficial insects predating on and parasitising larvae. Always try to select control methods that impact the least on these natural enemies.

- Budworms have a large number of natural enemies such as egg and larval parasitoids, predators and various diseases. Parasitism can at times exceed 30%.
- 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 while spraying later can affect pollination by bees.

Spined predatory bug

Natural enemies

Helicoverpa are attacked by a large number of predators and parasitoids. Predatory bugs attacking helicoverpa eggs and larvae include: spined predatory bug (*Oechalia schellenbergii*), glossy shield bug (*Cermatulus nasalis*), damsel bug (*Nabis kingbergii*), big-eyed bugs (*Geocoris* sp.), apple dimpling bug and assassin bugs. Predatory beetles include the red and blue beetle and predatory ladybirds.

Damsel bug (photo by K. Power)

Other important predators include ants, spiders and lacewings.

Helicoverpa parasitoids include tiny egg parasitoids wasps (*Trichogramma* spp.), and caterpillar parasitoids such *Microplitis* and *Netelia* (wasps), as well as numerous species of tachinid flies. With the exception of the egg parasitoids and *Microplitis,* most parasitoids mentioned do not kill helicoverpa until they reach the pupal stage. Mice, predatory earwigs and wireworm larvae are significant predators of helicoverpa pupae.

Fertile versus parasitised (right hand two images) helicoverpa eggs. Note the brown ring on the pink healthy eggs and the head capsules visible inside the dark healthy eggs. Note the shrunken nature of the black parasitised eggs, and the absence of a brown ring on the pink parasitised eggs.

Many natural enemies of helicoverpa also attack other pests. The number of beneficials varies markedly with crop age, from crop to crop, region to region, and from season to season. In many crops, the combined action of beneficial species is thought to have a 'useful' or significant impact on potentially damaging helicoverpa populations and those of other pests. For these reasons, it is desirable to conserve as many beneficials as possible.

Microplitis pupae

In addition to beneficial arthropods, naturally occurring caterpillar diseases can have a marked impact on helicoverpa numbers.

Making control decisions: considerations

- The stage of crop development (susceptibility) and the number and size (damage capacity) of the larvae.
- The level of natural enemy activity in the crop (potential survival of helicoverpa eggs and larvae).
- Insecticide selection is influenced by:
    - Which helicoverpa species in the crop. H. armigera resistance to pyrethroids and carbamates had decreased over the past 10 years, but is on the increase again. Local information on the efficacy of these products is important.
    - The need to control other pest species in the crop (e.g. Rutherglen bug).
    - Larval size affects efficacy, particularly NPV and Bt, which should be applied to populations no larger than 7 mm
    - Selectivity of the product and potential to flare secondary pests, or get some suppression of pests.
    - Withholding period and time to harvest

Green vegetable bug

Green vegetable bugs (GVB) (*Nezara viridula*) are a minor pest of sunflowers.

Green vegetable bug adults (left) and newly hatched nymphs

Identification

GVB are bright green, shield-shaped, 13-15 mm long with three small white spots between their shoulders. Over-wintering adults are purple-brown. Yellow or orange GVB variants are occasionally seen. When disturbed, GVB emit a foul smell to deter predators.

GVB eggs

GVB eggs are laid in rafts (50-100 eggs per raft) and are circular in cross section. Newly- laid eggs are cream but turn bright orange prior to hatching. Parasitised GVB eggs are black. GVB nymphs vary in colour. Newly hatched nymphs (1.5 mm long) are orange and brown (sometimes black). Later instars are either green or black, with white, cream, orange and red markings.

Spined predatory shield bug eggs

Final (fifth) instar nymphs have reduced patterning (i.e. more base colour, green to black), and have prominent wing buds. Younger nymphs are round or oval rather than shield shaped and usually aggregate in large clusters. Older nymphs are more widely dispersed.

Damage

Glossy shield bug eggs

- GVB have a wide host range and cause damage by sucking sap.
- GVB tend to feed on the upper stems and heads and when present in large numbers, causes shrivelling, wilting and deformed heads.
- If they gather around the peduncle water and nutrient supply to the developing head will be reduced.
- They occasionally feed on developing seed.

GVB with *Trichopoda* eggs

Threshold

One mature bug or 5th instar nymph/plant.

Natural enemies

GVB eggs are frequently parasitised by a tiny introduced wasp *Trissolcus basalis*. Parasitised eggs are easily recognised as 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 (5th) instar and adult GVB are parasitised by the recently introduced tachinid fly *Trichopoda giacomellii.*

Beneficials

Table 1 Key beneficial groups and pests that they attack

Parasitoids	Pests attacked
Ichneumonidae wasps	Larva of helicoverpa, cutworms and loopers
Microplitis wasps	Helicoverpa larvae
Litomastix wasps	Looper larvae
Trichogramma wasps	Eggs of helicoverpa and loopers
Trissolcus wasps	Eggs of green vegetable bugs
Trichopoda flies	Green vegetable bugs (adults and 5th instar nymphs)
Tachinid flies	Larva of helicoverpa
Predatory Insects	**Pests Attacked**
Ants	Caterpillar eggs and larvae, bug nymphs
Apple dimpling bug	Caterpillar eggs, very small larvae, and mites
Assassin bug	Large range of insects including caterpillars
Big eyed bug	Soft bodied insects, caterpillar eggs, and mites
Brown smudge bug	Caterpillar eggs, aphids, jassids, and mites
Common brown earwig	Caterpillar larvae and pupae
Damsel bug	Caterpillar eggs and larvae, mites
Glossy shield bug	Caterpillar larvae
Hoverflies	Aphids
Lacewings	Aphids, caterpillar eggs and small larvae
Ladybeetles	Aphids, mites,caterpillar eggs and small larvae
Pirate bugs	Thrips and caterpillar eggs
Predatory shield bug	Caterpillar larvae
Red and blue beetle	Caterpillar eggs and small larvae
Thrips	Mites
Spiders (arthropods)	Generalist predators, attack moths, larvae, eggs, bug nymphs and other spiders
Insect Pathogens	**Pests Attacked**
Bacteria e.g. *Bacillus thuringiensis*	Helicoverpa, looper caterpillars
Fungal diseases (including *Beavueria*, *Nomuraea rileyi* and *Metarhizium*)	Helicoverpa, loopers, armyworms, green vegetable bugs
NPV (Nucleopolyhedroviruses)	Helicoverpa, loopers **NOTE:** NPV viruses are specific to species e.g. Helicoverpa NPV and its commercial derivatives only control helicoverpa.

Bees

Honeybees – both from wild and hive populations are the predominant pollinators of sunflowers. During daylight hours, they constitute over 90% of the insects visiting the crop at flowering.

To prevent damage to bees during flowering, spraying should be avoided during this time, if possible. In addition, chemicals with a low residual effect should be used for all pre flowering control measures. Systemic insecticides should be avoided at all costs. If hive bees are used, hives should be closed up or moved when spraying is required.

Monitoring for insect pests in sunflower

Pre-plant to establishment

Soil insect control measures need to be applied at sowing. Soil insects, particularly damaging juvenile stages, cannot be controlled once the crop is planted. In high risk situations (e.g. following a weedy fallow, high stubble, or history of soil insects), check for pests using the following techniques:

Soil sampling by spade

Take a number of spade samples (deep enough to take in the moist soil layer) from random locations across the field. Hand sort samples to determine type and number of soil insects.

Germinating grain bait technique

Immediately following rain and before planting:

- Soak insecticide free crop seed in water for at least 2 hours to initiate germination
- Bury a small handful of the seed under 1 cm of soil at each corner of a 5 x 5 m square at five widely spaced sites per 100 ha. If the soil is dry, place seed at moisture, or water the baits to ensure germination.
- Mark the bait's position as high populations of soil insects can completely destroy them.
- 5-10 days after placing baits, dig up the germinated seed and check for insects.

Trials have shown that there is no difference in the type of seed used when it comes to attracting soil dwelling insects. However, for practical purposes, using the type of seed to be sown as a crop is likely to indicate the species of pests which could damage that crop.

Using insecticide seed dressings protects the crop from most soil dwelling insects during the seedling stage. However, monitoring at seedling stage is recommended as seed dressings may only partially control some insects such as earwigs, or when soil insects are very abundant.

Vegetative crops to harvest

During the highly susceptible budding – end flowering, monitor at least weekly. Monitor more frequently if pest pressure warrants it.

- Check leaves for pest presence and evidence of feeding.
- Monitor upper stems and buds for the presence of Rutherglen and grey cluster bugs as well as helicoverpa.
- Check flowers for Rutherglen bug adults and nymphs.
- Inspect the back of heads for helicoverpa and crickets.
- Check maturing heads for Rutherglen bugs, crickets and green vegetable bugs.

Rutherglen bugs tend to congregate on the upper stem. From a quick glance at the number infesting this plant it is clear that threshold is exceeded and control is warranted.

Caterpillar pests (helicoverpa, loopers, and cutworm) do the majority of their feeding (80%) in the final two instars (medium-large). If control is warranted, it should be implement before larvae reach damaging size.

Summary of sunflower pest thresholds

Table 2 Sunflower pest thresholds

Pest	Crop stage	Threshold	Comments
False wireworm	Seedling	1 larvae/gsb – summer 2 larvae/gsb - winter	Use treated seed* (or grain baits for beetles)
True wireworm	Seedling	1 larvae/gsb – summer 2 larvae/gsb - winter	Use treated seed
Cutworm	Seedling	When 90% plants infested or 50% have 75% leaf tissue loss	Treated seed offers some protection. Specific chemical sprays may be required.
Black scarab beetles	Seedling	4 beetles/m^2	Insecticide sprays or baits for beetles
Wingless cockroaches	Seedling	1/gsb – summer 2/gsb - winter	Use treated seed* or grain baits
Black field earwigs	Seedling	5/gsb – summer 10/gsb - winter	Treated seed* provides limited control; use grain baits
Thrips	Seedling Vegetative		Control if TSV risk is high in the region
Field crickets	Seedling Vegetative	1/gsb – summer 2/gsb - winter	Use treated seed* or grain baits
Glasshouse whitefly	Vegetative		No chemical options registered. Control rarely warranted.
Bemisia tabaci whitefly biotypes	Vegetative		No chemical options registered. Control rarely warranted.
Loopers	Vegetative		Control if defoliation >50% from R1-R7
Helicoverpa	Budding	1 medium or 3 small larvae/terminal bud	Aim to control larvae <7 mm in length
Rutherglen bug	Budding	Aug to Dec -10-15 Jan to Apr – 20-25*	Constant immigration may necessitate repeated treatments
Rutherglen bug	Flowering Seed set	Aug to Dec – 20-25 Jan to Apr – 50*	Apply control at petal fall to prevent breeding and damage to developing seed
Helicoverpa	Flowering Seed set		Control only if numbers are extremely high
Green vegetable bug	Flowering Seed set	1 adult or 5th instar per plant	

Lower thresholds apply for confectionary sunflowers.
gsb – germinating seed baits
Source: DAFF Queensland

* Insecticide treated seed offers some protection against surface active insects such as false wireworm beetles, black field earwigs, wingless cockroaches and field crickets, but if pest densities are high, treated baits may be necessary to protect the establishment of seedlings.

Further information

- TOPCROP Insect Ute Guide for the Northern Region
- The new big black sunflower pack – Australian Sunflower Association
- Pests of field crops and pastures, identification and control – P.T. Bailey (editor), published by CSIRO 2007.
- Department of Agriculture, Fisheries and Forestry website at: http://www.daff.qld.gov.au/26_3510.htm
- The Beat Sheet blog – a blog about IPM in field crops at: http://thebeatsheet.com.au

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