

BENEFICIALS –

Predators, parasitoids
and pathogens



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NORTHERN

**THE
BACK
POCKET
GUIDE**



White collared ladybird.

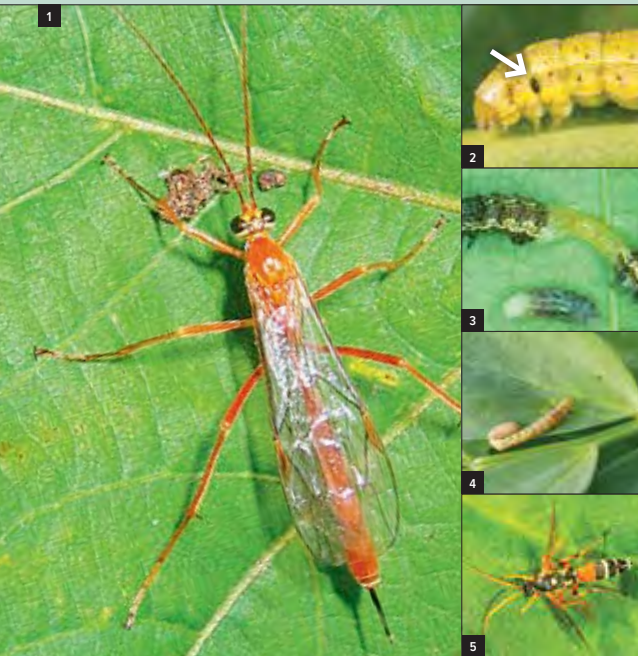
Ladybirds are probably the most recognisable and voracious natural enemy found in grain crops.

Natural enemies

Beneficial organisms in agricultural systems include natural enemies, pollinators and nutrient cyclers. Natural enemies play an important role in suppressing populations of many key pest species in grain crops.

Being able to identify the suite of natural enemies that are active in your crops is the first step in integrating them into your management decisions. The preservation of natural enemies, through the judicious and selective use of insecticides, is central to harnessing the contribution that they make to suppressing pest populations and, consequently, minimising crop loss.

This guide provides a snapshot of key natural enemies of pests commonly encountered in grain crops in the northern region. The photographs and identification information are designed to assist growers to include natural enemies in their day to day crop monitoring.



1. *Netelia* adult. 2. *Netelia* egg on *Helicoverpa punctigera* larva. 3. *Microplitis* larva removed from inside a *Helicoverpa* larva. 4. *Microplitis* cocoon attached to host larva. 5. Banded caterpillar parasite (*Ichneumon promissorius*).

Wasp parasitoids of caterpillars – solitary

Description

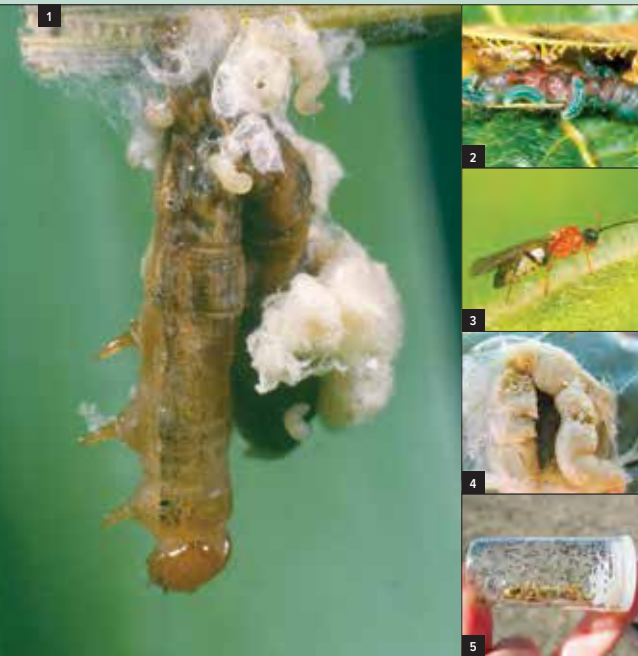
Several medium-sized (3–20mm) wasps contribute to the biocontrol of pest larvae, including armyworm and *Helicoverpa*. Caterpillar parasitoids tend to be slender. The most common species are reasonably large and often orange, with black and sometimes white markings.

Detecting them in the field

Adult wasps are commonly observed flying in crops, or attracted to lights at night. The black eggs of *Netelia* wasps are visibly attached to the head of parasitised larva. Developing *Microplitis* larvae can be found by ‘splitting’ medium caterpillar larvae.

Impact on pest

Most species attack larvae, but do not kill a larva until it pupates. *Microplitis* do kill mid-sized larvae, and their cocoons adhere to larvae. Some *Microplitis* transmit ascovirus which kills the caterpillar. *Ichneumon* parasitises the pupae of caterpillars in the soil.



Wasp parasitoids of caterpillars – gregarious

Description

Parasitism by another group of small (2–3mm) wasps results in caterpillars dying prior to pupation as scores of tiny wasp larvae emerge from and pupate on or beside their dying host. Species in this group include *Apanteles* sp. and *Cotesia* sp. Wasps in the genus *Litomastix* are very similar but pupate inside their host, with scores of pupae visible through the skin of the host.

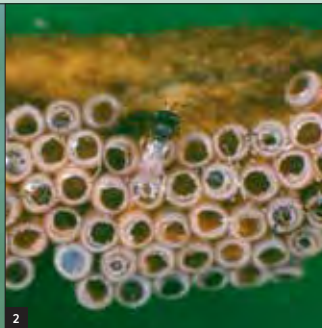
Detecting them in the field

The small dark adult wasps are most obvious when they emerge from the pupae beside or inside the dead host caterpillar. Parasitised and dying caterpillars are very distinctive, as are the white and fluffy pupae of *Apanteles* sp. and *Cotesia* sp.

Impact on pest

In some years, these small wasps have a major impact on their pest hosts as one caterpillar host can produce hundreds of wasps.

1. Characteristic white cocoons of *Apanteles* sp. covering an armyworm larva. 2. *Agathis* sp. larvae emerging from *Etiella* larva. 3. *Agathis* sp. wasp. 4. Parasitised soybean looper containing hundreds of *Litomastix* larvae. 5. Adult *Litomastix* wasps.



Wasp parasitoids of eggs – caterpillars and bugs

Description

Egg parasitoids are usually about 0.5mm long. *Trissolcus basalis* parasitise both pest and predatory bug eggs. *Trichogramma* and *Telenomus* lay their eggs into caterpillar eggs, killing the developing larvae.

Detecting them in the field

Seeing these tiny wasps and parasitised eggs in the field is difficult. To assess the level of parasitism occurring, collect eggs and store them for 10 days. If parasitised, the eggs will turn black and an adult wasp will emerge.

Impact on pest

Egg parasitoids can limit crop damage, as they kill the caterpillar before it emerges from the egg. They attack all major caterpillar and bug pests of grain crops.

1. *Trichogramma* adult inspecting egg.
2. *Trissolcus* adult on green vegetable bug egg mass.
3. Unparasitised white egg (left) and parasitised black egg.



Wasp parasitoids of whitefly (greenhouse and silverleaf)

Description

Eretmocerus sp. and *Encarsia* sp. attack whitefly nymphs. These tiny (0.5mm) wasps are active throughout the year in crops and non-crop vegetation that host whitefly.

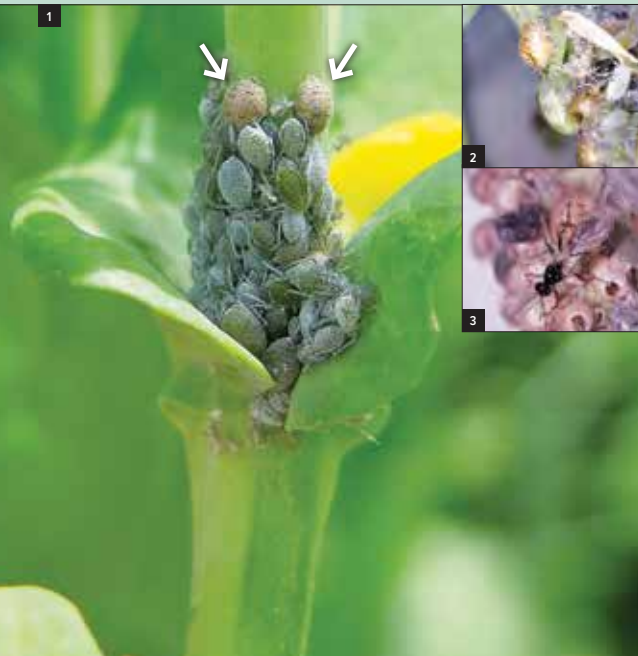
Detecting them in the field

Nymphs parasitised by *Encarsia* turn black; the change is visible with a hand lens. Parasitism by *Eretmocerus* is difficult to assess without a microscope.

Impact on pest

Adult whitefly do not emerge from nymphs that are parasitised, so parasitoid activity can significantly reduce the rate of whitefly build-up in the crop, provided they are not killed by non-selective (hard) insecticides.

1. *Encarsia* developing inside a silverleaf whitefly (SLW) nymph. 2. *Eretmocerus* adult.
3. SLW nymph containing a developing *Eretmocerus* larva.



1. Canola aphid colony with parasitised mummies. 2. Parasitoid exit holes visible in aphid mummies.
3. Aphid parasitoid wasp.

Wasp parasitoids of aphids

Description

Several species of wasps parasitise aphids; it is difficult to distinguish between species in the field. Generally they are small (2–3mm) and dark with clear wings and long antennae.

Detecting them in the field

Adult wasps can be difficult to see. The presence of parasitised aphid ‘mummies’ is visual evidence of parasitoid activity. Aphid mummies often look bronzed. Aphids that have been parasitised can take up to 10 days to develop into mummies. During this period, it is easy to underestimate the potential impact of the aphid parasitoids. When fully developed, the wasps emerge from a circular hole in the ‘mummy’.

Impact on pest

Female wasps lay eggs into live aphids, and the wasp larva grows within the aphid. Aphid parasitoids can have a major impact on aphid populations.



1. *Eupelmidae australiensis* stemfly parasitoid wasp adult. 2. Stemfly parasitoid larva. 3. Stemfly parasitoid pupa.

Wasp parasitoids of soybean stemfly

Description

Eupelmidae australiensis are small (2mm) metallic-coloured wasps that parasitise stemfly larvae feeding on pith in plant stems. The wasp larvae are more 'wrinkly' than stemfly larvae, and the developing wasps can be seen in the parasitoid pupae.

Detecting them in the field

Look for the distinctive wasps flying in the crop. Split stems open to check for stemfly infestations and for the parasitoid larvae and pupae.

Impact on pest

Significant parasitism by this species can help in suppressing stemfly outbreaks.



1. Tachinid adult. 2. Noctuid larva with tachinid egg attached. 3. Green vegetable bug with *Trichopoda* eggs adhering to thorax. 4. *Trichopoda* female. 5. *Trichopoda* male.

Fly parasitoids

Description

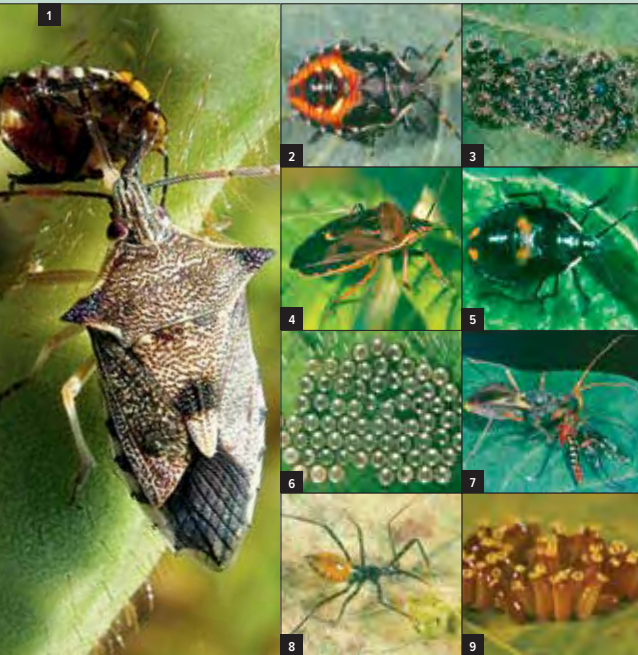
Tachinid flies are stout-bodied and bristly, and usually grey-brown in colour. They range from 5 to 10mm in length. There are many species of tachinids that parasitise caterpillars, bugs and beetles. *Trichopoda giacomellii* (attacks shield bug pests) has been introduced to and spread throughout many areas of the northern region. Adult flies are about 8mm long; female flies are black, males orange.

Detecting them in the field

Look for the adult flies on the canopy top and the presence of white eggs adhering to the head or neck of the host insect.

Impact on pest

Tachinid larvae develop in the host, but do not kill them until they pupate. They play a role in reducing pest populations over time. In grain crops, noctuid caterpillars (armyworm, helioverpa, loopers) are commonly attacked. Green vegetable bugs parasitised by *Trichopoda* stop feeding soon after being attacked, but do not die for up to two weeks.



Predatory bugs – large

Description

The spined predatory shield bug, *Oechalia schellenbergii*, is 11mm long with distinctive spines on its shoulders. Nymphs lack spines and have a distinctive red-orange ring on their backs. The glossy shield bug, *Cermatulus nasalis*, is a large (12mm) predatory shield bug. Nymphs are dark with four red-orange spots on their back. Both species lay dark spherical eggs in multi-row rafts. *Oechalia* eggs have long spines around the top whereas *Cermatulus*'s egg spines are short. Redbanded shield bug egg rafts are dark and laid in twin rows. Assassin bugs (multiple species) range from 10 to 30mm and have convex abdomens and small, narrow heads. Assassin bug eggs are orange and elongated, with no spines.

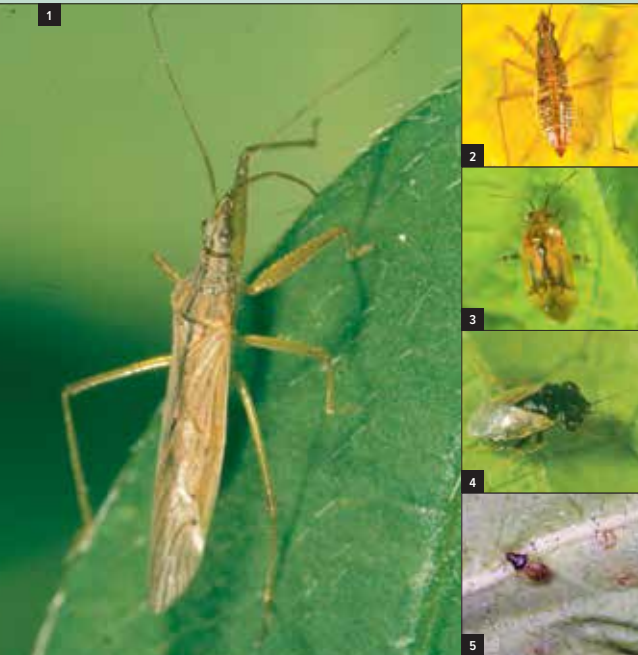
Detecting them in the field

Adult bugs are often seen in the field when sampling for pests. Look for the distinctive egg rafts on leaves.

Impact on pest

Adults and nymphs are predatory, feeding on and killing a wide range of soft and hard-bodied prey. Large assassin bugs are capable of killing medium-to-large caterpillar pests and pest bugs.

1. *Oechalia* adult feeding on green vegetable bug nymph. 2. *Oechalia* final instar nymph. 3. *Oechalia* eggs. 4. *Cermatulus* adult. 5. *Cermatulus* nymph. 6. *Cermatulus* egg raft. 7. Assassin bug adult. 8. Assassin bug nymph. 9. Assassin bug egg raft.



1. Damsel bug adult. 2. Damsel bug nymph. 3. Brown smudge bug adult.
4. *Geocoris lubra* bigeyed bug adult. 5. Minute pirate bug adult.

Predatory bugs – small to medium

Description

The damsel bug, *Nabis kingbergii*, is 8mm in length, pale and slender, with long antennae. Nymphs are similar in appearance to adults but lack wings.

The adult brown smudge bug, *Deraeocoris signatus*, is small (5mm), mottled brown and has a bent back. Nymphs are maroon and often mistaken for aphids

Bigeyed bugs, *Geocoris lubra*, have large, wide-set eyes (5mm).

Minute pirate bugs (*Orius* sp.) are similar to bigeyed bugs, but smaller (3mm) and with less prominent eyes.

Detecting them in the field

Smaller predatory bugs are common in grain crops and are active in the canopy. They are often overlooked in visual scouting, but are readily dislodged with beat sheet sampling.

Impact on pest

These bugs attack a wide range of soft-bodied prey including aphids, whitefly nymphs, small caterpillars, leafhoppers, mites, and immature bugs and beetles.



1. Transverse ladybird. 2. Ladybird eggs. 3. Transverse ladybird larva.
4. Ladybird pupa. 5. Three-banded ladybird.

Predatory beetles – ladybirds (large)

Description

Ladybirds are probably the most recognisable beneficial insect in grain crops. Adults of the larger species (4–7mm) are brightly coloured yellow, orange or red with black and white spots or lines. Eggs are bright yellow, elongated and laid in clusters.

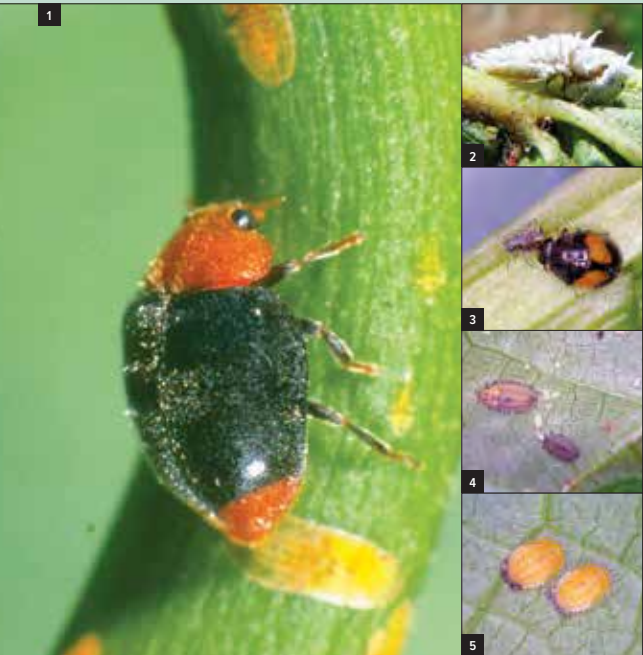
Larvae tend to be grey-black and elongated with yellow or white markings, and pupae are usually patterned in orange to black.

Detecting them in the field

The bright colours of adults make them highly visible in the crop. Larvae can be more difficult to observe, but are often seen near colonies of aphids, mites and other prey.

Impact on pest

Both larvae and adults are predacious. Across the species, ladybirds have a wide range of prey including aphids, mealybugs, mites, whitefly, thrips, small caterpillars, moth eggs and scale.



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Predatory beetles – ladybirds (small)

Description

Adults of the mealybug ladybird *Cryptolaemus montrouzieri* (3.5mm) are black with orange anterior and posterior. Adults of the minute two-spotted ladybird (*Diomus notescens*) are only 2.5mm long and are black with two red spots. Larvae of the mealybug ladybird look like their mealybug prey with white waxy filaments, and larvae of two-spotted ladybird are greyish and oval-shaped with a fringe along the edge of their bodies.

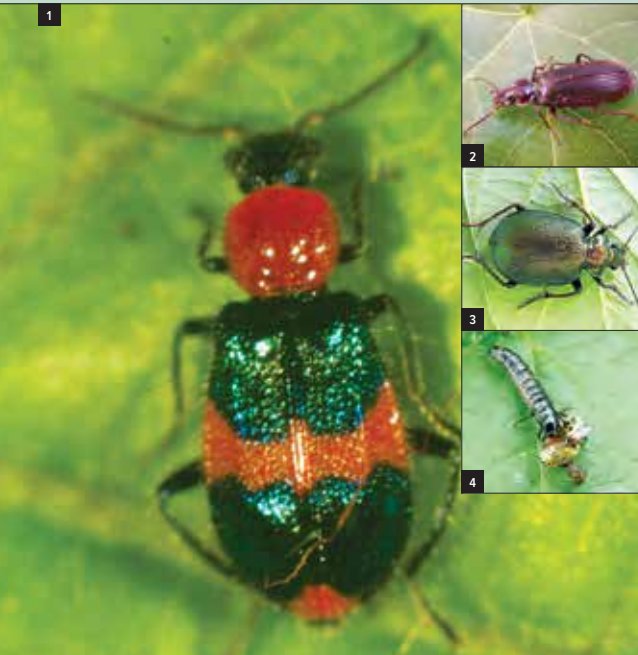
Detecting them in the field

These ladybird species are much more difficult to see in the field due to their smaller size, and in the case of *Cryptolaemus* larvae, their similarity in appearance to their mealybug prey.

Impact on pest

Both larvae and adults are predacious, although smaller ladybeetles are more likely to have specific prey preferences.

1. Adult mealybug ladybird. 2. Mealybug ladybird larva. 3. Minute two-spotted ladybird adult. 4. Minute two-spotted larvae. 5. Minute two-spotted pupae.



1. Red and blue beetle adult. 2. Brown carabid beetle adult. 3. Adult green carab beetle *Calosoma schayeri*.
4. Carabid larvae attacking cluster caterpillar.

Predatory beetles

Description

Red and blue beetle adults are small (5mm) with bright red and dark blue bands across the body and a dark head and legs. Carabid beetle adults are much larger (≥ 15 mm) with prominent, forward-projecting jaws. The most common species are dark brown to black, others are metallic green or spotted. Carabid larvae are long and slender with prominent jaws and paired rear appendages (cerci).

Detecting them in the field

Species that search for prey in the canopy (e.g. red and blue beetles) can be seen when sampling for pests. Carabids are found mostly on the ground and under leaf litter. They are easily caught in pitfall traps.

Impact on pest

Red and blue beetle adults eat eggs, smaller caterpillars and other soft-bodied prey. Carabid adults and larvae attack pest caterpillars of all sizes and slugs.



1. Brown lacewing adult. 2. Brown lacewing larva. 3. Green lacewing eggs.
4. Green lacewing adult. 5. Green lacewing larva.

Lacewings

Description

Adult lacewings hold their tent-like, clear wings over their back, and have long antennae and prominent eyes. The brown lacewing, *Micromus tasmaniae*, (8mm) is mottled; the green lacewing, *Mallada signatus*, is larger (15mm) and pale to bright green. Larvae have forward-protruding, sickle-shaped jaws. Green lacewing larvae are stout and camouflage themselves with the bodies of their prey. Brown lacewing larvae are elongated, and do not camouflage themselves.

Detecting them in the field

Clusters of green lacewing eggs are distinctive, due to their long stalks, and indicate lacewing activity.

Impact on pest

Adults of the green lacewing are not predatory. Brown adults and larvae and green larvae feed on soft-bodied insects, mites and eggs.



1. Hoverfly adult eating honeydew. 2. Hoverfly larva. 3. Hoverfly larva.
4. Hoverfly pupa near parasitised aphids. 5. Side view of hoverfly pupa.

Hoverflies

Description

Adult hoverflies are small (4–7mm), slender flies with dark and yellow markings on the body. They are often mistaken for wasps or bees. Small, white, oval eggs are laid close to aphid colonies. Larvae are greenish (up to 8mm) and maggot-like, and some species can be confused with grass blue butterfly larvae.

Detecting them in the field

Adults are easily observed flying and hovering in the crop, particularly flowering crops and around aphid colonies. To find larvae, look carefully in colonies of aphids. Tear-shaped pupae may be found adhering to leaves.

Impact on pest

Adults are not predatory. Larvae are voracious predators, and kill aphids by piercing them and sucking them dry.

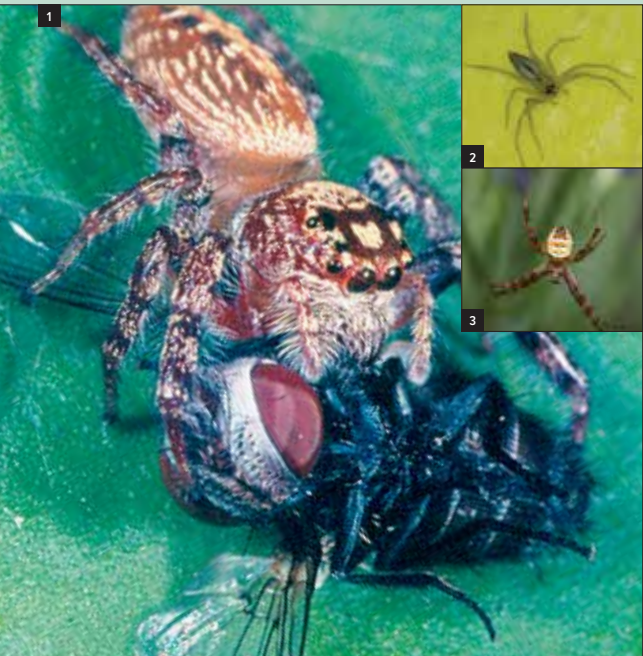


PHOTO: CESAR

Spiders

Description

A large variety of spiders occur in grain crops, including active hunters, such as the wolf, lynx and nightstalkers, and web-spinners, such as the tangle web and orbweaver. While considered relatively sedentary, juvenile spiders can travel large distances on the wind and colonise fields.

Detecting them in the field

Most spiders are well camouflaged, and many are active at night, either hiding in nests in the soil or in the canopy. Spiders are often collected when sampling for pests.

Impact on pest

Spiders have a broad range of prey. Active hunters prey on slow-moving targets including caterpillars, bug nymphs and eggs. Web-spinners can catch flying prey.

1. Jumping spider. 2. Lynx spider. 3. Web-building spider.



1. Ant (*Camponotus* sp.).

Ants

Description

Ants are usually several millimetres long, with biting mouthparts and a very narrow waist.

Detecting them in the field

Ants are more commonly encountered at field edges, where they are able to maintain nests in undisturbed areas. Typically, ants forage on the ground, but some species will move up onto plants to feed on other insects. They may also harvest honeydew and protect pest species that produce it.

Impact on pest

Ants are voracious predators of small, soft-bodied prey and eggs. In field studies, ants were major predators of helioverpa eggs, especially in close proximity to nests.



Predatory (native) earwigs

Description

Predatory earwigs are reddish-brown with a darker abdomen and pincers. They are widespread and feed on leaf litter as well as attacking other insects. They are about 35mm long.

Detecting them in the field

Earwigs are nocturnal, and can be detected in baiting stations or pitfall traps.

Impact on pest

Native earwigs are predators of soft-bodied insects, including ground-dwelling caterpillars and pupae.



1. *Helicoverpa* larva infected with NPV on sorghum. 2. Advanced NPV infection of larva on linseed.

Pathogens – bacteria and viruses

Description

Pathogens can infect hosts through naturally occurring outbreaks (epizootics). However, the bacterium *Bacillus thuringiensis* and the helioverpa nuclearpolyhedrosis virus (NPV) are available commercially for the control of caterpillar pests. Toxins produced by bacterial pathogens can cause a range of symptoms, including changes in colour and appearance of infected larvae. NPV-infected larvae typically move to the top of plants, ooze and eventually disintegrate.

Detecting them in the field

Look for infected hosts displaying specific symptoms. Also look for any slow-moving or moribund larvae. Viral epizootics are more likely to occur in wetter seasons or under high pest pressure.

Impact on pest

Pathogens can decimate populations rapidly. Their selectiveness makes them ideal for consideration in an integrated pest management program. Although death may take some days, feeding usually stops soon after infection, reducing the amount of potential crop damage.



Pathogens – fungi

Description

Fungi can infect a range of insects through naturally occurring outbreaks (epizootics). Fungus-infected pests erupt in fungal spores (the colour indicates the organism involved; for example, pale green for *Nomuraea*, dark green for *Metarhizium*, and white for *Beauveria*).

Detecting them in the field

Spores will be easily visible in advanced cases. Fungal outbreaks are more likely to occur in wetter seasons or under high pest pressure.

Impact on pest

Epizootics can decimate populations rapidly, particularly where the pests are in close contact – as in aphid colonies. Although death may take some days, infected individuals typically stop feeding soon after infection, reducing the amount of crop damage they can cause.

1. *Nomuraea*-infected helicoverpa larva. Note the pale-green fungal spores.
2. Aphid covered with fungal hyphae.

NOTES

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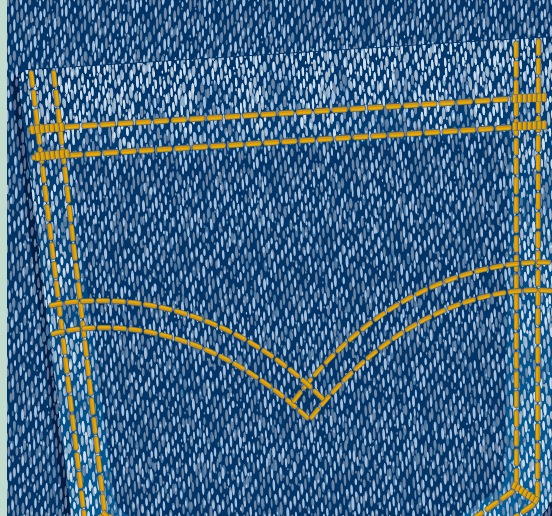
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- IPM Guidelines for Grains <https://ipmguidelinesforgains.com.au/ipm-information/biological-control/beneficial-insects>
- GRDC Integrated Pest Management Fact Sheet <https://www.grdc.com.au/factsheets>
- DAF Insect Pest Management <https://www.daf.qld.gov.au/business-priorities/plants/field-crops-and-pastures/broadacre-field-crops/integrated-pest-management>
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