

Biological Control in the Urban Environment: Part II

Parasites and Pathogens



Beauveria bassiana



Parasite pupae on host caterpillar



Viral infected larva



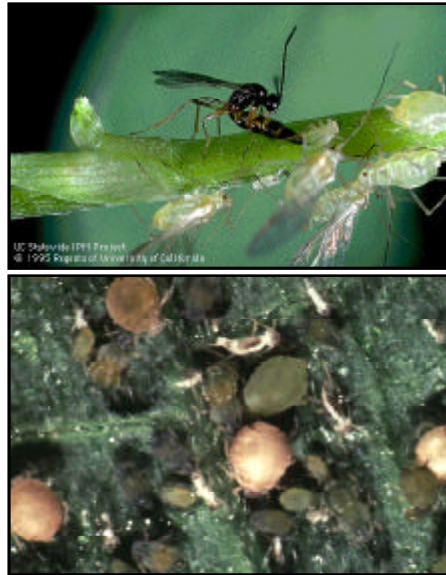
Caterpillar parasite

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Parasites (also called parasitoids) are very diverse in appearance, biology, and the hosts they attack. Most parasites are small to minute and are easily overlooked. There are thousands of different species of parasites in North America. Most insects, including pest insects, are attacked by parasites.

Pathogens are disease-causing organisms including bacteria, fungi, viruses, protozoa (microsporidia) and nematodes that can be important in natural control of pest populations. Pathogens that attack and kill insects are called entomopathogens.

Parasites



Aphid parasites

Aphid parasites reproduce by laying their eggs in aphids and the aphid becomes mummified (aphid mummy). Aphid parasites are an important biological control agent of many economic pest aphids.



Caterpillar parasites

Caterpillar parasites are slender with long segmented antennae. Females have a long needle-like ovipositor (egg laying apparatus) projecting from the posterior of the abdomen; some are stout bodied.

Hyposoter parasitizes cabbage looper, fall webworm, tent caterpillars, and tomato fruitworm.

Cotesia commonly parasitizes alfalfa caterpillar, imported cabbage worm, loopers, and tent caterpillars.



Trichogramma spp.
©Photo courtesy of Holt Studios, UK

Egg parasites

Egg parasites are usually about 1/50 to 1/16 inch, some of the smallest of insects.

Trichogramma egg parasite is an important biological control agent of tomato fruitworm.



Parasitic flies

Tachinidae is the most important family of parasitic flies. They usually look like large house flies, or are bee- or wasp-like in appearance. They attack the larvae of moths and butterflies including the alfalfa looper, fall armyworm, variegated cutworm, and codling moth. Parasitic flies attack many beetle species, including the Colorado potato beetle, elm leaf beetle, tent caterpillars, fall webworm, and lady beetles.

Parasitic flies are second only to parasitic wasps in their beneficial importance.



Sunflower stem weevil parasite (*Nealiothus curculionis*)

Beetle parasites

Beetle parasites are small insects, less than 1/8 inch long. Many have a brilliant metallic coloring and are parasites of a number of major crop pests.

Not all beetle parasites are beneficial. More than 40 species of beneficial lady beetles are attacked by the braconid wasp *Dinocampus* (= *Perilitus*) *coccinellae*.

Pathogens



Fungi

Beauveria bassiana, known as the white muscardine fungus because infected larvae turn white or gray, is available as a commercial formulation for whiteflies, aphids, grasshoppers, Colorado potato beetle, bark beetles, lygus bugs, chinch bug, European corn borer, and codling moth.

Metarhizium species are being tested for corn rootworm, white grub, and some root weevil control. Infected larvae turn a shade of green. *Metarhizium anisopliae* is registered in the U.S. for household cockroaches.

Paecilomyces fumosoroseus is a naturally occurring fungus that infects and kills several kinds of insects. Infected insects will be covered with a rosy-tan to smoky-pink (or gray) fungal mass.

Nomuraea rileyi has activity against green cloverworm, cabbage looper, imported cabbageworm, armyworms, and corn earworm. A light gray to green fungal mass can be seen on the infected host.

Zoophthora radicans infects potato leafhopper throughout the Midwest. Outbreaks of *Z. radicans* occurs during cool, wet periods in July and August, killing the leafhopper in two to three days. Infected insects become covered with a colorless to darkened fungal mass.

Entomophaga species attack grasshoppers. Grasshoppers infested with *E. grylli* crawl to the top of plants where they die with their head pointing upward and legs wrapped around the stem. *Entomophaga grylli* cannot not be mass produced and fairly dry conditions are necessary for this disease to spread.

Entomophthora muscae infects adult flies. Epizootics coincide with periods of cool and humid conditions that occur during the spring and fall. Infected flies attach to the underside of plant leaves or can be seen attached to windows. Characteristics of infected flies included a distended abdomen and outstretched legs and wings.

Hirsutella thompsonii infects mites. Infected mites appear erect and hard or leathery.



Viruses

Nuclear polyhedrosis viruses (NPV), cytoplasmic polyhedrosis viruses (CPV) and granulosis viruses (GV) are important groups of viruses that attack insects. A virus-infected insect appears sluggish and will stop feeding; the cuticle will have a pale discoloration and will often hang from its legs.



Nematodes

Steinernema carpocapsae is the most available commercial formulation of all the entomopathogenic nematodes. This nematode is most effective against surface-dwelling insects such as caterpillars, including various webworms, cutworms, armyworms, girdlers, and wood borers.

Steinernema feltiae also is available in commercial formulations and primarily attacks flies such as fungus gnats. This nematode can maintain its infectivity at soil temperatures below 50° F.

Heterorhabditis bacteriophora is an important entomopathogenic nematode, but it's short shelf-life and infectivity period of only a few days following application limits its commercial use. *Heterorhabditis bacteriophora* does attack caterpillars and beetle larvae but is most useful against root weevils.

Insects killed by these microscopic roundworms become brownish yellow to red in color and the tissue assumes a gummy consistency.



Bacteria

Bacillus thuringiensis (commonly called Bt) is an important *Bacillus* bacteria for insect pest control. Strains of Bt are specific against caterpillars, mosquito larvae and some beetles and their larvae.

Commercially available *Bacillus thuringiensis* (Bt) varieties and target pests:

- var. *tenebrionis* — Colorado potato beetle and elm leaf beetle larvae
- var. *kurstaki* — caterpillars
- var. *israelensis* — mosquito, black fly, and fungus gnat larvae
- var. *aizawai* — wax moth larvae, diamond back moth caterpillar, and other various caterpillars



Protozoans (Microsporidia)

Nosema locustae infects grasshoppers and crickets and is slow to kill its host.

Nosema pyrausta (= *Perexia pyraustae*) can be an important natural control of European corn borer. Spores are spread via contaminated frass or when infected larvae come into contact with healthy individuals.

Vairimorpha necatrix occurs naturally and infects corn earworm, European corn borer, armyworms, fall webworm, and cabbage looper. Insects can die within six days of being infected.

Parasites in Urban Landscapes

Aphid parasites Egg parasites
Beetle parasites Parasitic flies
Caterpillar parasites

Characteristics of parasites

- Inconspicuous and are usually smaller than their host.
- Usually specialized in their choice of host.
- Only immature stages feed on the host and require only a single individual host to complete development.
- The free-living adult feeds on nectar from available flowering plants.
- Only the female searches for the host.
- Parasites attack only one life stage (egg, larva or nymph, pupa, or adult) of its host.
- Are not harmful to humans.

Recognizing parasitism

Parasitism (parasite attacked host) is easily overlooked because parasites are less obvious than predators and parasitized hosts superficially appear healthy.

- Parasitized host usually changes color.
- Parasitized host may wander, leaving its food source for another location.
- Parasitized host may become mummified. (Mummies are puffy, paper- or leather-like, and golden in color, or black with little puffiness; usually attached to leaves.)
- Parasite eggs, pupae, or cocoons may be found on the host.
- An emergence hole made by the adult parasite may be found on the surface of the dead host.

Pathogens in Urban Landscapes

Characteristics of insect pathogens

- Tend to be specific to certain species or groups of pests.
- Kill, reduce reproduction, slow growth, or shorten the pest's life.
- Effectiveness may depend on environmental conditions or host abundance.
- Usually relatively slow acting, may take several days to provide adequate control.
- Under optimal environmental conditions they can cause rapid mortality, or epizootics.
- Do not harm nontarget organisms, such as beneficial insects, animals, humans, or plants.

Fungi

- Fungal hyphae penetrate the insect cuticle or "skin" and produce spores that multiply throughout the body.
- Fungi destroy the insect tissue or produce toxins, killing the insect.
- Fungal hyphae penetrate outward through the softer parts of the insect and produce spores that are released into the environment to complete the life cycle.
- Insects that are attacked by fungi often retain their shape but usually become hardened, "mummy-like" and appear "fuzzy" from the fungal growth.
- Primary hosts of fungi include aphids, whiteflies, leafhoppers, flies, beetle larvae, caterpillars, thrips, and mites.
- Some entomopathogenic fungi are available in commercial formulations.

Bacteria

- The early insect larval instars are the most susceptible stages to the bacteria.
- Infected insects show a loss of appetite, sluggishness, discharge from the mouth and anus, discoloration, and liquefaction and putrefaction of the body tissues.

Viruses

- Most insect viruses need to be ingested to successfully infect their host.
- Some spread from insect to insect during mating or egg laying.
- Viruses require living insects in which to grow.
- An infected insect appears sluggish, stops feeding, the cuticle will have a pale discoloration, and often hangs from its legs.
- The infected insect will die one to two days after the symptoms appear; GVs and CPVs debilitate their hosts.
- The decomposing cadaver will burst, liberating the viral particles into the environment.
- Viruses usually attack the larval stage.

Protozoans (microsporidia)

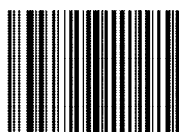
- Infect a wide range of insects.
- Must be consumed to infect an insect.
- Microsporidia slowly kill the host insect by reducing its reproduction or feeding.
- Infected insects appear sluggish and smaller than normal and may have difficulty molting.
- Infected insects are more susceptible to other mortality factors (other diseases or adverse weather).

Nematodes

- Tiny (microscopic) roundworms.
- Effective against many soil or surface dwelling insect pests.
- Most entomopathogenic nematodes kill their host in 24-48 hours.
- Insects killed by nematodes become brownish yellow to red or "milky" in color and the tissue assumes a gummy consistency.

A black cadaver with an associated putrefaction indicates that the insect was not killed by an entomopathogenic species. These insects are often killed by saprophagous nematodes.

For more information on this and other topics, see: www.ag.ndsu.nodak.edu



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