



NORTHERN

OCTOBER 2016

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DURUM

SECTION 7

INSECT CONTROL

CUTWORM | APHIDS | ARMYWORM | HELICOVERPA SPP. (HELIOTHIS) |
MITES | INSECT MONITORING TECHNIQUES FOR FIELD CROPS

SECTION 7

Insect control

More information

GRDC Insect Id App:
<https://www.grdc.com.au/Resources/Apps>

QDAFF Publications:
http://ipmworkshops.com.au/wp-content/uploads/Wintercereals_north-manual-July13.pdf

<http://www.daff.qld.gov.au/plants/field-crops-and-pastures/broadacre-field-crops/integrated-pest-management/ipm-information-by-crop/natural-enemies-who-eats-who>

QDAFF Integrated Pest Management For Australia's Northern Region Blog:
<http://thebeatsheet.com.au/about/>

NSW DPI Publications:
<http://www.dpi.nsw.gov.au/agriculture/broadacre/pests-diseases>

Insects are not usually a major problem in wheat but sometimes they build up to an extent that control may be warranted. For current chemical control options refer to the Pest Genie (<http://www.pestgenie.com.au>) or Australian Pesticides and Veterinary Medical Authority (APVMA) (www.apvma.gov.au) websites. ¹

7.1 Cutworm

Several species of **cutworms** (*Agrotis* spp.) (Figure 1) attack establishing cereal crops in Queensland and New South Wales. As their name suggests, cutworm larvae sever the stems of young seedlings at or near ground level, causing the collapse of the plant (Table 1). Damage usually shows up as general patchiness or as distinct bare areas in a very short time. Controlling weeds in the fallow prior to planting will assist in reducing cutworm populations and reduce crop damage. This should be done at least 3-4 weeks prior to sowing. Chemical control may be warranted if larval numbers exceed 1 larva/m² in emerging crops. The best time to monitor is late afternoon–evenings when larvae feed. During the day, scratch away soil around damaged plants to find larvae sheltering in the soil. For more information read [how to recognise and monitor for soil insects](#) in 'Insect pest management in winter cereals'. ²



Figure 1: Cutworm. (Source: QDAFF)

¹ DAFF (2012) Insect pest management in winter cereals. Department of Agriculture, Fisheries and Forestry Queensland, <http://www.daff.qld.gov.au/plants/field-crops-and-pastures/broadacre-field-crops/integrated-pest-management/ipm-information-by-crop/insect-pest-management-in-winter-cereals>

² DAFF (2012) Insect pest management in winter cereals. Department of Agriculture, Fisheries and Forestry Queensland, <http://www.daff.qld.gov.au/plants/field-crops-and-pastures/broadacre-field-crops/integrated-pest-management/ipm-information-by-crop/insect-pest-management-in-winter-cereals>

Table 1: Cutworm description and management summary³

Scientific name	<i>Agrotis</i> 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 still 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. 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

7.2 Aphids

Aphids are usually regarded as a minor pest of winter cereals, but in some seasons, they can build up to very high densities. Four different species of aphid can infest winter cereals, including oat aphid, corn aphid, rose-grain aphid, and the fourth species, rice root aphid, which exists in the northern grain region, but does not cause as much damage to cereals. For more information, see the Crop Aphids Back Pocket Guide at <https://grdc.com.au/CropAphidsBackPocketGuide>.

Aphids can impair growth in the early stages of crop and prolonged infestations can reduce tillering and result in earlier leaf senescence. Infestations during booting to milky dough stage, particularly where aphids are colonising the flag leaf, stem and ear, result in yield loss, and aphid infestations during grain-fill may result in low-protein grain. As aphids may compete with the crop for nitrogen (N), crops grown with marginal levels of N can be more susceptible to the impact of an aphid infestation. In barley, aphids can spread *Barley yellow dwarf virus* (BYDV). While this can have a large effect on barley yield in some areas, it is not considered a major problem in Queensland in most seasons. In virus-prone areas, use resistant plant varieties to minimise losses due to BYDV.

7.2.1 Thresholds for control

Inspect for aphids throughout the growing season by monitoring leaves, stems and heads as well as exposed roots. Choose six, widely spaced positions in the crop, and at each position examine five consecutive plants in a row. Research is under way into

³ DAFF (2010) Cutworm. Department of Agriculture, Fisheries and Forestry Queensland, <http://www.daff.qld.gov.au/plants/field-crops-and-pastures/broadacre-field-crops/integrated-pest-management/a-z-insect-pest-list/soil-insects/cutworm>

damage thresholds and control options for cereal aphids. Some research indicates that aphid infestations can reduce yield by ~10% on average. Current notional thresholds suggest that control is warranted when there are >10–20 aphids on 50% of the tillers.

The decision to control aphids on winter cereals depends on the size of the aphid population and the duration and timing of the infestation. Controlling aphids during early crop development generally results in a recovery of the rate of root and shoot development, but there can be a delay. Aphids are more readily controlled in seedling and pre-tillering crops, which are less bulky than post-tillering crops. Corn aphids in the terminal leaf tend to disappear as crops come into head, and other species usually decline in abundance about this time as natural enemy populations build up. Note that the rice root aphid feeds below-ground and cannot be controlled effectively by non-systemic foliar treatments.⁴

No firm economic thresholds exist (taking into account current costs of control and crop value), but there are thresholds suggested from work in Western Australia and by the Northern Grower Alliance (NGA).

The Western Australian threshold, based on checking crops regularly from late tillering, is, to consider control if the aphid population exceeds 15 aphids/tiller on 50% of tillers.

The NGA work shows that at some sites there is an economic (yield) benefit from controlling aphids early (either seed treatments or at the early tillering stage) using a threshold of 10 aphids/tiller.

In Queensland, several field and glasshouse trials have been conducted over the past four seasons, but entomologists have not been obtained consistent yield loss in trials that tested a range of aphid infestations at different stages of crop development.⁵

Recently the NGA has been involved in a large number of trials to improve industry understanding of the impact of aphids on winter cereal yields and the costs and benefits of different management approaches.

Key findings include:

- A threshold of 10-15 aphids/tiller (and increasing) appears a suitable commercial trigger for aphid management in winter cereals.
- Monitor for early populations of oat aphids by pulling up plants and examining crown and sub-crown regions.
- However, only consider foliar sprays when most oat aphids have moved above-ground into the lower canopy.
- Best results from foliar sprays are obtained when the aphid population is close to threshold and increasing.
- Beneficial insects can provide effective aphid control in winter cereals. Consider beneficial presence or activity before making spray decisions.
- Consider aphid-active seed treatments for use in barley or areas with consistently higher aphid pressure.⁶

7.2.2 Seed dressings

Prophylactic seed dressings may be effective in delaying the build-up of aphid populations in a crop, but because aphids are sporadic (not occurring every season), it can be difficult to decide whether a seed dressing is warranted. A locally wet summer and

⁴ DAFF (2012) Insect pest management in winter cereals. Department of Agriculture, Fisheries and Forestry Queensland, <http://www.daff.qld.gov.au/plants/field-crops-and-pastures/broadacre-field-crops/integrated-pest-management/ipm-information-by-crop/insect-pest-management-in-winter-cereals>

⁵ M Miles (2012) Making a decision about control of aphids in winter cereals. Queensland Government, *The Beatsheet*, <http://thebeatsheet.com.au/winter-cereals/making-a-decision-about-control-of-aphids-in-winter-cereals/>

⁶ NGA (2011) Aphid management in winter cereals 2009-2010. Results in a Nutshell. Northern Grower Alliance, <http://www.nga.org.au/module/documents/download/79>

More information

GRDC Fact Sheet:
http://www.grdc.com.au/uploads/documents/GRDC_FS_CerealAphids1.pdf

autumn is generally a precursor to an aphid outbreak, as there are abundant alternative hosts to breed on.⁷

7.2.3 Natural enemies

Delay any planned chemical control if rain is forecast, and check again after rain as intense rainfalls can reduce aphid infestations by dislodging aphids from the plants. Foliar insecticides registered for aphid control are generally broad-spectrum, meaning they kill natural enemies (beneficial insects such as [ladybird beetles](#) and larvae, [hover fly](#) larvae, [lacewing](#) larvae or [parasitic wasps](#)) as well as aphids. Preserving natural enemies is important in managing aphid populations in the long term. Natural enemies can exert effective control on small to moderate aphid infestations. Large populations of aphid can also be controlled, but often not until the crop is maturing, which may be too late to prevent impact on yield. Natural enemies can also be effective in suppressing aphids that survive post-treatment, preventing the need for subsequent treatments.⁸

More information

GRDC Beneficial insects
Back Paddock Guide
<http://www.grdc.com.au/BPG-BeneficialInsects-North>



Figure 2: Preserving natural enemies is important in managing aphid populations in the long term. (Source: QDAFF)

⁷ DAFF (2012) Insect pest management in winter cereals. Department of Agriculture, Fisheries and Forestry Queensland, <http://www.daff.qld.gov.au/plants/field-crops-and-pastures/broadacre-field-crops/integrated-pest-management/ipm-information-by-crop/insect-pest-management-in-winter-cereals>

⁸ DAFF (2012) Insect pest management in winter cereals. Department of Agriculture, Fisheries and Forestry Queensland, <http://www.daff.qld.gov.au/plants/field-crops-and-pastures/broadacre-field-crops/integrated-pest-management/ipm-information-by-crop/insect-pest-management-in-winter-cereals>

7.2.4 Oat or wheat aphid (*Rhopalosiphum padi*)

Oat or wheat aphid (Figure 3) is one of the most common aphid-infesting winter cereals. Typically, this species colonises the base and lower portions of the plant.⁹



Figure 3: Oat or wheat aphid (Source: QDAFF)

Table 2: Oat or wheat aphid management summary¹⁰

Scientific name	<i>Rhopalosiphum padi</i>
Description	Adults are 2 mm long, olive-green to black with a red rust patch at the rear end and may have wings. Antennae extend to half the body length. Nymphs are similar but smaller. Wheat and oat aphids are very similar to corn aphids
Distribution	An introduced species found in all states of Australia
Crops attacked	Barley, wheat and oats
Life cycle	A species that produces many generations through the growing season. Winged and non-winged forms occur
Damage	Aphids feed directly on stems, leaves and heads, and in high densities cause yield losses and plants may appear generally unthrifty. This type of damage is rare throughout the grainbelt. Aphids can spread BYDV in wheat and barley
Monitoring and action level	Aphids can affect any crop stage but are unlikely to cause economic damage to cereal crops expected to yield <3 t/ha. Consider treatment if there are 10–20+ aphids on 50% of the tillers
Control	Chemical control: Apply a foliar insecticide in late winter or spring to avoid direct damage to tillers and heads. To prevent losses from BYDV in virus-prone areas, control aphids early in the cropping year. For current chemical control options see Pest Genie or APVMA . Cultural control: There are no known effective cultural control methods
Host-plant resistance	In virus-prone areas, use resistant plant varieties to minimise losses due to BYDV
Natural enemies	Predation by hoverflies, lacewings and ladybeetles and parasitism by wasps can reduce aphid populations, but this does not happen in every season. Heavy rain may reduce aphid populations significantly

⁹ DAFF (2012) Insect pest management in winter cereals. Department of Agriculture, Fisheries and Forestry Queensland, <http://www.daff.qld.gov.au/plants/field-crops-and-pastures/broadacre-field-crops/integrated-pest-management/ipm-information-by-crop/insect-pest-management-in-winter-cereals>

¹⁰ DAFF (2011) Oat aphid, wheat aphid. Department of Agriculture, Fisheries and Forestry Queensland, <http://www.daff.qld.gov.au/plants/field-crops-and-pastures/broadacre-field-crops/integrated-pest-management/a-z-insect-pest-list/aphid-overview/oat-aphid.-wheat-aphid>

7.2.5 Corn aphid (*Rhopalosiphum maidis*)

Corn aphid (Figure 4) is also a common species found in winter cereals. It generally colonises the upper parts of the plant, particularly the rolled up terminal leaf.¹¹



Figure 4: Corn aphid (Source: QDAFF)

Table 3: Corn aphid management summary¹²

Scientific name	<i>Rhopalosiphum maidis</i>
Description	Up to 2 mm long, light to dark olive-green with a purple area at the base of small tube-like projections at the rear of the body. Adults are generally wingless. Antennae extend to about a third of body length. Nymphs are similar, but smaller in size
Similar species	Other species of aphids
Distribution	An introduced species, probably Asiatic in origin, found in all states of Australia
Crops attacked	Sorghum, maize, winter cereals and many grasses. Life cycle on sorghum: Corn aphids breed throughout the summer on sorghum with a life cycle of about 1 week. There can be up to 13 generations on a sorghum crop and 30 generations/year. Life cycle on cereals: A parthenogenetic species that undergoes many generations through the growing season. Both winged and non-winged forms occur

¹¹ DAFF (2012) Insect pest management in winter cereals. Department of Agriculture, Fisheries and Forestry Queensland, <http://www.daff.qld.gov.au/plants/field-crops-and-pastures/broadacre-field-crops/integrated-pest-management/ipm-information-by-crop/insect-pest-management-in-winter-cereals>

¹² DAFF (2010) Corn aphid. Department of Agriculture, Fisheries and Forestry Queensland, <http://www.daff.qld.gov.au/plants/field-crops-and-pastures/broadacre-field-crops/integrated-pest-management/a-z-insect-pest-list/aphid-overview/corn-aphid>

Damage	<p>In sorghum: Adults and nymphs suck sap and produce honeydew. Very high numbers may turn plants yellow. High populations on heads produce sticky grain and clog harvesters. Rain will readily remove honeydew. Water-stressed dryland crops lose yield.</p> <p>In cereal: Aphids feed on stems, leaves and heads, and in high densities cause yield losses. However, this type of damage is uncommon throughout the cereal belt.</p> <p>Risk period: In sorghum: All stages of the crop are attacked, but the most serious damage occurs when high populations infest heads.</p> <p>In cereals: Most prevalent on cereals in late winter and early spring. High numbers often occur in years when an early break in the season and mild weather in autumn and early winter provide favourable conditions for colonisation and multiplication</p>
Monitoring	Estimate percentage of plants infested and percentage of leaf area covered by aphids
Action level	<p>The action level in the vegetative stage of sorghum is 100% of plants with 80% of the leaf area covered by aphids. On the heads it is 75% of heads with 50% of the head covered by aphids.</p> <p>Aphids are unlikely to cause economic damage to cereal crops expected to yield <3 t/ha. To avoid damage by direct feeding, consider treatment if there are ≥ 10–20 aphids on 50% of the tillers</p>
Chemical control	<p>Chemical control is cost-effective. See Pest Genie or APVMA for current control options.</p> <p>Conservation of natural enemies: A range of parasitoids and predators will help reduce aphid populations. Predators of aphids include: ladybird larvae, damsel bugs, big-eyed bugs and the larvae of green lacewings and hoverflies. Wasp parasitoids mummify and kill aphids</p>
Host plant resistance	In sorghum, hybrids with open heads are less infested than tight-headed hybrids

7.2.6 Rose-grain aphid (*Metopolophium dirhodum*)

[Rose-grain aphid](#) (Figure 5) generally colonises the undersides of the leaves, high in the canopy.¹³



Figure 5: Rose-grain aphid (Source: QDAFF)

¹³ DAFF (2012) Insect pest management in winter cereals. Department of Agriculture, Fisheries and Forestry Queensland, <http://www.daff.qld.gov.au/plants/field-crops-and-pastures/broadacre-field-crops/integrated-pest-management/ipm-information-by-crop/insect-pest-management-in-winter-cereals>

Table 4: Rose-grain aphid management summary ¹⁴

Scientific name	<i>Metopolophium dirhodum</i>
Description	Adults are 3 mm long, green to yellow-green with long and pale siphunculi (tube-like projections on either side at the rear of the body) and may have wings. There is a dark green stripe down the middle of the back. Antennae reach beyond the base of the siphunculi. Nymphs are similar but smaller in size
Similar species	Because of its distinctive colour, it is unlikely to be confused with other aphids
Distribution	An introduced species that has been recorded in New South Wales, Queensland, South Australia, Tasmania and Victoria
Crops attacked	Wheat, barley, triticale, oats
Life cycle	Undergoes many generations during the growing season; winged and non-winged forms occur
Damage	Adults and nymphs are sap-suckers. Under heavy infestations, plant may turn yellow and appear unthrifty. Can spread BYDV in wheat and barley
Monitoring and action level	Can affect any crop stage; assess the potential for direct-feeding damage in late winter. Estimate the number of aphids per tiller. Aphids are unlikely to cause economic damage to cereal crops expected to yield <3 t/ha
Control	<p>Chemical control: Apply a foliar insecticide in late winter or spring to avoid damage to tillers. To prevent losses from BYDV in virus-prone areas, control aphids early in the cropping year. For current chemical control options see Pest Genie or APVMA</p> <p>Cultural control: There are no known effective cultural control methods for this aphid</p>
Natural enemies	Predation by hoverflies , lacewings and ladybird beetles , parasitism by wasps and heavy rainfall can reduce aphid populations

¹⁴ DAFF (2011) Rose-grain aphid. Department of Agriculture, Fisheries and Forestry Queensland, <http://www.daff.qld.gov.au/plants/field-crops-and-pastures/broadacre-field-crops/integrated-pest-management/a-z-insect-pest-list/aphid-overview/rose-grain-aphid>

7.2.7 Rice root aphid (*Rhopalosiphum rufiabdominalis*)

Rice root aphid (Figure 6) colonises the roots of the plants under the soil surface, and colonies may extend up from the roots to the base of the plant. Rice root aphid can be quite abundant on below-ground parts of winter cereals, but are more noticeable during periods of moisture stress.¹⁵



Figure 6: Rice root aphid (Source: QDAFF)

Table 5: Rice root aphid management summary¹⁶

Scientific name	<i>Rhopalosiphum rufiabdominalis</i>
Description	Fully grown aphids are 1.2–2.2 mm long and dark green to grey-brown in colour. Nymphs are lighter in colour with a reddish area at the tip of the abdomen
Damage	Rice root aphids suck fluids from the plant roots, but only do so when the bases of plants are exposed
Control	Cannot be controlled using contact insecticides because of their below-ground location on plants. Seed dressings may be effective

¹⁵ DAFF (2012) Insect pest management in winter cereals. Department of Agriculture, Fisheries and Forestry Queensland, <http://www.daff.qld.gov.au/plants/field-crops-and-pastures/broadacre-field-crops/integrated-pest-management/ipm-information-by-crop/insect-pest-management-in-winter-cereals>

¹⁶ DAFF (2010) Rice root aphid. Department of Agriculture, Fisheries and Forestry Queensland, <http://www.daff.qld.gov.au/plants/field-crops-and-pastures/broadacre-field-crops/integrated-pest-management/a-z-insect-pest-list/aphid-overview/rice-root-aphid>

7.3 Armyworm

Armyworm (Figure 7) is the caterpillar stage of certain moths, and can occur in large numbers, especially after good rain following a dry period. Larvae shelter in the throats of plants or in the soil and emerge after sunset to feed on the leaves of all winter cereals, particularly barley and oats, generally during September and October. Leafy cereal plants can tolerate considerable feeding, and control in the vegetative stage is seldom warranted unless large numbers of armyworms are distributed throughout the crop or are moving in a 'front', destroying young seedlings or completely stripping older plants of leaf. The most serious damage occurs when larvae feed on the upper flag leaf and stem node as the crop matures, or in barley when the older larvae start feeding on the green stem just below the head as the crop matures.



Figure 7: Armyworm (Source: QDAFF)

The most common species are [common and northern armyworm](#) (*Leucania convecta* and *L. separata*), and [lawn armyworm](#) (*Spodoptera mauritia*). Infestations are evident by scalloping on margins of leaves caused by feeding of the older larvae. Larvae target the stem node as the leaves become dry and unpalatable, and the stem is often the last part of the plant to dry. One large larva can sever up to seven heads of barley a day. One larva/m² can cause a grain loss of 70 kg/ha.day (Table 6). A larva takes around 8–10 days to develop through the final, most damaging instars, with crops susceptible to maximum damage for this period (Table 7).

Check for larvae on the plant and in the soil litter under the plant. The best time to do this is late in the day when armyworms are most active. Alternatively, look around the base of damaged plants where the larvae may be sheltering in the soil during the day. Using a sweep net (or swing a bucket), check a number of sites throughout the paddock. Sweep sampling is particularly useful early in an infestation when larvae are small and actively feeding in the canopy. One full sweep with a net samples the equivalent of 1 m² of crop.

Table 6: The value of yield loss incurred by armyworm larvae (1 or 2/m².day), based on approximate values for wheat and an estimated loss per larva of 70 kg/ha. Based on these figures, and the relatively low cost of controlling armyworm, populations in ripening crops of >1 large larva/m² warrant spraying

Value of grain (AU\$/t)	Value of yield loss (\$) per day	
	1 larva/m ²	2 larvae/m ²
\$140	\$9.80	\$19.60
\$160	\$11.20	\$22.40
\$180	\$12.60	\$25.20
\$200	\$14.00	\$28.00
\$220	\$15.40	\$30.80
\$250	\$17.50	\$35.00
\$300	\$21.00	\$42.00
\$350	\$24.50	\$49.00
\$400	\$28.00	\$56.00

Early recognition of the problem is vital, as cereal crops can be almost destroyed by armyworm in just a few days. Although large larvae do the head lopping, controlling smaller larvae that are still leaf-feeding may be more achievable. Prior to chemical intervention, consider how quickly the larvae will reach damaging size, and the development stage of the crops. Small larvae take 8–10 days to reach a size capable of head-lobbing, so if small larvae are found in crops nearing full maturity/harvest, spray may not be needed, whereas small larvae in late crops that are still green and at early seed-fill may reach a damaging size in time to reduce crop yield significantly.

Control is warranted if the armyworm population distributed throughout the crop is likely to cause the loss of 7–15 heads/m². Many chemicals will control armyworms. However, their effectiveness often depends on good penetration into the crop to achieve contact with the caterpillars. Control may be more difficult in high-yielding, thick-canopied crops, particularly when larvae are resting under soil at the base of plants. As larvae are most active at night, spraying in the afternoon or evening may produce the best results. If applying sprays close to harvest, be aware of relevant withholding periods.

Biological control agents may be important in some years. These include parasitic flies and wasps, predatory beetles and [diseases](#). Helicoverpa NPV (nucleopolyhedrovirus) is not effective against armyworm.¹⁷

¹⁷ DAFF (2012) Insect pest management in winter cereals. Department of Agriculture, Fisheries and Forestry Queensland, <http://www.daff.qld.gov.au/plants/field-crops-and-pastures/broadacre-field-crops/integrated-pest-management/ipm-information-by-crop/insect-pest-management-in-winter-cereals>

Table 7: Armyworm management summary¹⁸

Scientific name	<p><i>Leucania convecta</i>—common armyworm</p> <p><i>L. separata</i>—northern armyworm</p> <p><i>L. stenographa</i>—sugarcane armyworm</p>
Description	<p>Common armyworm: First-instar larvae are about 1 mm long. From the second instar, stripes develop along the top and sides of the larva and become more distinct as the larva grows. Crowded larvae are usually darker than uncrowded. The mature larva grows up to 40 mm in length and has three characteristic pale stripes on the head, collar (segment behind the head) and tail segment. They are smooth-bodied with no distinct hairs. The body of the larva also has lateral stripes. The forewings of the moth have a wingspan of about 40 mm and are fawn or buff coloured.</p> <p>Northern armyworm: Larvae and adults are very similar to the common armyworm.</p> <p>Sugarcane armyworm: Moths have pale forewings with a dark line running the length of the forewing</p>
Similar species	Adults of the common and northern armyworms may be confused. Genitalia dissections by a specialist are required to separate the species. The larval stages likely to be encountered in cereals are all similar in appearance
Distribution	<p>Common armyworm: Native Australian species, recorded in New South Wales, Queensland, South Australia, Tasmania, Victoria and Western Australia.</p> <p>Northern armyworm: Throughout South-East Asia, New Zealand and in Australia, where it occurs in all states except Tasmania.</p> <p>Sugarcane armyworm: Recorded from Asia and Australia, where it occurs throughout drier parts of the mainland and as an occasional vagrant to Tasmania</p>
Crops attacked	<p>Common armyworm: Damages barley, oats, wheat, native pasture grasses and perennial grass seed crops.</p> <p>Northern armyworm: In Queensland, recorded as damaging sorghum, maize, barley, wheat and rice.</p> <p>Sugarcane armyworm: A minor pest, occasionally damaging some WA grain crops</p>
Life cycle	<p>Common armyworms have three generations per year. The winter and spring generations damage cereals. Moths fly into cereal crops and lay their eggs in the folds of dried or drying leaves on grasses or cereals. Females lay up to 1000 eggs in irregularly shaped masses, cemented in tight folds of foliage. Eggs hatch in as little as 3–4 days after laying and young larvae, with the assistance of wind, disperse through the crop on fine silken threads. The larvae feed on leaves and stems. Larvae usually develop through six instars but sometimes seven. Indicative development times at constant temperature are: egg-laying to hatch, 7 days at 20°C and 2.5 days at 30°C; larval stages (including pre-pupal stage) 34.2 days at 20°C and 17.2 days at 30°C. Larvae pupate in the soil. Pupal stage lasts 20.1 days at 20°C and 10.1 days at 30°C. Development time from neonate to adult emergence is 61 days at 20°C and 41 days at 30°C (Smith 1984).</p> <p>Northern and sugarcane armyworms—similar to common armyworm</p>

¹⁸ DAFF (2010) Common, northern and sugarcane armyworms. Department of Agriculture, Fisheries and Forestry Queensland, <http://www.daff.qld.gov.au/plants/field-crops-and-pastures/broadacre-field-crops/integrated-pest-management/a-z-insect-pest-list/armyworm-overview/common,-northern-and-sugarcane-armyworms>

Risk period and damage	<p>Risk period: The greatest risk to cereals is spring. Moth flights occur in September and October, and the later-stage larvae damage cereals often in the weeks prior to harvest. The mature larval stages of the winter generation will sometimes march in cereal crops in late winter and cause serious damage to crops, particularly on the edges of paddocks. Crops directly seeded into standing stubbles are susceptible to severe defoliation during the vegetative stage as the winter generation matures.</p>
	<p>Damage: There are two distinct periods for economic damage. The first, defoliation during early vegetative development, is less common than the second through ripening. Ripening barley is most susceptible to armyworm damage because the last part of the head to dry off is the green tissue just below the head. Mature larvae feed on that area and thereby sever the head of the cereal, which falls to the ground. One larva can lop many heads very quickly causing large grain losses. Oats are also damaged but the less compact seed head means less damage. In northern Australia, wheat can also be damaged, but in the south the wheat head stays green later and armyworms feed along the heads and damage grain rather than excise the whole head</p>
Monitoring and action level	<p>Large numbers of armyworm moths are attracted to farm lights on warm nights in September and October. This provides the first warning of potential problems in cereals. Armyworm larvae are difficult to find in cereal crops as they hide at the base of plants or under clods of soil during the day. Search at the base of plants and under clods of soil to estimate the number of larvae per m². Presence of green-yellow pellet-shaped droppings of the larvae on the ground is usually a reliable sign of larvae. Monitor for larvae at dusk with a sweep net; sweep netting during the day can be unreliable.</p> <p>Two larvae/m² for barley. Other cereals are likely to tolerate slightly higher numbers</p>
Control	<p>Chemical control: A range of insecticides is registered for armyworm control in cereals. Insecticides should target larvae 10–20 mm long. Larvae >20 mm long can be difficult to kill and may require higher rates of insecticide. If possible spray late in the day as larvae are active at night. See Pest Genie or APVMA for current control options.</p> <p>Cultural control: Windrowed or swathed crops dry out rapidly, rendering them unattractive to the feeding of armyworm larvae. They are also less susceptible to wind damage (head shattering)</p>
Natural enemies	<p>Armyworm larvae are attacked by a number of parasitoids that may be important in reducing the intensity of outbreaks. However, when armyworms are in numbers likely to cause damage, parasitoids are unlikely to give timely control. Predators include green carab beetles, populations of which increase dramatically in inland Australia in response to abundant noctuid larvae induced by favourable seasons. Other predators include the predatory shield bugs and perhaps common brown earwigs. Fungal diseases are recorded as causing mortality of armyworm</p>

7.4 *Helicoverpa* spp. (*Heliiothis*)

Helicoverpa spp. are frequently found in winter cereals, usually at levels too low to warrant control, but occasionally numbers may be sufficiently high to cause economic damage. Virtually all *Helicoverpa* present are *H. armigera* (Figure 8), which has developed resistance to many of the older insecticide groups. It is not unusual to find both *Helicoverpa* and armyworm in cereal crops, so correct identification of the species present is important. *Helicoverpa* do not cause the typical head-cutting damage of armyworms. Larvae tend to graze on the exposed tips of a large number of developing grains, rather than totally consuming a low number of whole grains, thus increasing the potential losses. Most (80–90%) of the feeding and crop damage is done by larger larva (the final two instars).



Figure 8: *Helicoverpa armigera* (Source: QDAFF)

Check for larvae on the plant throughout the growing season (monitoring can be done in conjunction with sampling for armyworm). Using a sweep net, check a number of sites throughout the paddock (read more about [insect sampling methods](#) below, under heading 1.6.3). Larger larvae are more difficult to control than small larvae, and NPV is most effective when larvae <13 mm long are targeted.

No thresholds have been developed for *Helicoverpa* in winter cereals; however, using a consumption rate determined for *Helicoverpa* feeding in sorghum (2.4 g/larva), one larvae/m² can cause 24 kg grain loss/ha. Table 8 shows the value of yield loss incurred by a range of larval densities, using an estimated consumption of 2.4 g/larvae and a range of grain values for wheat. Note that larval damage is irrespective of the crops yield potential (i.e. each larva will eat its fill whether it is 1 t/ha crop or a 3 t/ha crop).

Table 8: Value of yield loss (\$/ha) incurred by a range of *Helicoverpa* larval densities

Cereal price (\$/t)	Larval density			
	4 larvae/m ²	6 larvae/m ²	8 larvae/m ²	10 larvae/m ²
150	14.4	21.6	28.8	36
200	19.2	28.8	38.4	48
250	24.0	36.0	48.0	60
300	28.8	43.2	57.6	72
350	33.6	50.4	67.2	84
400	38.4	57.6	76.8	96
450	43.2	64.8	86.4	108

Based on Table 8, a crop worth \$250/t will incur a loss of \$6/ha from each larvae. If chemical intervention costs \$30/ha (chemical + application costs), the economic threshold or break-even point is 5 larvae/m². These parameters can be varied to suit individual costs, and they can incorporate a working benefit/cost ratio. A common benefit/cost ratio of 1.5 means that the projected economic benefit of the spray will be 1.5 times the cost of the spray. Spraying at the break-even point (benefit/cost ratio of 1) is not recommended.

Small larvae (<7 mm) can be controlled with biopesticides (e.g. [NPV](#)) (see Table 9 for management summary). Biopesticides are not effective on larger larvae. *Helicoverpa armigera* has historically had high resistance to pyrethroids, and control of medium-large larvae using pyrethroids is not recommended. Predators of *Helicoverpa* eggs and larvae include [spined predatory bug](#), [glossy shield bug](#), [damsel bug](#) and [big-eyed bug](#).

Where winter cereals have previously been treated with broad spectrum insecticides to control aphids, fewer natural enemies may be present and survival of caterpillar pests could be greater than in an untreated field.¹⁹

Table 9: Management summary for *Helicoverpa*²⁰

Scientific name	<i>Helicoverpa armigera</i> (cotton bollworm or corn earworm) and <i>H. punctigera</i> (native budworm)
Identification	<p>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.</p> <p>Medium larvae develop lines and bands running the length of the body and are variable in colour. <i>H. armigera</i> have a saddle of darker pigment on the fourth segment and at the back of the head and dark-coloured legs. <i>H. punctigera</i> have no saddle and light-coloured legs.</p> <p>Large larvae of <i>H. armigera</i> have white hairs around the head; <i>H. punctigera</i> have black hairs around the head.</p> <p>Pupae are found in soil underneath the crop. Healthy pupae wriggle violently when touched. <i>H. armigera</i> pupal tail spines are more widely spaced than those of <i>H. punctigera</i></p> <p>Moths are a dull light brown with dark markings and are 35 mm long. <i>H. armigera</i> has a small light or pale patch in the dark section of the hindwing, while the dark section is uniform in <i>H. punctigera</i>. Forewings are brown in the female and cream in the male</p>

¹⁹ DAFF (2012) Insect pest management in winter cereals. Department of Agriculture, Fisheries and Forestry Queensland, <http://www.daff.qld.gov.au/plants/field-crops-and-pastures/broadacre-field-crops/integrated-pest-management/ipm-information-by-crop/insect-pest-management-in-winter-cereals>

²⁰ DAFF (2012) *Helicoverpa* species. Department of Agriculture, Fisheries and Forestry Queensland, <http://www.daff.qld.gov.au/plants/field-crops-and-pastures/broadacre-field-crops/integrated-pest-management/a-z-insect-pest-list/helicoverpa/helicoverpa-species>

Similar species	Commonly confused species include armyworms and loopers. <i>Helicoverpa</i> larvae have a group of four pairs of 'legs' in the back half of the body, whereas loopers can have a group of two, three or four pairs of legs at the rear and loop when walking. Armyworms also have four pairs of prolegs, but are smoother and fatter, with more coloured bands than <i>Helicoverpa</i>
Life cycle	<i>H. armigera</i> and <i>H. punctigera</i> take about 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 time females lay 1000 eggs. Read more about Helicoverpa life cycle and behaviour
Crops attacked	The two <i>Helicoverpa</i> species prefer different hosts: <i>H. punctigera</i> attacks broadleaf species (e.g. cotton, chickpea, sunflower, soybean, mungbean, navy bean, lucerne, canola, peanut, faba bean, safflower, linseed, azuki bean). It is not found on grass or cereal crops, such as wheat, barley, sorghum or maize. <i>H. armigera</i> 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	<i>Helicoverpa</i> 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 only need to be monitored closely from budding/flowering through to maturity. Eggs are most commonly laid on the top third of the plant and growing points
Management	To manage <i>H. armigera</i> and <i>H. punctigera</i> well, it is important to understand the basic differences between the two species. IPM strategies incorporating chemical, cultural and biological methods aim to restrict populations to below damaging levels. <i>H. armigera</i> has developed resistance to a wide range of insecticides; however, several products are now registered for both species that have reduced impacts on natural enemies in the crop. Larvae are best targeted when smaller than 7 mm. Read more about key principles of <i>Helicoverpa</i> management
Natural enemies	All stages of the <i>Helicoverpa</i> lifecycle 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 prevent/minimise the need for insecticide treatments. Read more about Helicoverpa's natural enemies

7.5 Mites

7.5.1 Brown wheat mite (*Petrobia latens*)

Brown wheat mite (Figure 9) damage is severe only in dry seasons.

The mature wheat mite is about the size of a pinhead, globe-shaped and brown. It has been a sporadic pest of winter cereals (Table 10). Populations reach troublesome levels only under very dry conditions.



Figure 9: Brown wheat mite (Source: QDAFF)

Table 10: Management summary of brown wheat mite

Scientific name	<i>Petrobia latens</i>
Description	Adults are oval, up to 0.6 mm long and have eight legs. The front legs are significantly longer than the others. The mite is brown and appears dark greenish-brown to black when on a green leaf. It is significantly smaller than, and has finer legs than, the blue oat mite. Immature mites are smaller and orange-red
Similar species	A very small mite that is unlikely to be confused with the blue oat mite or redlegged earth mite
Crops attacked	Wheat, barley, triticale, oats, cotton and grasses. Crops are at risk during warm, dry periods
Damage	Adults and nymphs pierce and suck on leaves, resulting in a mottled and 'drought-like' appearance. Crops with heavy infestations appear bronzed or yellowish and seedlings can die
Monitor	Check from planting to early vegetative stage, particularly in dry seasons
Action level	Spray if mottled patches appear throughout the crop and if conditions are dry
Chemical control	Foliar treatments may sometimes be cost-effective. For current chemical control options see Pest Genie or APVMA
Natural enemies	No natural enemies recorded

7.5.2 Blue oat mite (*Penthaleus* spp.)

Blue oat mites (Figure 10) are important pests of seedling winter cereals, but are generally restricted to cooler grain-growing regions (southern Queensland through eastern New South Wales, Victoria, South Australia and southern Western Australia).



Figure 10: Blue oat mite (Source: QDAFF)

Adults and nymph mites pierce and suck leaves, resulting in silvering of the leaf tips. Feeding causes a fine mottling of the leaves, similar to the effects of drought. Heavily infested crops may have a bronzed appearance, and severe infestations cause leaf tips to wither and can lead to seedling death. Damage is most likely during dry seasons when mites in large numbers heighten moisture stress and control may be warranted in this situation.

Check from planting to early vegetative stage, particularly in dry seasons, monitoring a number of sites throughout the field (Table 11). Blue oat mites are most easily seen in the cooler part of the day, or when it is cloudy. They shelter on the soil surface when conditions are warm and sunny. If pale-green or greyish irregular patches appear in the crop, check for the presence of blue oat mite at the leaf base.

Where warranted, foliar application of registered insecticide may be cost-effective. Check the most recent research to determine the likely susceptibility of blue oat mite to the available registered products. Cultural control methods can contribute to reduction in the size of the autumn mite population (e.g. cultivation, burning, controlling weed hosts in fallow, grazing and maintenance of predator populations). Since eggs laid in the soil hibernate throughout winter, populations of the mite can build up over a number of years and cause severe damage if crop rotation is not practiced. The use of control tactics solely in spring will not prevent the carry-over of eggs into the following autumn.

Predators of blue oat mites include **spiders**, ants, predatory beetles and the predatory anystis mite and snout mite. Blue oat mites are also susceptible to infection by a fungal pathogen (*Neozygites acaracida*), particularly in wet seasons.²¹

The blue oat mite is an important pest of seedling winter cereals. When infestations are severe, the leaf tips wither and eventually the seedlings die. Eggs laid in the soil hibernate over winter, allowing populations to build up over a number of years. This can cause severe damage if crop rotation is not practiced.

²¹ DAFF (2012) Insect pest management in winter cereals. Department of Agriculture, Fisheries and Forestry Queensland, <http://www.daff.qld.gov.au/plants/field-crops-and-pastures/broadacre-field-crops/integrated-pest-management/ipm-information-by-crop/insect-pest-management-in-winter-cereals>

Table 11: Management summary of blue oat mite²²

Scientific name	<i>Penthaleus major</i>
Description	Adults are 1 mm long and have eight legs. Adults and nymphs have a purplish-blue, rounded body with red legs. They move quickly when disturbed. The presence of a small red area on the back distinguishes it from the redlegged earth mite
Similar species	Brown wheat mite , redlegged earth mite
Crops attacked	Mainly a pest of cereals and grass pastures, but will feed on pasture legumes and many weeds
Damage	Adults and nymphs pierce and suck on leaves resulting in silvering of the leaf tips in cereals. When heavy infestations occur, the leaf tip withers and the seedling can die. In canola, leaves are mottled or whitened in appearance
Monitor	Check from planting to early vegetative stage, particularly in dry seasons. Most easily seen in the late afternoon when they begin feeding on the leaves
Control	Foliar applications of insecticides may be cost-effective if applied within 2–3 weeks of emergence in autumn. The use of control tactics solely in spring will not prevent the carry-over of eggs into the following autumn. For current chemical control options see Pest Genie or APVMA
Natural enemies	Thrips and ladybirds

7.5.3 Redlegged earth mites *Halotydeus destructor*

Characteristics and management of redlegged earth mites (Figure 11) are summarised in Table 12.

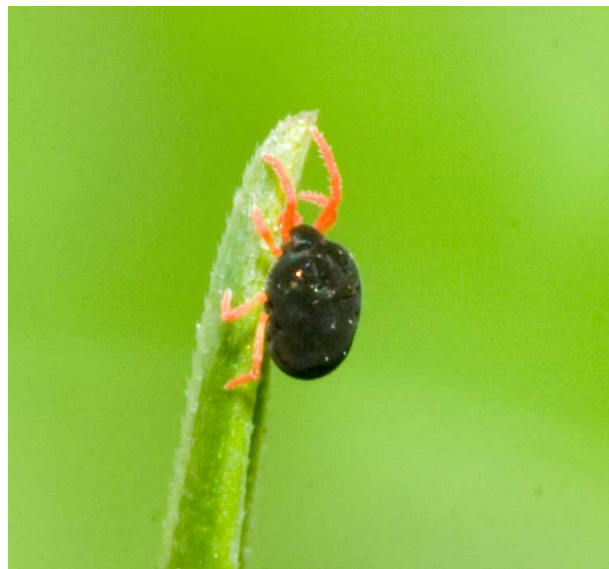


Figure 11: Adult redlegged earth mites (Source: CESAR)

Table 12: Management summary of redlegged earth mite

Scientific name	<i>Halotydeus destructor</i>
Description	Adults are 1 mm long and have eight legs. Adults and nymphs have a black, somewhat flattened body and red legs
Similar species	Similar in appearance to blue oat mite; however, blue oat mite can be distinguished by a small oval red area in the middle of the back
Distribution	Originated in South Africa, now found in New Zealand and Australia. The redlegged earth mite is widely distributed in winter rainfall dominant regions of southern Australia

²² DAFF (2010) Blue oat mite. Department of Agriculture, Fisheries and Forestry Queensland, <http://www.daff.qld.gov.au/plants/field-crops-and-pastures/broadacre-field-crops/integrated-pest-management/a-z-insect-pest-list/mites-overview/blue-oat-mite>

Pest status	Major, widespread, regular, in southern Australia
Crops attacked	Damages all field crops and pastures, especially at seedling stage. A major pest of legume pastures and canola
Damage	Adults and nymphs feeding cause a silver or white discoloration of leaves and distortion of leaf shape. Affected seedlings can die. Seedlings can be killed before emergence. There is also reduced production and quality of older green plants during the growing season and reduced seed yield of legumes in spring
Risk period	Autumn to spring, especially at germination
Life cycle	<p>On winter rainfall pastures: The redlegged earth mite is active in the cool, wet months from May to November. They hatch in autumn at the break of the season, from over-summering eggs that have been in a state of arrested development (diapause) since the end of the previous spring. Hatching is triggered by a significant rainfall event combined with a period of 7–10 days where the mean daily maximum temperature is <21°C</p> <p>Eggs hatch into six-legged larvae and then develop through three nymphal stages into adults. Nymphs and adults have eight legs. During winter, the redlegged earth mite passes through three generations on average, each lasting about 8 weeks. When conditions are favourable, numbers can increase rapidly, with peaks in autumn and/or spring</p>
Monitoring	Monitor pastures regularly from the time of first emergence of seedlings. Approach quietly as mites will disperse quickly if disturbed. If mites are not found on the plants, look carefully at the soil surface. A hand lens will be required to detect newly hatched larvae and young nymphs
Action level	Any sign of mite activity or damage at germination warrants control. At other times of the season, feeding damage to more than 20% of the leaf area may warrant control
Control	<p>Chemical control: Treating seed with systemic insecticide before sowing pastures protects seedlings from attack. Chemical sprays do not kill mite eggs so it is important to time sprays when most mites have emerged. Spraying should be timed for autumn or spring. In autumn, chemicals should be applied after the break of season, and after all of the over-summering eggs have hatched but before adult mites start laying eggs. For current chemical control options see APVMA</p> <p>Cultural control: Heavy grazing in winter and spring reduces mite populations. Control of broadleaf weeds in summer can reduce mite populations in autumn.</p> <p>Natural enemies: A predatory mite, <i>Anystis wallacei</i>, was imported from France to Australia in 1965 for biological control and has established at some sites where it has caused significant mortality of redlegged earth mites. Its effectiveness is limited by its slow dispersal</p>

More information

GRDC Insect ID App:
<https://itunes.apple.com/au/app/insect-id-ute-guide-tablet/id667854493?mt=8>

7.6 Insect monitoring techniques for field crops

Monitoring for insects is an essential part of successful integrated pest management programs. Correct identification of immature and adult stages of both pests and beneficials, and accurate assessment of their presence in the field at various crop stages, will ensure appropriate and timely management decisions. Good monitoring procedure involves not just knowledge of, and the ability to identify, the insects present, but also good sampling and recording techniques and a healthy dose of common sense.

7.6.1 Factors that contribute to quality monitoring

Knowledge of likely pests/beneficials and their life cycles is essential when planning a monitoring program. As well as visual identification, you need to know where on the plant to look and the best time of day to get a representative sample.

Monitoring frequency and pest focus should be directed at crop stages likely to incur economic damage. Critical stages may include seedling emergence and flowering/grain formation.

Sampling technique is important to ensure that a representative portion of the crop has been monitored, since pest activity is often patchy. Defining sampling parameters (e.g. number of samples per paddock and number of leaves per sample) helps sampling consistency. Actual sampling technique, including sample size and number, will depend

on crop type, age and paddock size, and is often a compromise between the ideal number and location of samples, and what is practical considering time constraints and distance covered.

Random sampling should be balanced with areas of obvious damage. Random sampling aims to give an overall picture of what is happening in the field, but any obvious hot-spots should also be investigated. The relative proportion of hotspots in a field must be kept in perspective with less heavily infested areas.

Site: *Cameron's*
 Date: *15/9/06*
 Row spacing: *75cm*

Sample (1 m row beat)	VS	S	M	L
1	8	5	1	0
2	1	1	1	0
3	3	3	0	1
4	3	2	1	0
5	2	6	0	0
Average		3.4	0.6	0.2
Adjust for 30% mortality (S*0.7)	$3.4 \times 0.7 = 2.4$			
Mean estimate of larval number (Adjusted S)+M+L	$2.4 + 0.6 + 0.2 = 3.2$			
Adjust for row spacing divide by row spacing (m)	$\frac{3.2}{0.75}$	4.2 Density Estimate per square metre		

Figure 12: An example of a field check sheet for chickpeas, showing adjustments for field mortality and row spacings.

7.6.2 Keeping good records

Accurately recording the results of sampling is critical for good decision making and being able to review the success of control measures (Figure 12). Monitoring record sheets should show the following:

- numbers and types of insects found (including details of adults and immature stages)
- size of insects (particularly important for larvae)
- date and time
- crop stage and any other relevant information (e.g. row spacings, weather conditions, and general crop observations)

Consider putting the data collected into a visual form that enables you to see trends in pest numbers and plant condition over time. Being able to see whether an insect population is increasing, static or decreasing can be useful in deciding whether an insecticide treatment may be required, and if a treatment has been effective. If you have trouble identifying damage or insects present, keep samples or take Figuregraphs for later reference.

Records of spray operations should include:

- date and time of day
- conditions (wind speed, wind direction, temperature, presence of dew and humidity)
- product(s) used (including any additives)
- amount of product(s) and volume applied per hectare
- method of application including nozzle types and spray pressure
- any other relevant details

7.6.3 Sampling methods

Beat sheet

A beat sheet is the main tool used to sample row crops for pests and beneficial insects. Beat sheets are particularly effective for sampling caterpillars, bugs, aphids and mites. A standard beat sheet is made from yellow or white tarpaulin material with heavy dowel on each end. Beat sheets are generally 1.3–1.5 m wide and 1.5–2.0 m deep (the larger dimensions are preferred for taller crops). The extra width on each side catches insects thrown out sideways when sampling, and the sheet's depth allows it to be draped over the adjacent plant row. This prevents insects being flung through or escaping through this row.

To use the beat sheet, place one edge at the base of plants in the row to be sampled.

Drape the other end of the beat sheet over the adjacent row. This may be difficult in crops with wide row spacing (≥ 1 m); in this case, spread the sheet across the inter-row space and up against the base of the next row.

Using a 1-m stick, shake the plants in the sample row vigorously in the direction of the beat sheet 5–10 times. This will dislodge the insects from the sample row onto the beat sheet.

Reducing the number of beat sheet shakes per site greatly reduces sampling precision. The use of smaller beat sheets, such as small fertiliser bags, reduces sampling efficiency by as much as 50%.

Use the datasheets to record type, number and size of insects found on the beat sheet.

One beat does not equal one sample. The standard sample unit is five, non-consecutive 1-m-long sections of row, taken within a 20-m radius (i.e. 5 beats = 1 sample unit). This should be repeated at six locations in the field (i.e. 30 beats per field).

Increasing the number of samples taken increases the accuracy of the assessment of pest activity, particularly for pests that are patchily distributed, such as pod-sucking bug nymphs.

When is the best time to use the beat sheet?

Pulse crops are at greatest risk from insect attack from budding onwards.

Crops should be checked weekly during the vegetative stage and twice weekly from the start of budding onwards.

Caterpillar pests are not mobile within the canopy, and checking at any time of the day should report similar numbers.

Pod-sucking bugs, particularly green vegetable bugs, often bask on the top of the canopy during the early morning, and they are more easily seen at this time.

Some pod-sucking bugs, such as brown bean bugs, are more flighty in the middle of the day and therefore more difficult to detect when beat-sheet sampling. Other insects (e.g. mirid adults) are flighty no matter what time of day they are sampled, so it is important to count them first.

In very windy weather, bean bugs, mirids and other small insects are likely to be blown off the beat sheet.

Using the beat sheet to determine insect numbers is difficult when the field and plants are wet.

While the recommended method for sampling most insects is the beat sheet, visual checking in buds and terminal structures may also be needed to supplement beat-sheet counts of larvae and other, more minor pests. Visual sampling will also assist in finding eggs of pests and beneficial insects.

Most thresholds are expressed as pests per square metre (pests/m²). Hence, insect counts in crops with row spacing <1 m must be converted to pests/m². To do this,

divide the 'average insect count per row metre' across all sites by the row spacing (in metres). For example, in a crop with a row spacing of 0.75 m (75 cm), divide the average pest counts by 0.75.

Other sampling methods

Visual checking is not recommended as the sole form of insect checking; however, it has an important support role. Leaflets or flowers should be separated when looking for eggs or small larvae, and leaves checked for the presence of aphids and silverleaf whitefly. If required, dig below the soil surface to assess soil insect activity. Visual checking of plants in a crop is also important for estimating how the crop is progressing in terms of average growth stage, pod retention and other agronomic factors.

Sweep-net sampling is less efficient than beat-sheet sampling and can underestimate the abundance of pest insects present in the crop. Sweep netting can be used for flighty insects and is the easiest method for sampling mirids in broadacre crops or crops with narrow row spacing. It is also useful if the field is wet. Sweep netting works best for smaller pests found in the tops of smaller crops (e.g. mirids in mungbeans), is less efficient against larger pests such as pod-sucking bugs, and it is not practical in tall crops with a dense canopy such as coastal or irrigated soybeans. At least 20 sweeps must be taken along a single 20-m row.

Suction sampling is a quick and relatively easy way to sample for mirids. Its main drawbacks are unacceptably low sampling efficiency, a propensity to suck up flowers and bees, noisy operation, and high purchase cost of the suction machine.

Monitoring with traps (pheromone, volatile, and light traps) can provide general evidence on pest activity and the timing of peak egg-lay events for some species. However, it is no substitute for in-field monitoring of actual pest and beneficial numbers.²³

More information

GRDC Pestlinks:
<http://www.grdc.com.au/Resources/Links-Pages/PestLinks>

²³ DAFF (2012) Insect monitoring techniques for field crops. Department of Agriculture, Fisheries and Forestry Queensland, <http://www.daff.qld.gov.au/plants/field-crops-and-pastures/broadacre-field-crops/integrated-pest-management/help-pages/insect-monitoring>

