Identifying Natural Enemies in Field Crops
Michigan State University
Cooperative Extension Service
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Introduction

Photo: © Marlin E. Rice

Why recognize natural enemies and spiders in field crops? These arthropods provide natural pest control. Natural enemies feed on pest insects, including aphids, thrips, caterpillars and beetles that damage crops. The ability to distinguish natural enemies from pest insects will help you make informed pest control decisions.

This guide is divided into sections by major groups of natural enemies and spiders: beetles, true bugs, lacewings, predatory flies, parasitoids, spiders and ants. Identification information provided can be used in the field.

Don't be surprised to find numerous natural enemies and spiders in fields where pests occur. For example, alfalfa is particularly rich in biological control because it is rich in alfalfa aphids,

which serve as food for natural enemies. When you scout for pest species such as soybean aphid, you may find these beneficials as well. Work is in progress to better understand how biological control affects soybean aphid populations.

This flip book is a useful counterpart to other management guides that focus on pest species. It is also useful for anyone – agribusiness, producers and homeowners – who want to know more about insects out in the field. Many of them are beneficial!

About beetles

Order: Coleoptera

The beetles are a large and diverse group of insects. Beetles exhibit complete metamorphosis with egg, larval, pupal and adult stages. All beetles have 2 pairs of wings. The first (outer) set of wings are hard protective covers called elytra. The elytra cover the clear, membranous second pair of wings. Beneficial species of beetles are typically predaceous as both larvae and adults.

About beetles – *continued*

At right, lady beetle anatomy; below, lady beetle larva anatomy.

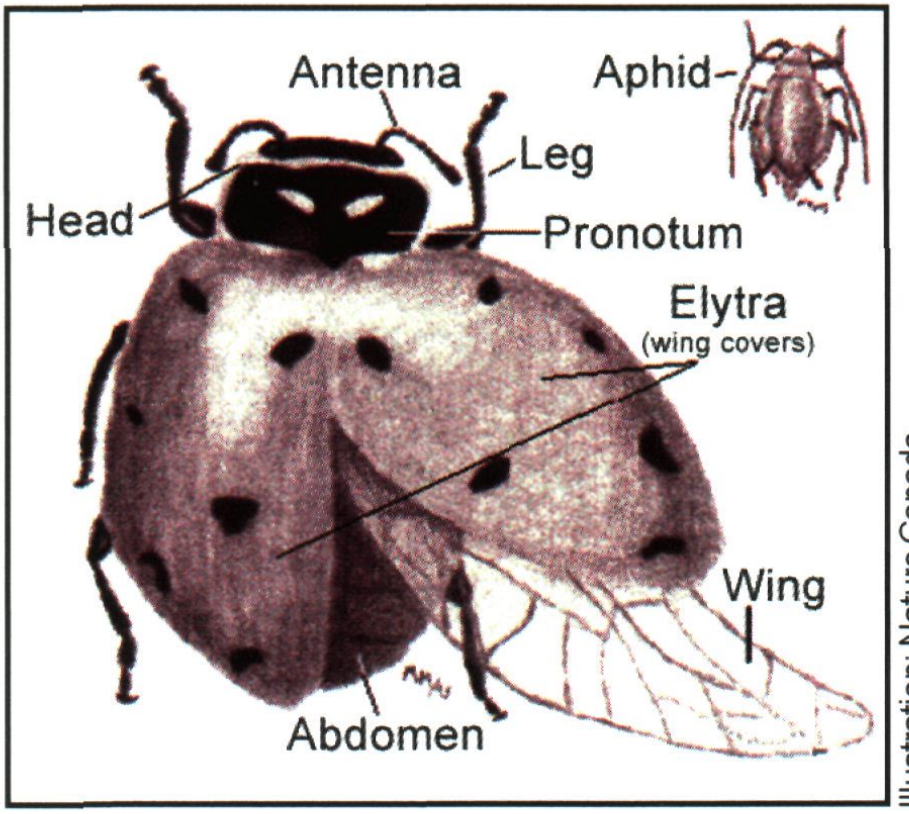
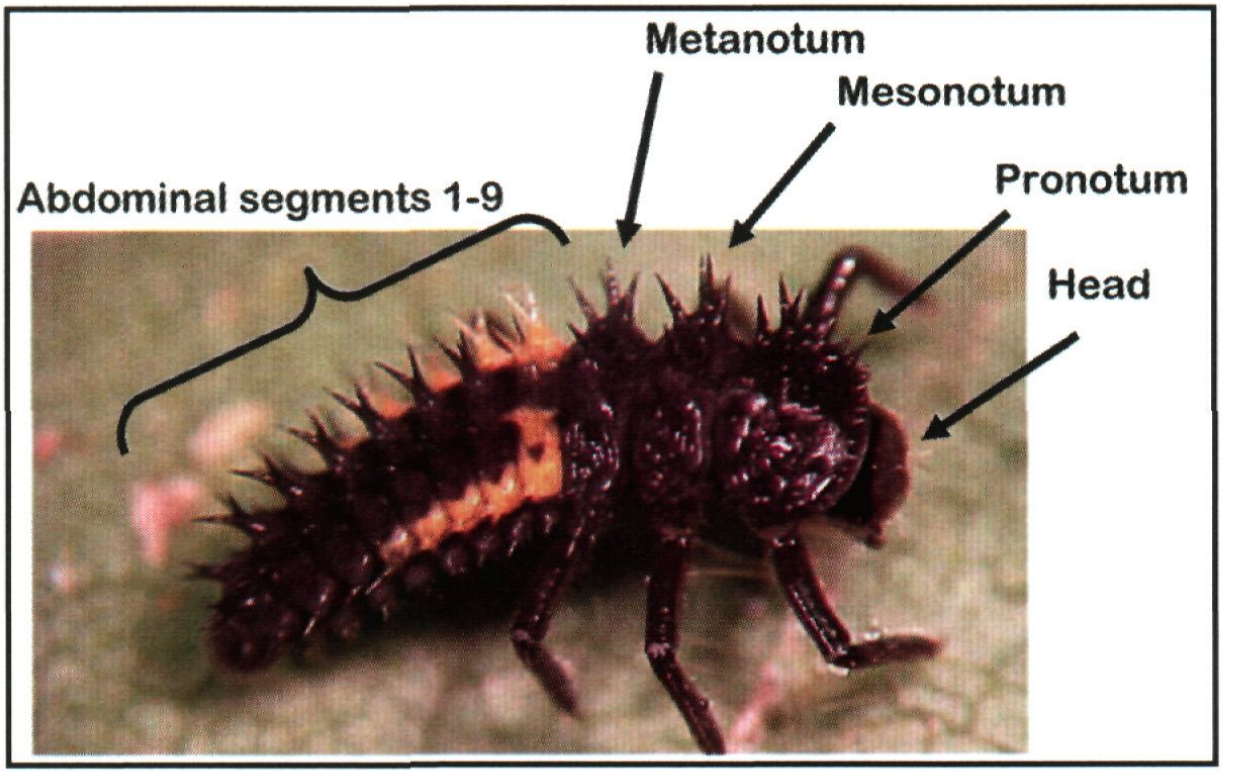


Illustration: Nature Canada



About lady beetles

Coccinellidae

Adults: Generally oval. Elytra typically red to orange with dark spots.

Eggs: Oval. Orange to yellow in color. Deposited in clusters.

Lady beetle adult laying eggs.

Larvae: Often alligator-shaped. Typically black or gray with light markings. May be covered with flexible spines.

Lady beetle larva.

About lady beetles – *continued*

Pupae: Oval. Resemble adults in coloration. May look wrinkled. Often found attached to plant leaves or stems.

Lady beetle pupa.

Diet: Adults and larvae are predaceous, feeding on field crop pests including aphids, mites and thrips.

Multicolored Asian lady beetle

Harmonia axyridis

Adults: Many color forms exist, ranging from yellow to red. May or may not have black spots on the elytra. Diagnostic feature is the white pronotum with a black M or W pattern depending on the viewing direction (see photo).

Length: 7-8 mm

7 mm

Multicolored Asian lady beetle – *continued*

Larvae: Covered with tiny, flexible spines. Orange lateral stripes and four central orange spots.

Photo © N.A. Schellhorn

Seven-spotted lady beetle

Coccinella septempunctata

Adults: Oval. Bright red elytra. Seven spots total – three spots on each wing cover and one central spot at the base of the pronotum. Pronotum is black with a white spot on each side.

Length: 7-8 mm

Photo: © Marlin E. Rice

Photo © Bruce Marlin

Pronotum on the adult is black with two white spots.

Seven-spotted lady beetle – *continued*

Larvae: Grey with orange spots on abdominal segments 1 and 4.

Photo: © N.A. Schellhorn

Pink lady beetle

Coleomegilla maculata

Adults: Oval. Bright red to pink. Six spots on each wing cover. Pronotum has two black triangular spots.

Length: 5-7 mm

5 mm

Photo: © Marlin E. Rice

Pink lady beetle adults have two black triangular spots on their pronotum (see arrow).

Photo: © N.A. Schellhorn

Larvae: Dark gray to black. Yellow stripe on abdominal segments 4, 7 and 8.

Convergent lady beetle

Hippodamia convergens

Adults: Oval. Color varies from light to dark red. Six or fewer black spots on each wing cover. Diagnostic feature on the pronotum is two white dashes angled towards the center forming a "V" pattern.

Length: 6-7 mm

6 mm

Photo: © Marlin E. Rice

Photo: © N.A. Schellhorn

Larvae: Dark gray to black. Pairs of orange spots on abdominal segments 1, 4, 6 and 7.

Parenthesis lady beetle

Hippodamia parenthesis

Adults: Oval. Yellowish-red elytra. Diagnostic feature is a black parenthesis-shaped spot on each wing cover.

Length: 4-5 mm — 4 mm

Thirteen-spotted lady beetle

Hippodamia tredecimpunctata

Photo: © Marlin E. Rice

Adults: Oval. Yellowish-red elytra. Six spots on each elytron and one central spot. Length: 4.5-5.5 mm

5 mm

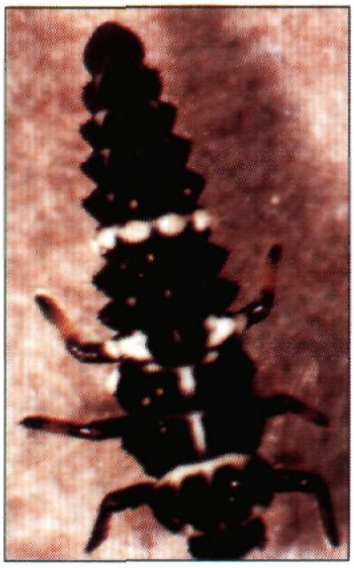


Photo: © N.A. Schellhorn

Larvae: Black with white markings. Distinguished by solid white strip on abdominal segment 4.

Variegated lady beetle

Hippodamia variegata

Adults: Red elytra. Elongate. Three spots on each elytron and one central spot. Pronotum with two small white spots.

Length: 5 mm

5 mm

Two-spotted lady beetle

Adalia bipunctata

Adults: Round. Red elytra with two black spots. Pronotum black and yellow.

Length: 4-5 mm

4 mm

Photo: © N.A. Schellhorn

Larvae: Dark gray or black. Yellow-orange spot on abdominal segment 4. Two lateral light-colored spots on each abdominal segment.

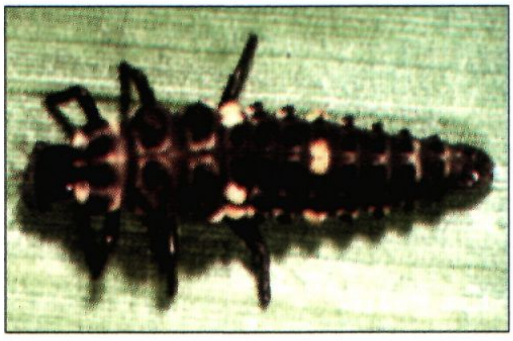


Photo: © N.A. Schellhorn

Red lady beetle
Cycloneda munda

Adults: Round. Elytra color varies from reddish yellow to bright red. No black spots. Distinctive black and white pronotum.

Length: 4-5.5 mm 5 mm

Photo: © Marlin E. Rice

Photo: © N.A. Schellhorn

Larvae: Dark gray to black. Yellow spot in the middle of each body segment, resembling a stripe down the back.

Ground beetles
Carabidae

Adults: Usually dark and shiny with threadlike antennae. Color varies – commonly black, brown or metallic. Abdomen often much wider than the head or pronotum. Elytra may have striations or pits.

Ground beetles – *continued*

Metallic ground beetle.

Length: 3-25 mm

Eggs: Deposited singly in or on the soil surface. Small, difficult to see. Number per female varies widely among species.

Black ground beetle with striated elytra.

Larvae: Segmented, tapers from head to tail. Head large with well-developed jaws.

Pupae: Pupate in the soil.

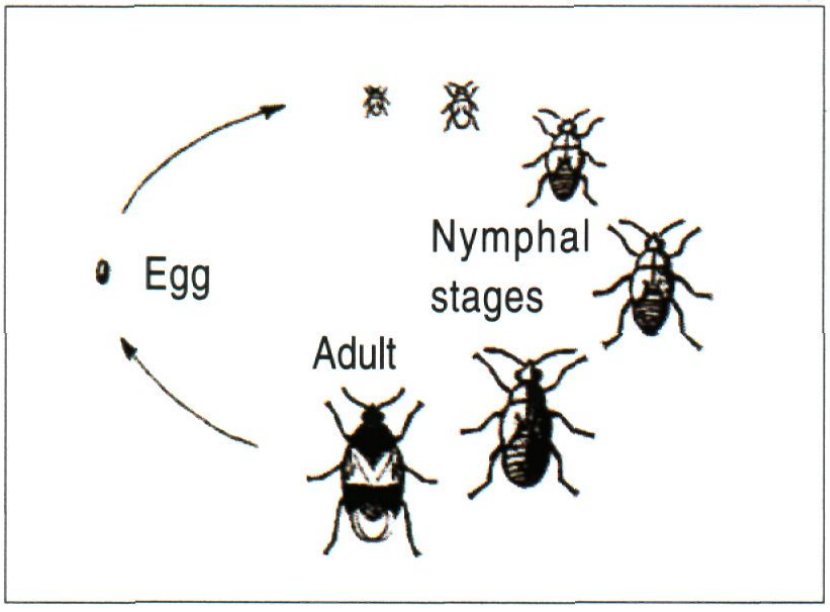
Diet: Eggs and larvae of root maggots, caterpillars, aphids, beetle larvae and weed seeds.

About true bugs

Order: Hemiptera

The order Hemiptera consists of the "true bugs." Though many species in this group are plant feeders, others are predaceous.

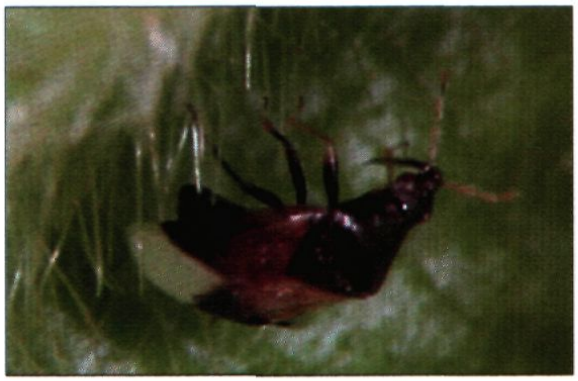
True bugs exhibit simple metamorphosis, growing from egg through several juvenile stages to winged adult. The immature stages, called nymphs, look like adults with shortened wing pads instead of fully developed wings. All true bugs have piercing-sucking mouthparts that are formed into a straw-like beak. Both nymphs and adults are predaceous.



Minute pirate bug

Anthocoridae, *Orius insidiosus*

Adults: Elongate, oval, flattened. Black and white wing patches. Sharp, piercing beak.



Length: 2-5 mm ■ 2 mm

Eggs: Deposited inside plant material.

Nymphs: Small and wingless. Teardrop-shaped. Orange to brown.

Both nymphs and adults are fast-moving and often take refuge in developing leaves and flowers.

Diet: Aphids, mites and small caterpillars, including corn earworm, as well as insect eggs. Minute pirate bugs feed on plant material if prey is in short supply, but do not cause detectable damage.

Damsel bug

Nabidae, *Nabis* spp.

Adults: Long and slender. Gray to light brown. Enlarged front legs.

Eggs: Inserted into plant stems.

Length: 9-13 mm

Adult.

Photo: Ken Gray, Oregon State Univ.

Nymph.

Nymphs: Similar to adults but with wing pads instead of fully formed wings.

Diet: Small insects, including aphids and caterpillars.

Spined soldier bug

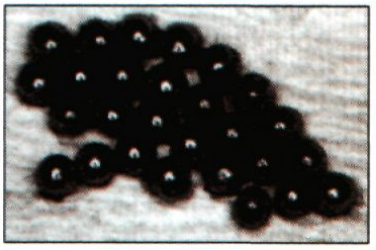
Pentatomidae, *Podisus maculiventris*

Adults: Shield-shaped with prominent lateral spines on the pronotum. Pale brown to tan. Diagnostic feature is a distinctive dark line on the membranous tip of each forewing.

Photo: © Marlin E. Rice

Length: 8-13 mm 8 mm

Eggs: Barrel-shaped and shiny. Often ornamented with spines. Laid in clusters.



Nymphs: Young nymphs are red and black. Older nymphs are marked with red, black, yellow-orange and cream bands and patches. Wingless and round rather than shield-shaped.

Photo: © Russ Ottens, U Ga

Diet: Immature bugs and caterpillars.

Assassin bug
Reduviidae

Adults: Black, yellow, brown or green. Narrow head and long mouth-parts form a curved beak.

Photo: Peter Bryant

Length: 20 mm — 20 mm

Assassin bug mouthparts.

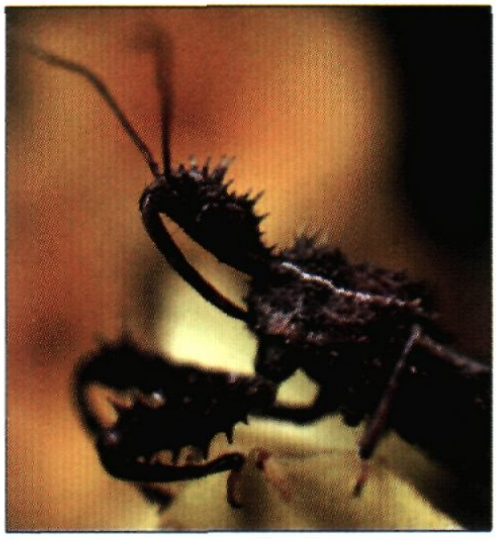


Photo: Peter Bryant

Eggs: Elliptical, often with a distinct cap. Deposited in clusters on leaves or in the soil.

Photo: © Lance Resley

Assassin bug – *continued*

Nymphs: Resemble adults, but are smaller with undeveloped wings. Some are brightly colored.

Photo: Peter Bryant

Assassin bug nymph.

Diet: Aphids, leafhoppers, small caterpillars, and beetle eggs and larvae.

About lacewings

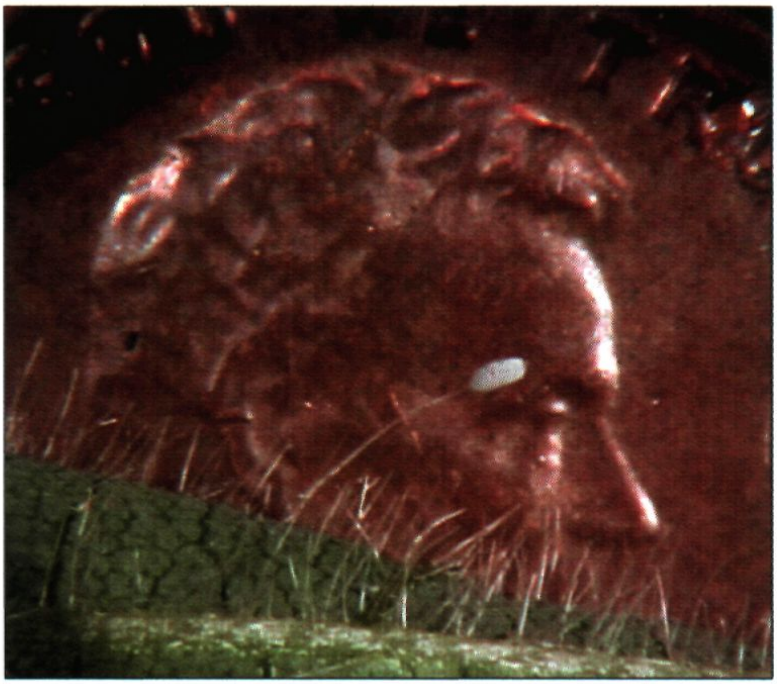
Neuroptera

Lacewings are important predators in a large number of agricultural systems. Lacewings have complete metamorphosis, with egg, larval, pupal and adult stages. Adults are soft-bodied with large, transparent, intricately veined wings. Larvae are alligator-like with long, sickle-shaped mouth-parts extending forward from the head. All lacewing larvae are predaceous; adults may be predaceous or feed on nectar and pollen.

Green lacewing
Chrysopidae

Adults: Pale green body. Large, transparent, pale green wings. Long, thin antennae.

Length: 12-20 mm



Eggs: Several hundred small eggs per female laid on thin stalks.

An egg on a stalk compared with a penny. The egg is to the left of the eyebrow.

Green lacewing – *continued*

Larvae: Gray to brown and alligator-like. Large, sickle-shaped mandibles. Head similar in width to the pronotum.

Photo: Peter Bryant

Pupae: Enclosed inside round, silken cocoons attached to plant material. Some species pupate in the soil.

Diet: Larvae eat aphids, caterpillars, beetle larvae and insect eggs. Adults may feed on insects or pollen, depending on species.

Brown lacewing

Hemerobiidae

Adults: Reddish brown, thin body. Large, membranous, brown wings. Long antennae and a long, thin body. Smaller than the green lacewing.

Photo: Peter Bryant

Length: 6-12 mm

Eggs: Several hundred oval eggs per female, laid on the undersides of leaves; eggs **not** on stalks like green lacewing eggs.

Larvae: Similar in appearance to green lacewing larvae, except head is similar in width to the pronotum. Gray to brown and alligator-like. Large, sickle-shaped mandibles.

Photo: © Joseph Berger

Brown lacewing – *continued*

Photo: © Bradley Higbee

Pupae: Pupation occurs inside a light brown, loosely woven cocoon on plant material.

Diet: Larvae and adults feed on aphids, caterpillars, beetle larvae and insect eggs.

About flies

Diptera

The flies are a large and diverse order of insects. Flies exhibit complete metamorphosis with egg, larval, pupal and adult stages. Beneficial species of flies may be either predaceous or parasitic. Flies are distinguished from other insects by having only one pair of wings. Adult flies often require flowers as nectar sources. Providing these resources may increase their abundance.

Hover fly
Syrphidae

Adults: Resemble bees. Abdomen usually has black and yellow stripes. Adults often hover over flowers (hence the common name "hover flies" or "flower flies").

Length: 4-15 mm

4 mm 15 mm

Eggs: Small (1 mm in length). Cylindrical, white and laid singly on leaves or shoots near aphid colonies.

Larvae (maggots): Creamy-white to green or brown. Worm-like, lacking legs. Narrow toward the head with a pair of respiratory tubes projecting at the rear end. Distinctive markings, stripes or spines often seen from the dorsal view.

Hover fly – *continued*

Pupae: Green, tan or brown. Typically pear-shaped with a pair of respiratory tubes projecting at the rear end. May pupate on plants or drop from plants and pupate in the soil.

Diet: Larvae of many species eat aphids or other soft-bodied insects. Adults feed on nectar and pollen.

Aphid predatory midge

Cecidomyiidae, *Aphidoletes aphidimyza*

Adults: Fragile, mosquito-like long legs. Active at night and so rarely seen.

Eggs: Minute (less than 0.3 mm), oval and orange. Laid singly on leaves among aphid colonies.

Photo: © Troy Bartlett

Length: 2-3 mm 2 mm

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Aphid predatory midge – *continued*

Larvae (maggots): Tiny (less than 3 mm long) and orange. Narrow toward the head and tail.

Pupae: When ready to pupate, larvae drop to the ground and spin cocoons in the soil.

Diet: Many species of aphids.

Aphid predatory midge larva eating an aphid.

Tachinid fly

Tachinidae

Adults: Dark, robust, hairy. Resemble house-flies, but with very stout bristles at the tip of the abdomen.

Length: 3-14 mm

Photo: Bruce Marlin, http://cirrusimage.com/

Tachinid fly – *continued*

Eggs: White, oval. Deposited near, on or in the host insect.

Larvae (maggots): Legless. Feed and develop inside the prey hosts. Exit the dead host to pupate.

Pupae: Oblong. Dark reddish.

Diet: Immature beetles, butterflies, moths, sawflies, earwigs, grasshoppers or true bugs. Adults are nectar feeders.

About parasitoids

Hymenoptera

The most abundant group of parasitoids is the wasps (order Hymenoptera). Parasitic wasps exhibit complete metamorphosis with a free-living adult stage that may be predaceous or feed on pollen and nectar. Parasitoids require a host insect to develop into adults. In the majority of parasitoids, females lay an egg(s) in, on or near the host. The larva hatches and feeds within a host, ultimately killing it, and emerging as an adult parasitoid.

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About parasitoids – *continued*

Parasitic wasps share two diagnostic features that greatly contribute to their success. Female wasps have an ovipositor that allows them to deposit eggs on or in a host body. Parasitoids also have a narrow "waist," called the petiole, which allows their abdomens to be highly flexible. This facilitates attack of active or protected hosts. The size of parasitoids is quite variable, and the visibility of these features depends partly on size.

Trichogramma wasp

Tricogrammatidae

Adults: Minute. Often yellow or yellow and black. Red eyes.

Eggs: Female deposits an egg inside the egg of the host insect.

Larvae: Hatch inside and feed on the host eggs.

Length: 0.5 mm

Trichogramma wasp – *continued*

Pupae: Pupation occurs within the parasitized egg. Adults emerge in 7-10 days. One or more individuals develop within the same host egg. Parasitized eggs are often black; a small hole in the host egg indicates the wasp emerged.

Hosts: Moth eggs, including corn earworm, European corn borer, diamondback moth, and tomato and tobacco hornworm.

Aphelinid wasp

Aphelinidae

Adults: Minute. Body color varies from black to yellow. Antennae and legs usually pale yellow. Abdomen may be dark or yellow. Very small – slender waist is not visible.

Photo: © Troy Bartlett

Length: 1 mm

Eggs: Deposited inside aphids and scale insects.

Aphelinid wasp – *continued*

Larvae and pupae: Occur inside the host and are not visible. Parasite eventually kills the host. Parasitized body of an aphid transforms into a "mummy."

Aphelinid mummy.

Aphid mummy: Black and somewhat swollen. Still resembles the aphid in shape.

Hosts: Aphids, scales.

Braconid wasp
Braconidae

Adults: Stout-bodied. Often black. Slender waist often visible only under magnification.

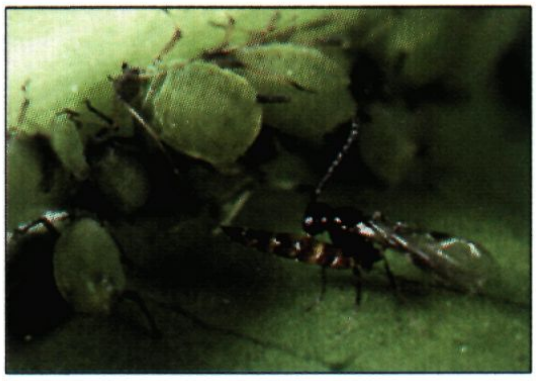
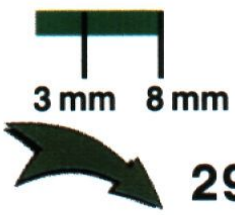


Photo: Peter Bryant

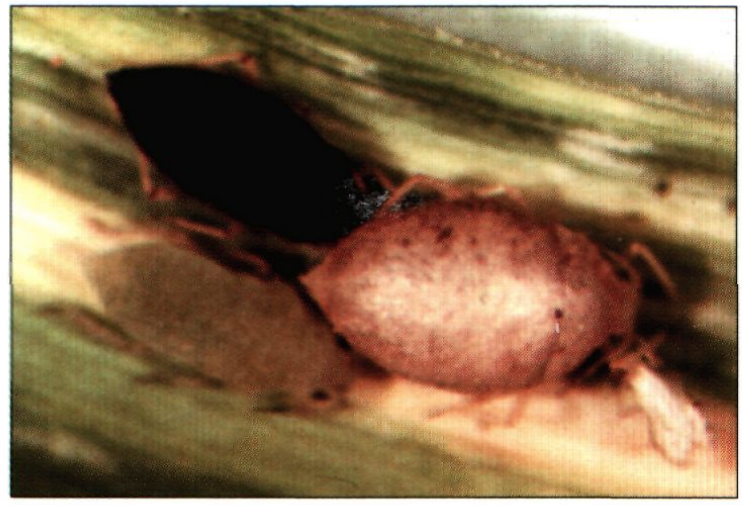
Length: 3-8 mm



Eggs: In most cases, wasps insert several eggs in one host. Others lay only a single egg in each host.

Braconid wasp – *continued*

Larvae: One or many larvae per host. Parasite eventually kills the host. Parasitized body of an aphid transforms into a "mummy."



Aphelinid mummy (black) with Braconid mummy (brown) and healthy aphid (green).

Pupae: Occur inside the host body (one larva per host) or outside the host body (multiple larvae per host). Multiple cocoons may be visible on or near host.

Aphid mummy: Tan. Considerably swollen. Still resembles the aphid.

Hosts: Aphids and caterpillars, including European corn borer, armyworms, hornworms, diamondback moth, and corn rootworm, and leafminers.

Ichneumonid wasp

Ichneumonidae

Adults: Black body, light legs. Long antennae. Abdomen is longer than head and thorax combined. Long ovipositor (females).

Eggs: Deposited on or in host larvae or pupae.

Larvae: One or many per host.

Photo: Jim Kalisch/Tom Clark, Ento. UNeb-L.

Length: 6-26 mm (commonly – may be larger)

Pupae: Occur inside the host body (one larva per host) or outside the host body (multiple larvae per host). Multiple cocoons may be visible on or near host.

Diet: Common hosts include armyworms and European corn borer.

Braconids and Ichneumonids can be confused. Both groups are completely beneficial parasitoids.

About spiders

Spiders are an important group of predators. Spiders are not insects – they are in the order Araneae. They differ from insects in having eight walking legs and only two body regions. The first region is called the prosoma. This region contains the eyes, fangs and legs. The second region is the abdomen, which has spinnerets at its base that produce silk.

Photo: Peter Bryant

Body length: 5-18 mm

Jumping spider
Salticidae

Adults: Stout, flattened body with stout legs. Square prosoma. Large eyes. Attractive and often brightly colored, iridescent or patterned.

Diet/web: Common on plant foliage. Day-active. Walks with an irregular gait and pounces to capture prey, sometimes jumping several times its own length. Does not make a web.

Photo: Jim Kalisch, Ento. UNeb-L.

Face of jumping spider.

Crab spider
Thomisidae

Adults: Flattened body with diverse coloring, from bright neon to dark with gray and brown patterns. Front two pairs of legs are much longer than the back two pairs.

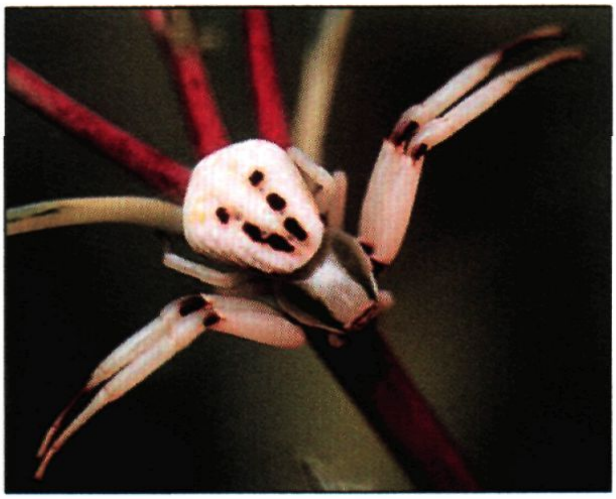
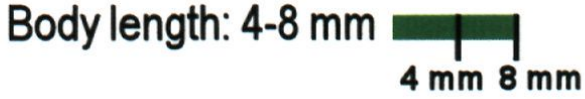


Photo: David Keith, Ento. UNeb



Diet/web: Ambush hunters use their large legs to grasp unsuspecting prey. Named for their ability to walk sideways, holding their legs crab-like out at their side. Does not make a web.

Wolf spider
Lycosidae

Adults: Among the most common spiders. Large. Typically brown to gray, often with a

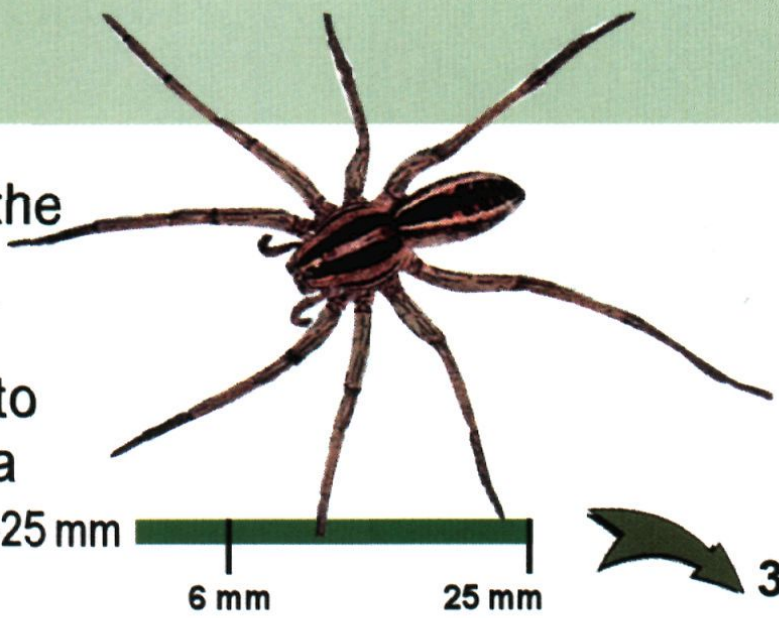


Photo: Jim Kalisch, Ento. UNeb.

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Wolf spider – *continued*

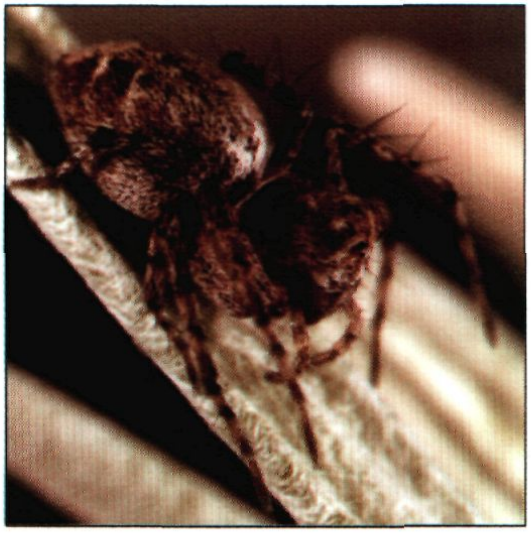
patterned abdomen. The female wolf spider attaches her egg sac to the spinnerets at the end of her abdomen and carries it with her (see photo).

Photo: Jim Kalisch, Ento. UNeb.

Diet/web: Hunt for prey along the ground, using visual and vibrational cues. Typically day-active; may hunt at night in warm climates. Does not make a web.

Lynx spider

Oxyopidae



Adults: Colorful, bright green and yellow to light brown. Often have a patterned, pointed abdomen. Very spiny legs. Eyes form a hexagonal pattern.

Body length: 5-16 mm

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Lynx spider – *continued*

Diet/web: Chase prey over vegetation or lie in wait for prey to come near. Do not make a web.

Orb weaver

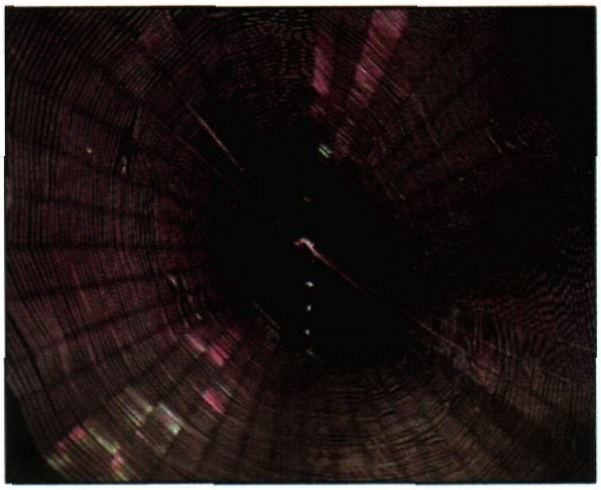
Araneidae

Adults: Immense range of size and color patterns. Often have large spherical abdomens. Among the largest spiders found in the North Central United States, with body lengths of up to 1 inch.

Body length:
13-26 mm

Photo: David Keith, Ento. UNeb.

Diet/web: Produce a large, orb-shaped web to catch prey. Use vibrational cues to locate trapped prey. Webs made by orb weavers are very organized and resemble a circular grid.



Long-jawed orb weaver

Tetragnathidae

Adults: Thin, elongate body. Often have iridescent markings on abdomen. Large jaws are projected forward.

Body length: 12 mm

12 mm

Photo: Jim Kalisch, Ento. UNeb.

Diet/web: Orb-shaped webs are taken down and reconstructed frequently. Spider is often found on an incomplete web. Awaits prey with front two pairs of legs projected forward while back pairs are projected backwards, so the spider resembles a blade of grass.

Photo: Jim Kalisch, Ento. UNeb.

Funnel weaver
Agelenidae

Adults: Typically brown or gray with light and dark stripes on the prosoma. Long spinnerets and very bristly legs.

Body length: 12-20 mm

Photo: Leon Higley, Ento. UNeb.

Diet/web: Flat web that narrows like a funnel on one end. Spider spends most of its time in the funnel with its legs outstretched to receive vibrations from the web. Insects that hit the web are bitten and carried back into the funnel.

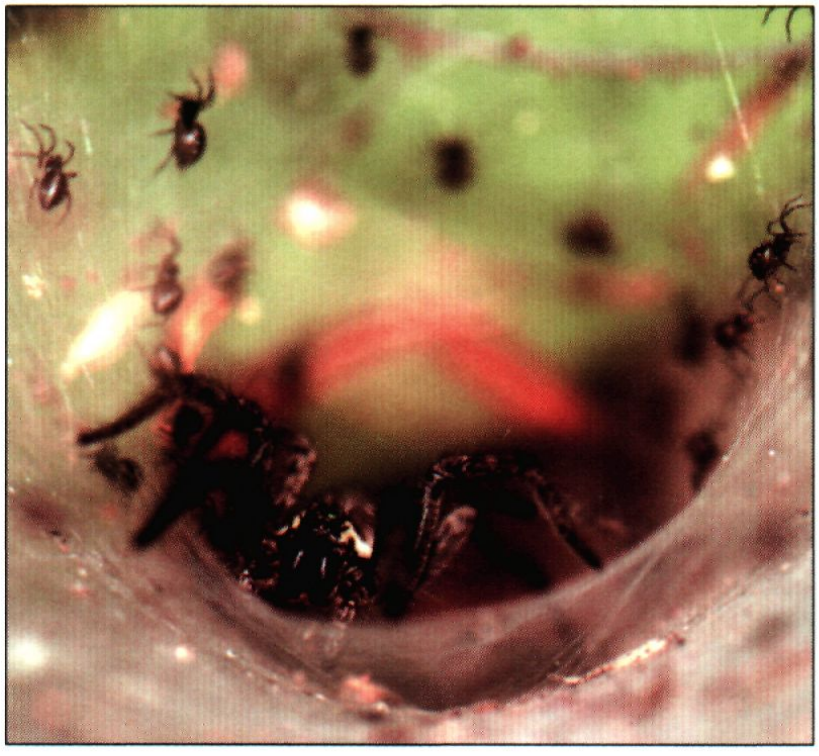


Photo: Peter Bryant

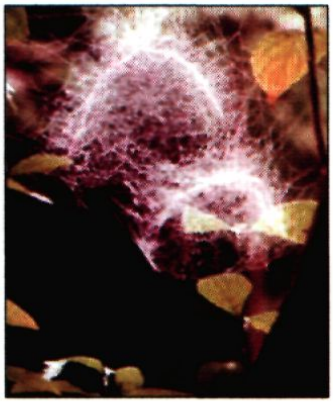
Funnel weaver adult and juveniles in their funnel-shaped web.

Sheet web spider
Linyphiidae

Adults: Small. Typically with orange-brown prosoma and legs. Abdomen varies from gray or brown to patterned.

Body length: 2 mm ■ 2 mm

Diet/web: Produces a sheet web of non-sticky silk on ground, bark, stones or plant material. Spider hangs underneath the web and waits for prey. When an insect lands on the web, the spider pulls it through the sheet, entangling it.



Cobweb spider

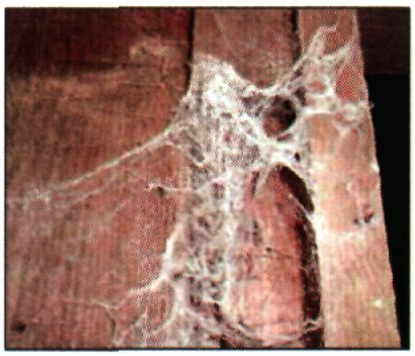
Theridiidae

Adults: Generally small, except for the widows, which can be up to 20 mm long. Most have a large, spherical abdomen and small prosoma. Best distinguished by their web.

Body length: 3-16 mm

Photo: Jim Kalisch, Ento. UNeb.

Diet/web: Irregular, messy web. Often called "cobweb." Spider hangs upside-down in web waiting for prey. Web has sticky outer threads that entangle insects.



Harvester

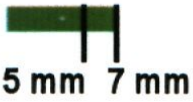
Opiliones

Adults: Not true spiders; in the order Opiliones. Distinguished from spiders by having one body region instead of two. Many have long, thin legs, but short-legged species also occur.

Diet/web: Feed on living insects as well as dead animals and plant juices. Nocturnal; found resting on walls and fences by day. They do not produce webs.

Despite the legend, they do not produce toxic venom; they are harmless to humans.

Body length: 5-7 mm



About ants

Many ant species may be present in field crops, feeding on seeds or leaf tissue; other species are predaceous.

A unique association exists between ants and aphids, particularly soybean aphids. Ants are often found on soybean plants in infested fields. Many assume the ants are eating the aphids; instead, the ants are actually tending the aphids, protecting them from predators. The ants feed on the sweet honeydew secreted by aphids.

Glossary

Beneficial: An insect or spider that provides an ecosystem service that is beneficial to humans. This includes organisms that feed on pests as well as pollinators and decomposers.

Complete metamorphosis – A change in form at each development stage: egg, larva, pupa and adult.

Elytra: The hard forewings of beetles that protect their membranous hind wings.

Maggot: The legless larva of a fly, which does not have a well-developed head.

Mummy: The dead body of a parasitized insect that serves as a pupal case for the wasp parasitoid.

Natural enemy: A predator, parasite or pathogen that kills a pest.

Ovipositor: Egg-laying apparatus of female wasps. Commonly called a "stinger."

Glossary – *continued*

Parasitoid: A specialized organism usually about the size of its host as an adult. The immature stage kills its host internally or externally and requires only one host for development into the free-living stage (adult).

Petiole: A constricted abdominal segment of a wasp that gives the appearance of a waist.

Predator: An organism usually larger than its prey that kills prey by feeding externally. It requires more than one prey to complete its development and is a free-living organism throughout its life.

Pronotum: The body segment directly behind the head of an insect.

Prosoma: Anterior body segment of a spider that contains the eyes, fangs and legs.

Simple metamorphosis: Development that occurs from the egg stage through multiple juvenile stages to the reproductive adult. There is no pupal stage.

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