



# Field guide natural enemies

development & characteristics



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# Colophon

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# Foreword

Natural enemies, useful insects or beneficial bugs are different names for insects that can help us in the fight against pests. Using beneficial insects for pest control is not new and has been around for some time. However, their use has been accelerated more recently due to compulsory integrated pest management. This no longer focuses solely on plant protection products, but also recommends encouraging beneficial insects and boosting their populations. Knowing and recognising these beneficial insects is important in the control of various pests. It is therefore essential to be able to recognise these pests in the first place, and also recognise the right beneficial insects.

Various organisations have worked hard to develop extensive knowledge about pests, and also how to recognise beneficial insects. This field guide aims to improve knowledge about beneficial insects even further. Because perception creates appreciation. Some of the species in this guide require a magnifying glass; others don't. Looking and comparing should suffice. Alongside visible characteristics, attention is also paid to the life cycles and occurrence of the various species.

The most common species of beneficial insect groups have been selected. But in addition to the species discussed, there are many other natural enemies such as harvestmen, velvet mites and even some bird species.

The idea for this guide arose in the context of a PWO research project at Ghent University of Applied Sciences and Arts, which conducted a three-year study on functional biodiversity in standard tree production. This project investigated the impact of a flower border and mixed hedgerow on the number of beneficial insects (functional biodiversity).

Sowing field margins or planting hedgerows, bushes and trees provides shelter for different species of beneficial insects, which dramatically increases their numbers. The presence of beneficial insects within crops or the immediate vicinity can only be advantageous.

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# Glossary of terms

**Adult:** full-grown (sexually mature) stage of an organism.

**Aphidophagous:** when organisms feed on aphids.

**Cerci:** paired appendages on the rearmost segments of insects (e.g. earwig pincers).

**Phytophagous:** when organisms feed on plants.

**Haemolymph:** bodily fluid in insects. This can be compared to blood in mammals.

**Integument:** outer protective layer on insects/mites.

**Cannibalistic:** when organisms eat their own kind.

**Larva:** juvenile stage of insects with complete metamorphosis or the first stage of mite development.

**Mimicry:** the phenomenon whereby a harmless insect closely resembles another harmful insect in order to benefit.

**Nymph:** immature form of insects with an incomplete metamorphosis or of mites (e.g. protonymph, deutonymph).

**Incomplete metamorphosis:** organisms belonging to this group go through the following stages in their metamorphosis or development to the adult stage: egg and a number of nymphal stages. Each nymphal stage looks like a small version of the adult but getting slightly bigger with age. The adult form is often only distinguishable from the nymph by size and the presence of wings. Wing development increases with each moulting.

**Litter layer:** a layer of the ground surface consisting of recently fallen organic material (leaves, needles, twigs, etc). The organic material can still be clearly identified in this layer.

**Complete metamorphosis:** insects belonging to this group go through the following stages in their metamorphosis or development to the adult stage: egg, a number of larval stages and pupa. The larvae moult their exoskeleton in their transition to the next larval stage. Insects do not look like the adult stage when they hatch from the egg.





# Lacewings

## including Chrysopidae, Hemerobiidae

There are numerous families of lacewings (including Chrysopidae, Hemerobiidae). The green lacewing (*Chrysoperla carnea* Stephens) is the most common and well-known of the Chrysopidae, and is described on the following pages unless stated otherwise.

### Lacewings as a natural enemy

- Lacewing larvae can feed on various insect pests/mites with a soft integument, such as aphids, mealybugs, thrips, spider mites, whiteflies, cicadas, eggs and caterpillars of various pest butterflies.
- The larvae use their large sickle-shaped jaws to grab hold of their prey and inject a digestive fluid before sucking the fluids out.
- Some species of lacewings (e.g. brown lacewings) also feed on insect pests as adults. Other species (e.g. green lacewings) only feed on pollen, nectar and honeydew as adults.
- A single larva can consume 200 to 500 aphids or other prey insects during its full development.
- Lacewing larvae can be cannibalistic.

# life cycle



Lacewing egg

## Egg

- laid individually or in a group
- on stalks or leaf surfaces
- development period: 1 to 2 weeks



Final or third-stage larva

## Larva

- active at night
- hides under leaves, in cracks and crevices during day
- development period: 2 to 3 weeks



Lacewing cocoon

## Pupa

- larva pupates in cocoon
- cocoon can be found in a sheltered place (e.g. in the litter layer)
- development period: 5 days to 2 weeks



Adult green lacewing  
(*Chrysoperla carnea*)

## Adult

- active from April
- active at night
- poor flyers
- lifespan: 3 to 4 weeks

# characteristics

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- 0.9 mm long and 0.4 mm wide
- white to pale green; as the larva gets close to hatching, it turns from white-grey to grey-green

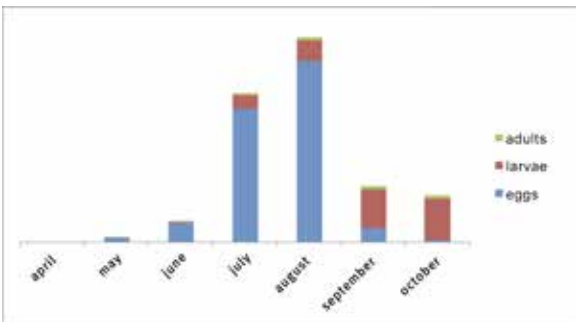
- 
- 2 to 20 mm
  - irregular brown colour
  - size and food consumption increase as development progresses
  - large sickle-shaped jaws
  - clearly visible legs

- 
- bullet-shaped
  - inactive
  - does not eat food
  - very vulnerable

- 
- 15 to 30 mm
  - 2 two pairs of membranous wings with highly reticulate venation
  - golden-coloured eyes
  - green or brown body
  - long antennae
  - a female can lay 200 to 500 eggs during her lifetime



full-size adult



phenology (more info on p. 78)

## General characteristics

- complete metamorphosis
- number of generations/year: 2 to 4
- spends winter in sheltered places as a pupa (brown lacewings) or an adult (green lacewing)

## Did you know that...

- the larvae of lacewings camouflage themselves with pieces of plant or dead aphids to escape the attention of their enemies?
- the adult green lacewing turns brown to reddish-brown in the winter and then changes colour back to green again in the spring?
- the eggs of the brown lacewing strongly resemble hoverfly eggs?
- the larvae are also known as aphid lions?



Camouflaged lacewing larva



Lacewing larva attacks aphid



Green lacewing (*Chrysoperla carnea* S.)



Brown lacewing (*Micromus* sp.)



Lacewing larva attacks sawfly larva



Blue-green lacewing (*Chrysopa perla* L.)



# Ladybirds

## Coccinellidae

### Ladybirds as a natural enemy

- Both adult ladybirds and larvae are predators that feed mainly on aphids. They can also feed on psyllids, beetle larvae, mites and other soft bodied invertebrates. When there is not enough prey available, they can also feed on nectar, pollen and/or honeydew as emergency rations. Some species are phytophagous.
- A single larva can eat 90 to 800 aphids during its full development, depending on the aphid species and environmental conditions.
- Adult ladybirds consume 15 to 100 aphids per day on average, with females eating more than males.
- Young larval stages bite their prey and suck them dry. Third and fourth-stage larvae and adults eat their prey whole.
- Ladybirds can be cannibalistic.
- Some common ladybirds include: the seven-spot ladybird (*Coccinellae septempunctata* L.) and the harlequin or multicoloured Asian ladybird (*Harmonia axyridis* Pallas).

# life cycle



Ladybird eggs

## Egg

- laid individually or in a group
- standing or lying on the underside or top of leaf surfaces
- development period: 2 to 10 days



Third-stage larva  
seven-spot ladybird

## Larva + prepupa

- can be found scattered throughout the plant
- always looking for prey (with the exception of the prepupa)
- larva + prepupa development period: 8 to 23 days



Ladybird pupa

## Pupa

- development period: 7 days



Seven-spot ladybird  
as a natural enemy for aphids

## Adult

- from April
- lifespan: 3 months to 1 year (including hibernation)



# characteristics

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- 0.3 to 2 mm
- oval and smooth surface
- pale yellow to bright orange
- eggs turn green-grey as larval hatching approaches

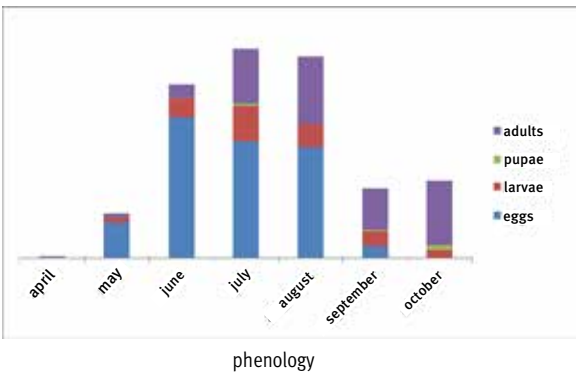
- 
- 1 mm to 1 cm
  - recently hatched larvae are darker in colour and feed on eggshell remnants
  - as development progresses:
    - size and food consumption increase
    - external features become more evident (species-specific discolouration of the spines on the body's surface)
  - fourth stage is the most voracious and can be used to distinguish species
  - prepupa is c-shaped, similar to fourth larval stage

- 
- 2 to 5 mm (pupa)
  - inactive
  - does not eat food
  - very vulnerable

- 
- 1 to 9 mm
  - $m < f$
  - oval
  - beautifully coloured with a variable number of spots and colour (varies according to the species and within the species)
  - one female can lay 10 to 50 eggs per day



full-size adult



### General characteristics

- complete metamorphosis
- number of generations/year: 1 to 2
- hibernating as adult

### Did you know that...

- some species lay unfertilised eggs as food for newly hatched larvae?
- there are around 60 different ladybird species in Belgium?
- ladybirds are capable of reflex bleeding? They excrete a foul-smelling yellow-orange liquid (haemolymph) when they feel threatened.



Seven-spot ladybird larva  
eats aphid



Recently hatched multicoloured  
Asian ladybird



14-spot ladybird  
(*Propylea quatuordecimpunctata* L.)



Poplar ladybird larva  
(*Oenopia conglobata* L.)



Mating ladybirds



Multicoloured Asian ladybird larva  
(*Harmonia axyridis*)  
feeds on sawfly larva



Seven-spot ladybird prepupa



# Earwigs

## including Forficulidae

### Earwigs as a natural enemy

- Earwigs are omnivores. They can survive on a plant-based diet, but rely on food from animal sources for good development.
- They prefer to feed on aphids, mealybugs, scale insects, psyllids (egg and larva), insect eggs, small caterpillars. They also eat snails, algae, moss and hyphae.
- Third-stage nymphs can eat around ten psyllid eggs per days, and adults can eat around 30. Final-stage nymphs are the best predators. They can consume up to 90 aphids every day.
- If there is a shortage of prey, earwigs can also feed on cultivated crops, occasionally causing damage. They scrape off the top layer of young leaves and cause secondary damage to already damaged fruits.

# life cycle



Earwig eggs

## Egg

- laid in a group
- in the ground (5 to 20 cm deep)
- laid from February to April/May
- development period: 20 to 70 days



Female earwig showing parental care with first-stage nymphs

## Nymph

- 4 to 5 nymphal stages
- first-stage nymph nest in the ground
- second-stage nymph leaves the nest to hunt, but stays close to the ground
- from the third stage, they go in/on the crop looking for prey
- the eggs hatch from May
- development period: 50 to 80 days



Adult female earwig

## Adult

- active at dusk and night
- common from May to October, then they hibernate
- lifespan: 8 to 18 months

# characteristics

---

- 1 to 1.5 mm long and 0.8 to 0.9 mm wide
- oval to elliptical
- shiny white eggs

- 
- 4 to 11 mm
  - resemble adults, but are initially white before turning darker and increasing in size as development progresses
  - the other body structures gradually become more evident (pincers, antennae)
  - the wing lobes can be observed in the final nymphal stage

- 
- 10 to 17 mm
  - slim flattened body with folded wings
  - dark to reddish-brown coloured body
  - males and females can be distinguished from each other by shape and size of their pincers and abdomen (cerci). These are thicker, more curved and longer (4 to 8 mm) on males than on the females (3 mm).
  - one female can lay 20 to 90 eggs
-



male earwig



female earwig  
full-size adult

## General characteristics

- incomplete metamorphosis
- number of generations/year: 1 to sometimes 2
- the adults hibernate as a pair in a nest under the ground (from October)

## Did you know that...

- earwigs are susceptible to dehydration and are therefore often found under stones, bark, etc?
- earwigs have fully developed wings under their elytra, but only fly very rarely? They use their pincers to unfold or fold their wings.
- the female earwig provides parental care? She guards and cares for her eggs and feeds the youngest nymphs.
- the nymphs eat their mother if she dies?
- straw sacks and rolled up cardboard are very popular hiding places for earwigs?





Second-stage nymph



Fourth-stage nymphs



Adult earwig in an earwig roll



Earwigs feasting on sunflower nectar at dusk



Earwig searching for food (aphids)



# Predatory gall midges

## Cecidomyiidae

Most gall midges (Cecidomyiidae) are phytophagous and harmful to various crops. The larvae of a number of species are however predators and important natural enemies of various insect pests (aphids, spider mites, etc). This latter group, the predatory gall midges, are described in more detail below.

### Predatory gall midges as a natural enemy

- Only the larvae are predators. Depending on the species, they feed either on aphids or spider mites. Larvae of the aphid midge hunt no less than 60 different species of aphids.
- The larvae inject a toxic substance into their prey, which paralyses it and helps with digestion. Then the prey is sucked dry.
- Predatory gall midge larvae adjust the amount of food that they consume depending on availability. With large colonies of prey, they kill more prey than they need to feed.
- A larva of the aphid gall midge eats around 100 aphids during its development. A larva of the spider mite gall midge eats around 30 spider mites or 80 spider mite eggs per day. The larvae also eat all development stages of their prey.
- The adult predatory gall midges feed on nectar or honeydew.
- The most well-known predatory gall midges are the aphid gall midge (*Aphidoletes aphidimyza* Rondani) and the spider mite gall midge (*Feltiella acarisuga* Vallot).

# life cycle



Aphid gall midge eggs

## Egg

- laid individually or in a group
- in colonies of their prey
- on the underside of leaves preferably on the lower foliage
- development period: 2 to 3 days



Aphid gall midge larva

## Larva

- development period: 7 to 14 days

## Pupa

- pupation takes place in a cocoon
- in the soil (aphid gall midge [*Aphidoletes* sp.]) or on the underside of a leaf (spider mite gall midge [*Feltiella* sp.])
- development period: 4 to 14 days



Adult predatory gall midge

## Adult

- active at night
- appear from May
- lifespan: 5 to 10 days

# characteristics

---

- 0.1 to 0.3 mm
- oval and smooth surface
- pale yellow to bright orange
- the eggs turn green-grey as larval hatching approaches

- 
- 0.2 mm to 3 mm
  - three larval stages
  - legless larva that appears quite transparent after hatching and later turns white, yellow to orange-red

- 
- 1 to 2 mm
  - inactive and does not absorb any food
  - pupation takes place in an oval, brown (aphid gall midge) or a white silken cocoon (spider mite gall midge)

- 
- 1.5 to 3 mm
  - long, hairy antennae
  - thin, long legs
  - brown
  - a female can lay 30 to 250 eggs during her lifetime



full-size adult

## General characteristics

- complete metamorphosis
- number of generations/year: 2 to 3
- overwintering in a cocoon in the ground
- peak period: June to September

## Did you know that...

- adults rest hanging from spider webs during the day?
- some predatory gall midges are also commercially available (e.g. *A. aphidimyza* and *F. acarisuga*)?
- the larvae enter a kind of resting state, in which they no longer move and do not pupate, when food sources are in short supply? They become active again when sufficient prey becomes available?
- predatory gall midges need relatively high humidity to survive (min. 70%)?



Aphid gall midge larvae in a colony of mealy aphid



Aphid gall midge larvae attack an lime aphid



Aphid gall midge larva



Spider mite gall midge larva





# Predatory mites

## including Phytoseiidae

### Predatory mites as a natural enemy

- Phytoseiidae are important predators of spider mites, soft-skinned gall and rust mites, and of immature stages of whitefly and thrips.
- Some species are specialist predators that can only feed on one type of prey (monophagous). Others can survive on a greater variation of prey and also feed on nectar, pollen, water, honeydew, fungal spores and nematodes (polyphagous).
- Protonymphs and deutonymphs both eat an average of 5 to 7 spider mites during their development period.
- Adult females are the most voracious and can eat up to 20 spider or thrips eggs, 15 thrips larvae or 5 adult spider mites per day.
- They tear open the prey with pincer-shaped mouthparts and then suck out the contents.
- In the absence of suitable food sources, some predatory mites may feed on each other or other Phytoseiidae species.

# life cycle



Predatory mite eggs (*Phytoseiulus* sp.)

## Egg

- laid on the underside of the leaf
- in the vicinity of prey
- development period: 2 to 3 days



Predatory mite larva (*Neoseiulus* sp.)

## Larva

- depending on the species, there are non-feeding and feeding larvae
- development period:  $\pm 1$  day



Protonymph (*Neoseiulus* sp.)

## Nymph

- protonymph development period (first nymphal stage): 1 to 2 days
- deutonymph development period (second nymphal stage): 1 to 2 days



Adult predatory mite (*Phytoseiulus* sp.)

## Adult

- lifespan: 1 to 2 months

# characteristics

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- $\pm 0.1$  mm long
- oval
- transparent just after laying
- yellow to orange with further development

- 
- oval to teardrop-shaped body
  - 3 pairs of legs
  - pale in colour before feeding
  - depending on the species and diet: orange to dark brown

- 
- 4 pairs of legs
  - very similar to the adults apart from being smaller in size
  - nymphs have the same colour spectrum as the larvae

- 
- 0.3 to 0.6 mm
  - $m < f$
  - 4 pairs of legs
  - teardrop-shaped, hairy body
  - colour varies from white to brown and is similar to larvae and nymphs

full-size adult



10x full-size adult

## General characteristics

- number of generations/year: 4 to 6
- peak period: April to September
- usually on the underside of the leaves (where the prey is)
- hibernates in sheltered places such as bark, fallen leaves, bud scales, etc. as an adult

## Did you know that...

- the various species of predatory mites are determined based on their hair distribution, among other things?
- there are also soil mites? These belong to the Laelapidae family (e.g. *Hypoaspis* sp.), among others.
- some predatory mites can survive without food for at least 10 days? Predatory soil mites even survive easily for 3 to 4 weeks.
- many species can sustain themselves without prey by feeding on pollen and plant secretions?



Deutonymph (*Neoseiulus* sp.)



Predatory mite attacks dust louse



Predatory mite (*Phytoseiulus* sp.) attacks spider mite



Predatory mite attacks thrips



# Predatory bugs including Anthocoridae

There are various families of predatory bugs (Nabiidae, Miridae, Reduviidae, Anthocoridae, etc). The Anthocoridae, commonly called pirate bugs or flower bugs, are the most important for biological pest control because of their high requirement for food and adaptability. This family is therefore described on the following pages.

## Predatory bugs as a natural enemy

- The adults feed on pollen from flowers (mainly alder) in the spring after leaving their overwintering sites. They switch to feeding on animal prey when it becomes available.
- The nymphs in particular are predators and feed on aphids, psyllids, spider mites, caterpillars, and eggs of various insects. Some species also eat rust mites, gall midges and other insects.
- The prey insects are pierced with the proboscis before being sucked empty.
- With high densities of prey, the bugs kill more than they need for food.
- Predatory bugs are fairly mobile and can fly well so they can quickly discover new prey hot spots.
- Predatory bugs can also feed on plant sap if there is a shortage of prey.

# life cycle



Predatory bug eggs hatching

## Egg

- laid individually or in a group
- laid near colonies of prey, on the underside of the leaves on young shoots, usually by the veins
- some species lay their eggs in the plant tissue
- development period: 5 to 10 days



Predatory bug nymph

## Nymph

- there are 5 nymphal stages
- development period: around 3 weeks



Adult predatory bug (*Orius* sp.)

## Adult

- active from May
- lifespan: 3 to 4 weeks



# characteristics

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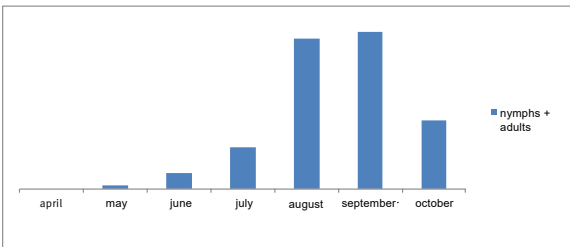
- 0.4 mm long and 0.13 mm wide
- elongated
- colourless; turns white to milky as nymph hatching approaches

- 
- 0.4 to 3 mm
  - young larvae are yellow and turn darker with age
  - size and food consumption increase as development progresses
  - the wing buds become clearly visible in the fifth nymphal stage

- 
- 2 to 4.5 mm
  - flattened and elongated body
  - dark brown to black; front wings have a striking pattern with light brown, grey and black patches
  - the tips of the wings are membranous, the rest hardened
  - wings flat to the body at rest
  - triangular shoulder shield
  - head and neck shields are black
  - a female can lay up to 200 eggs during her lifetime
-



full-size adult



Phenology

## General characteristics

- incomplete metamorphosis
- number of generations/year: 1 to 3
- hibernates in sheltered places as an adult: in bark crevices, bushes and litter layer

## Did you know that...

- predatory bugs are sometimes mistaken for beetles?
- predatory bugs can largely suppress pear psyllid infestations in pear cultivation?
- predatory bugs have a proboscis with two channels? One for sucking up liquid food and one for injecting saliva into the punctured tissue.
- the saliva from predatory bugs has a paralysing effect? This allows them to catch prey much bigger than themselves.
- predatory bugs are often attracted to the scent of honeydew produced by psyllids?
- predatory bugs sometimes dare to bite people by mistake in their search for food?



Predatory bug nymph attacks aphid



Predatory bug nymph attacks aphid



*Anthocoris* sp. looking for prey



# Parasitoid wasps

## including Braconidae

There are many different species of parasitoid wasps, some of which are useful as a natural enemy of insect pests (aphids, whiteflies, caterpillars, leaf miners, mealybugs, etc). In addition to these species, however, there are also parasitoid wasps that can attack beneficial insects such as ladybirds, hoverflies, etc. Parasitoid wasps can parasitise several host species (polyphagous) or be reliant on a single host species (monophagous). Furthermore, not all of the hosts' stages are equally suitable for parasitism. Some parasitoid wasps prefer their hosts' eggs whereas other species only choose their hosts' larvae or pupae. The lifecycle of these parasitoid wasps varies greatly. Depending on the parasitoid wasp species, they develop within (endoparasitoid) or on their host (ectoparasitoid). They can also develop alone (solitary) or simultaneously together (gregarious) in their host.

Larvae from parasitoid wasps feed on the tissue of their host, causing their death (upon completion of larval development). Adult parasitoid wasps on the other hand feed on nectar and honeydew, which they need as a source of energy. Proteins, necessary for egg production, are usually obtained from pollen or from their host by wounding it and then feeding on the wound.

Adult parasitoid wasps generally are characterised by two pairs of membranous transparent wings, with the forewings distinctly larger than the hindwings. They also have long antennae and a narrow 'waist' (i.e. a clear constriction between the first and second segments of the abdomen). Parasitoid wasps can vary in size from 0.5 to 30 mm depending on the species. Adult females have an ovipositor to lay eggs and possibly to paralyse the host during oviposition (depending on the species).

The aphid parasitoids belonging to the Aphidiinae subfamily are discussed on the following pages.

## Parasitoid wasps as a natural enemy

- Plants infested by aphids secrete odours that parasitoid wasps can detect with their antennae via their senses of touch and smell.
- Parasitoid wasps lay their eggs in the adult or nymphal stages of the aphid. Laying the egg barely takes a second.

# life cycle



Parasitoid wasp laying egg in aphid

## Egg

- females puncture the aphid and lay their eggs in the host using a ovipositor
- development period:  $\pm 3$  days



Parasitoid wasp larva in host

## Larva

- develops in the aphid and so is not visible
- solitary endoparasite
- four larval stages
- development period: 13 days



Parasitised aphid with parasitoid wasp pupa inside

## Pupa

- in the host
- does not eat food
- larva spins a cocoon in the remaining aphid skin
- visible as an aphid mummy to the naked eye
- development period:  $\pm 4$  days



Adult parasitoid wasp (Aphidiinae)

## Adult

- lifespan: 10 to 30 days

# characteristics

---

- not visible
- laid in the host

- 
- 2 to 3 mm
  - legless
  - not visible, develops in the aphid

- 
- most species pupate in the dead aphid which is then referred to as a mummy
  - the colour of the mummy varies from golden yellow to light brown, depending on the species of parasitoid wasp that has parasitised it
  - *Praon* species pupate under the dead aphid

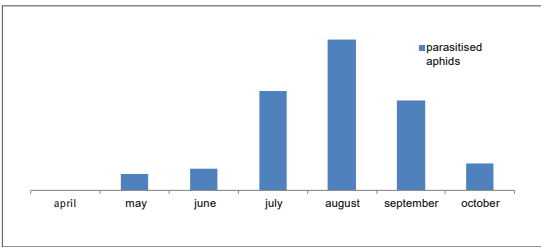
- 
- 1 to 4 mm
  - colour varies from black, brown to orange-yellow
  - the forewings are characterised by a stigma (i.e. a darker patch on the edge of the front wing)
  - the adult female's ovipositor is short and barely visible
  - depending on the species: 8 to 28 antennal segments
  - a female can lay over 300 eggs during her lifetime



full-size adult



5x full-size adult



Phenology

## General characteristics

- complete metamorphosis
- number of generations/year: several
- overwinters as larva in the host

## Did you know that...

- a parasitoid wasp's eggs are initially very small because they need to pass through the ovipositor? Once in the host, they can swell enormously due to the moisture they absorb.
- parasitoid wasp larvae or pupae in the host can in turn be parasitised by another parasitoid wasp? This phenomenon is called hyperparasitism.
- the choice of a particular aphid partly depends on the size of the host?
- there are approximately 808 known species within this subfamily of parasitoid wasps?
- in addition to the Aphidiinae, there is another important family of aphid parasitoids: the Aphelinidae?





Aphid mummies. Exit openings indicate parasitoid wasp has already hatched



Adult parasitoid wasp (Aphidiinae)



Parasitoid wasps (Aphelinidae) (left) are sometimes barely larger than their host (aphid)



# Hoverflies

## including Syrphidae

### Hoverflies as a natural enemy

- Not all hoverfly larvae eat aphids; only the aphidophagous hoverfly species do. The larvae from the other species feed on plant or dead organic matter.
- Only the larvae from aphidophagous hoverflies feed on aphids. Adult hoverflies feed on nectar and pollen, which they need as a source of energy and protein respectively.
- A single larva can eat 400 to 700 aphids during its development, depending on the aphid species and environmental conditions.
- The larvae grab their prey with their mouth hooks, open them up and suck out their contents, leaving only the prey's skin behind.
- Adult females are attracted to aphid populations by the scent of honeydew excreted by the aphids.
- The larvae of hoverflies are mainly active at dusk and during the night.
- Some common hoverflies whose larvae feed on aphids are: the marmalade hoverfly (*Episyrphus balteatus* Degeer), common banded hoverfly (*Syrphus ribesii* L.), vagrant hoverfly (*Eupeodes corollae* Fabricius), long hoverfly (*Sphaerophoria scripta* L.) and the very common species of hoverfly, *Melanostoma mellinum* L.

# life cycle



Hoverfly eggs

## Egg

- laid individually or in a group in the vicinity of their prey
- on the underside of the leaves
- development period: 3 to 5 days



Marmalade hoverfly third-stage larva

## Larva

- three larval stages
- scattered around the plant, in the vicinity of their prey
- passive, only covers short distances looking for prey
- on hairless plants
- development period: 8 to 15 days



Marmalade hoverfly pupa

## Pupa

- inactive; very vulnerable
- development period: 7 to 12 days



Adult marmalade hoverfly

## Adult

- from March
- lifespan: 27 to 38 days (+ possibility of overwintering)

# characteristics

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- $\pm 2$  mm
- oval with reticulated pattern
- white to white-grey

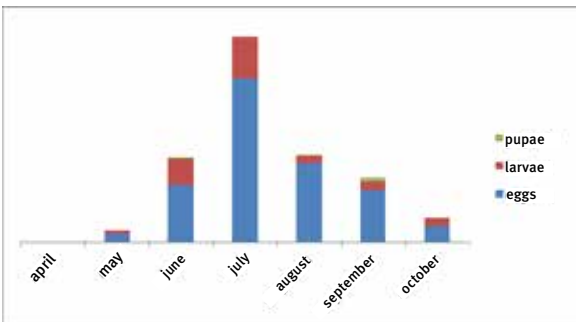
- 
- 10 mm to 20 mm
  - legless
  - no head but mouth hooks that grab the prey
  - colour varies from species to species
  - intestinal contents are visible through the larval skin
  - size and food consumption increase as development progresses

- 
- $\pm 7$  mm
  - teardrop-shaped
  - colour varies from species to species (green, beige, yellow...)
  - the adult hoverfly is clearly visible through the pupal skin just before it emerges
  - does not eat food

- 
- $m < f$
  - 10 mm to 15 mm
  - often display wasp mimicry: the black and yellow pattern is reminiscent of wasps
  - one pair of wings; the second pair has been modified to halteres (club-shaped organs)
  - a female can lay up to 1000 eggs during her lifetime
  - hang in place  $\approx$  hover



full-size adult



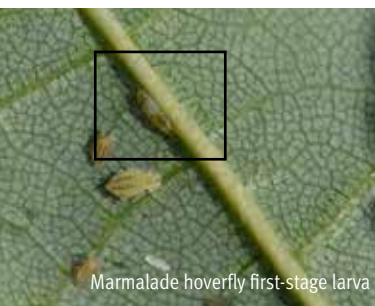
phenology

### General characteristics

- complete metamorphosis
- number of generations/year: 1 to 5

### Did you know that...

- unlike bees and wasps, hoverflies do not sting?
- larvae discharge their intestinal contents just before pupation?  
The black spot that this creates is characteristic of the presence of hoverflies.



Marmalade hoverfly first-stage larva



Marmalade hoverfly second-stage larva



Hoverfly larva



Hoverfly larva



Adult common species of hoverfly,  
*Melanostoma mellinum*



Adult long hoverfly



Adult *Eupodes* sp.



Adult common banded hoverfly





# Rove beetles

## Staphylinidae

There are over 1000 species of rove beetles in Belgium and the Netherlands, which vary greatly in size (1 to 40 mm). They are primarily distinguished by their short elytra that typically leave more than half of their abdominal segments exposed.

### Rove beetles as a natural enemy

- Many rove beetles are true hunters. Both the larvae and the adult beetles feast on all kinds of prey, from snails and worms to all kinds of other small invertebrates.
- Some species also feed on larvae (maggots) of flies that are harmful to agriculture (carrot fly, cabbage fly, etc).
- Some species do not hunt and have dead organic matter on the menu.

# life cycle



Rove beetle eggs

## Egg

- the eggs are usually laid in the ground
- development period: 3 to 19 days



Rove beetle third-stage larva

## Larva

- live in the ground
- three larval stages
- some are parasitic and develop in their host's pupa
- development period: 1 month on average

## Pupa

- in the ground, litter layer or a host
- development period: 12 to 35 days



Adult rove beetle

## Adult

- active during the day and/or night, depending on the species
- most species are exceptional flyers
- move mainly over the ground surface, in the litter layer
- active from early spring (February)
- lifetime from 1 to 2 months

# characteristics

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- 0.3 to 0.5 mm
- oval and gelatinous
- pale green/yellow and turning darker as larval hatching approaches

- 
- 2 to 26 mm
  - pale brown
  - slim, segmented, flattened
  - large dark head with pincer-like jaws
  - wingless

- 
- some species spin a silken cocoon to pupate in
  - other species form a pupal stage where the different body parts can clearly be seen
  - and other species pupate in their host

- 
- 1 to 40 mm
  - (predominantly) slim body
  - much-shortened elytra that only cover two segments of the abdomen
  - folded wings under the elytra
  - mostly black or brown
  - a female can lay 4 to 10 per day, and around 100 during her lifetime.

## General characteristics

- number of generations/year: 1 to 2
- hibernation mainly takes place in (sod-forming) grasses and the litter layer, where they are protected against fluctuating temperatures

## Did you know that...

- some species curl their abdomen up tightly when threatened? If this is not enough, they squirt a smelly white substance from their abdomen.
- some (larger) species can bite hard and even penetrate human skin with their strong jaws?



Rove beetle buries itself in the ground  
(*Bledius* sp.)



Devils coach-horse beetle  
(*Ocypus olens* Muller)



Greenhouse rove beetle  
(*Atheta coriaria*) larva



Rove beetle larva



# Ground beetles

## Carabidae

### Ground beetles as a natural enemy

- Most ground beetles are hunters that feed on various prey such as snails, caterpillars, aphids, worms, sawfly larvae, maggots... Some ground beetles can consume more than 20% of their body weight in a day. They have large, serrated and forward-pointing jaws for this, which enable them to get a good grip on their prey.
- They are mostly active at night, and seek shelter in the ground or litter layer during the day. Some common species reach high densities around their peak period in June, and so have a big impact on suppressing pests.

# life cycle

## Egg

- the eggs are laid in or on the ground
- development period: 1 to 4 weeks



Ground beetle larva

## Larva

- 2 to 4 larval stages
- active during the day and/or night, depending on the species
- live in or on the ground
- development period according to their reproductive period:
  - spring reproduction: 6 to 8 weeks
  - autumn reproduction: 6 months

## Pupa

- beetle larvae dig a hole in the ground or rotting wood to pupate
- development period: 1 to 4 weeks



Adult ground beetle

## Adult

- peak activity during the reproduction season (spring or autumn)
- mostly active at night
- lifespan: 1 to 4 years



# characteristics

---

- oval
- white to pale yellow

- 
- 1 to 38 mm
  - elongated
  - brown to black
  - exclusively carnivorous
  - most sensitive stage
  - not very active

- 
- shrimp-shaped
  - inactive
  - does not eat food

- 
- 1 to 40 mm but the majority < 7mm
  - good runners that appear mainly on the ground surface
  - rarely fly
  - have quite long legs adapted to digging in the ground
  - mostly inconspicuous brown to black colouration (sometimes coloured with metallic sheen)
  - one female can lay 15 to 500 eggs

### General characteristics

- complete metamorphosis
- number of generations/year: 1
- some beetle species hibernate as larvae in the litter layer, others as adults in the litter layer or in sheltered places on the ground

### Did you know that...

- ground beetles secrete a foul-tasting and -smelling substance when they feel threatened?
- the larvae from *Carabus coriaceus* ground beetles need up to 3 years to develop into a full-grown adult?



Larva looking for prey



Larva looking for prey



(*Harpalus* sp.)



(*Acupalpus* sp.)



# Soldier beetles

## Cantharidae

### Soldier beetles as a natural enemy

- Soldier beetle larvae and adults both feed on aphids and other insects with a soft skin. Adults also have pollen and nectar on their menu.
- The larvae in particular are important in the biological control of aphids because they are active during the autumn and winter when other insects are dormant.

# life cycle

## Egg

- the eggs are deposited in moist soil after mating in May and June



Soldier beetle larva

## Larva

- 6 larval stages
- active at night
- active during autumn and winter
- live on the ground
- development period: around 1 to 3 years



Soldier beetle pupa

## Pupa

- pupation takes place in the ground in spring (April to May)



Adult soldier beetle

## Adult

- end of April to September
- mostly active in the day
- observable from April to end of August
- lifespan: 1 year

# characteristics

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- microscopically small
- smooth
- laid in clusters

- 
- velvety appearance
  - brown to dark brown
  - feed exclusively on insects with a soft skin (aphids, midge and fly larvae, caterpillars, earthworms, etc).
  - prefer humid environments such as overgrown fields

- 
- visible appendages
  - inactive
  - does not eat food

- 
- 7 to 15 mm
  - slim beetles
  - characterised by weak elytra
  - yellow to orange-red or black
  - observable in grasslands and open landscapes, often on umbellifers

### General characteristics

- complete metamorphosis
- number of generations/year: 1

### Did you know that...

- like ladybirds, these beetles exhibit reflex bleeding when they feel threatened?
- soldier beetles are so-called because they are slender and straight, often with colouring that is reminiscent of regimental uniforms?





Soldier beetle (*Cantharis fusca*) pupae



Soldier beetle (*Cantharis fusca*) on alder buckthorn flowers (*Frangula alnus*)



Common red soldier beetle (*Rhagonycha* sp.)



Common red soldier beetle on umbellifers



# Spiders

## Araneae

Our country is home to over 690 species of spiders. They are not counted as insects because of their 8 legs and 2-part bodies. They belong to the same class of arachnids as mites and ticks.

### Spiders as a natural enemy

- Spiders are everywhere and can sometimes reach high densities (up to 50 spiders/m<sup>2</sup>) in agricultural and horticultural plots. They consume about 15% of their own body weight every day, and play an important role in pest control. Spiders are particularly important for biological control in early spring. This is when the first winged aphids start flying but most of their enemies are still hibernating or not very active.
- Spiders use a wide range of methods to catch their prey. Some species are active hunters, some lie in wait for prey to pass by, and others make tripwires to locate their victims or build webs. After being caught, the victims are killed with a venomous bite from their pointed poison claws. The prey are then injected with digestive juices and their contents sucked out.

# life cycle



Spider eggs

## Egg

- after mating, the eggs are laid in a cocoon of spider silk
- some hunter spiders carry the eggs with them and display parental care
- most native species hibernate in the egg stage

## Juvenile

- 5 to 10 juvenile stages
- first juvenile stage takes place in the cocoon



Adult spider

## Adult

- most web-building species: autumn
- hunter species: spring
- active during the day or night, depending on the species
- lifespan: 1 to 3 years

# characteristics

---

- the eggs are usually laid in groups surrounded by a cocoon
- mostly oval
- mostly pale

- 
- same appearance as adult spiders but smaller
  - initially colourless, more colour as moulting progresses

- 
- 1 to 18 mm
  - body divided into 2 parts: cephalothorax and abdomen
  - has spinnerets at the back of its abdomen
  - one female lays around 100 eggs on average (varies per species)
-

## General characteristics

- incomplete metamorphosis
- number of generations/year: 1
- hibernates in sheltered places hidden in dense webbing as the egg stage (most species) or as a juvenile

## Did you know that...

- some spiders can travel by air? This form of travel is called 'ballooning'. Spiders crawl to a high point for this, raise their abdomen and produce a silken thread. When the thread is long enough, the spider is transported through the air by the upward airflow. They can cover distances up to 300 km like this.
- male spiders risk their life when mating? Female spiders are often much larger than their male counterparts and can also be very aggressive. Mating follows a strict protocol, and many males pay with their lives if they deviate from it.



Spider with cocoon



Zebra spider with prey



Spider with aphid prey



Ground spider looking for prey

## Sources and references

Verschoren L., De Bleeker V., Moens J., De Vos A. Scientific research project '*Functionele biodiversiteit als basis voor de geïntegreerde bestrijding in de laanboomteelt*' (*Functional biodiversity as a basis for integrated pest management in standard tree cultivation*). Ghent University

Moens, J. & De Roissart, A. Scientific research project '*Beheren van Bladluizen op bomen m.b.v. natuurlijke vijanden*' (*Controlling aphids on trees with natural enemies*). Ghent University

De Roissart, A., Paulus, I. & Moens, J. 'Citizen science' project '*Inrvivi: insecten, vriend of vijand?*' (*Inrvivi: insects, friend or foe*). Ghent University

Graphs on occurrence of beneficial insects:

The data (graphs) on the occurrence of the various beneficial insects are based on visual assessments of lime trees during a four-year study in standard tree cultivation.

Soortenbank.nl.

Groenkennisnet.nl

[http://www.kvlt.be/kvlt/projecten/biobestrijders/infoBestrijders.asp?vijand\\_ID=8](http://www.kvlt.be/kvlt/projecten/biobestrijders/infoBestrijders.asp?vijand_ID=8)

<https://www.thoughtco.com/rove-beetles-family-staphylinidae-1968139>

[http://entnemdept.ufl.edu/creatures/misc/beetles/rove\\_beetles.htm](http://entnemdept.ufl.edu/creatures/misc/beetles/rove_beetles.htm)

<https://faculty.ucr.edu/~legneref/identify/staphy.htm>

[www.natuurpunt.be](http://www.natuurpunt.be)

Muilwijk, J., Felix, R., Deconinck, W. & Bleich, O. (2015) De loopkevers van Nederland en België (The ground beetles of the Netherlands and Belgium) (Carabidae).

Kanat, M., Toprak, Ö & Akbulut, S. 2005. Determination of some biological characteristics of *Calosoma sycophanta* L. (Coleoptera: Carabidae). Turkish Journal of Zoology

Three Carabid Beetles New to Maryland and a Preliminary Annotated Checklist for Cove Point, Calvert County, Maryland By Brent W. Steury (2016)



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This field guide was conceived and created for farmers and horticulturalists, students... and anyone involved in nature on a daily basis who wants to consider beneficial insects and predatory mites.

Characteristics, development and clear photos of various useful insects and predatory mites are provided so that they can be easily identified in nature.

