



Home & Garden Pest Management Guide For British Columbia

2019 Edition

Chapter 6 Beneficial Organisms and Biological Control Agents



Beneficial Organisms & Biological Control Agents

Biological pest control has been growing in popularity in British Columbia due to many factors, including a concern for the environment, pesticide resistance, withdrawal of registered pesticides, and an increased availability and variety of commercially available biocontrol agents. Several insect pest problems in home gardens and greenhouses can be managed with beneficial insects and organisms. The use of biological control agents will reduce the environmental and health hazards of chemical use in the garden.

Many insects found in the garden are beneficial insects that eat plant pests and are harmless to the plants themselves. When planning your garden, consider including plants that are good hosts for beneficials or “refuge” areas where beneficials can feed and reproduce. Plants from the parsley (Apiaceae) and daisy (Asteraceae) families such as parsley, dill, coriander, daisies, asters, sunflowers and zinnias are good ‘lures’ for beneficials. When food for predators and parasites is eliminated, they will move on in search of other food. Keeping plants completely free of pests will discourage these beneficials from becoming established because they will not lay eggs where there is no food for their offspring.

Some naturally occurring beneficial insects can be mistaken for pests and accidentally wiped out by insecticide use. An example is the predatory midge, *Aphidoletes*, whose juvenile stage is a reddish/orange maggot. They can be mistaken for harmful insects, but they are actually eating the aphids! The presence of naturally occurring beneficial insects is taken into account when using an integrated pest management program.

Before using pesticides to control insects and mites on plants, always check to see if beneficial insects are present first. If they are present in sufficient numbers, other management techniques may not be necessary. If you choose to use a pesticide, plan to use products least harmful to beneficials. Your garden centre or a Master Gardener can advise you on what is best to use. Always refer to the pesticide label for detailed information and correct usage.

Beneficial Insects

Beneficial insects belong to three categories: predators, parasitoids, and pollinators.

Predators capture and eat other organisms such as insects or weeds. Examples are larvae and adults of ladybird beetles, ground beetles and brown lacewings; larvae of syrphid (hover) flies, green lacewings, aphid midges (*Aphidoletes*); and yellowjacket wasps.

Parasites/Parasitoids: A parasite is an organism that lives and feeds within or on a larger living organism, its host. Parasites weaken and sometimes kill their hosts. Parasites of insect pests include disease-producing bacteria, fungi, protozoa, viruses and some nematodes.

Insects that parasitize other insects and arthropods are referred to as parasitoids. The immature stages of parasitoids develop on or within its host, eventually killing it. Parasitoids may attack all stages of their host – eggs, larvae, nymphs, pupae, and adults. Examples of parasitoids are aphid

and whitefly parasitoids, which lay their eggs inside their host. Tachinid flies lay their oblong white egg(s) on the outside of their host (usually caterpillars). When the eggs hatch, the maggots bore into the caterpillar. The caterpillar may die or develop into a pupa. In either case, a tachinid fly, not a moth or butterfly, will emerge from the caterpillar or from the pupa.

Predators that may be available for direct purchase at garden centers include predatory nematodes (indoor and outdoor), ladybugs, preying mantids, mealybug predators, aphid midge, and predatory mites for control of spider mites, thrips and fungus gnats.

Pollinators are insects that pollinate many of our berry, fruit and vegetable crops, as well as many seed crops. Some commercial vegetable growers will use bumble bee hives to pollinate tomato crops. Examples of pollinators are honey bees, leafcutter bees, other wild bees, some flies, butterflies, moths and other insects that visit flowers to feed on nectar and pollen. See ‘Protecting Insect Pollinators, page 6-6.’

Predators

Ladybird beetles

Ladybird adults and larvae feed on aphids, whiteflies, scales, mites, mealybugs and other soft-bodied insects. Adults vary in size, colour and pattern depending on the species. Adults can be black, red, and orange-red to almost yellow and may have coloured spots or markings on their backs. Immature stages may look like tiny alligators. Purchasing ladybird beetles for release in outdoor gardens is not recommended as they usually just fly away. However, they can be very helpful in managing pests in greenhouses and solariums.



Ladybird beetle adults



Ladybird beetle larvae



Ladybird beetle pupae



Ladybird beetle eggs

Lacewings

Lacewing larvae feed on aphids and other soft-bodied insects. Adults are light green delicate looking insects with large “lace-like” wings and larvae are flat with big mouthparts extending from the head.



Green lacewing adult



Brown lacewing adult

Photo courtesy of E.S. Cropconsult Ltd.



Green lacewing eggs



Lacewing larva

Syrphid (Hover) fly

Syrphid fly larvae feed on aphids, scales, thrips and other small soft-bodied insects. Adult syrphid flies resemble yellowjacket wasps in colour; they can often be seen hovering around flowers before landing to feed on nectar and pollen (their only food source). Larvae are maggot-like and may be yellow, green or brown; eggs are white and look like grains of white rice in aphid colonies.



Syrphid fly



Syrphid larva feeding on aphid



Syrphid fly eggs (red arrow)



Syrphid fly

Ground beetle larvae live in the soil and feed on soil dwelling pests such as caterpillars, cutworms and slugs. **Spiders and predatory mites** are also highly beneficial. Spiders feed almost entirely on insects, and predatory mites feed on plant-feeding pest mites. Ants are predators of many insects, but some protect aphids to feed on their honeydew.



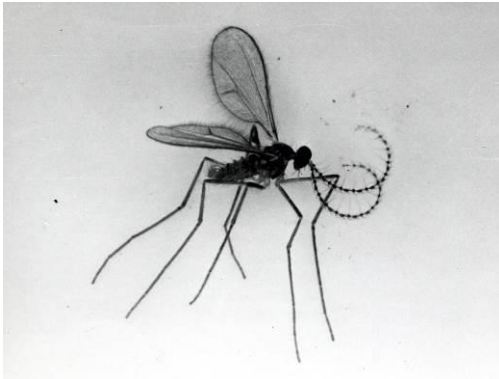
Carabid ground beetle adult



Crab spider

Aphid Midge

Aphid midges are tiny flies with long, slender legs. They often stand with their antenna curled back over their head. Adults hide under leaves during the day; feed on the honeydew produced by aphids, and lay eggs within aphid colonies. Their larvae are bright orange and consume soft-bodied insect pests. The larvae are voracious feeders and can be more effective at managing an aphid infestation than ladybugs and lacewings. Aphid midges are commercially reared and can be purchased as pupa, which should be scattered onto moist, shaded soil.



Aphidoletes thompsoni,
Photo courtesy of USDA Forestry Service



Aphidoletes larvae

Predatory Mites

Predatory mites have either small, almost spider-like bodies or red, pear-shaped bodies. Unlike other mites, predatory mites do not feed on plants. Predatory mites also have longer legs and are able to move more actively along leaves and soil as they search for prey. They also do not have wings, segmented bodies or antennae. The predatory mite's special characteristic is its ability to consume large populations of spider mites. Predatory Mites attack and eat most species of spider mites including damaging Red Spider Mites also known as Two Spotted Mites.



Predatory mite and 2-spotted spider mite



Predatory mites (arrows) with European red mite

Parasites/Parasitoids



Tachinid fly,
photo courtesy of Joseph Berger, Bugwood.org



Tachinid eggs on Armyworm,
photo courtesy of Robert J. Bauemfiend,
Kansas State Univ., Bugwood.org



Encarsia formosa, whitefly parasite



Encarsia Formosa, photo courtesy of
David Cappaert, Bugwood.org

Biological Control Agents

Biological control agents are useful pest control tools for reduction of pest populations in home gardens. These agents may be beneficial insects, mites or nematodes, or micro-organisms such as fungi, viruses or bacteria which attack pests or reduce pest numbers by competition. Some biological control agents occur naturally. For example, many types of compost contain bacteria that can protect plants from root-rotting micro-organisms and other diseases. Other specific agents, such as predatory mites, can be introduced deliberately into a crop or garden. Some biological control agents are registered as domestic pesticides. An example is the natural fungicide *Bacillus subtilis*, a bacterium that helps to control several plant diseases.

Beneficial nematodes are very small round worms which infect soil dwelling insects such as weevils, beetle larvae or fungus gnat larvae. They kill insects by injecting them with a bacterium, then using the insect as a food source. Two species of nematodes that attack insects are *Heterorhabditis* and *Steinernema*. These are commercially available and have proven effective if used properly on many significant lawn and garden soil pests such as Japanese beetle, European chafer, crane fly larvae (leatherjackets), weevils, rootworms, fleas, sod webworms, and larvae and pupae of fungus gnats. The nematode *Steinernema feltiae* is used indoors to control fungus gnats and thrips pupae in the soil of potted plants, and as foliar sprays to control thrips and scale insects.

Bacillus thuringiensis (Bt) is the most widely used bacteria for pest control. Different subspecies are commercially available for the control of foliage feeding caterpillars, larvae of leaf beetles, mosquitoes, blackflies and fungus gnats. Bt products are very safe for the applicator and the environment, and do not harm non-target organisms.

Adult *Encarsia formosa*, is a parasitoid used to control whitefly in the greenhouse and home garden. The female lays eggs in whitefly scales (larvae). The parasite develops inside the scale, turning it black. The complete cycle takes 3 to 4 weeks at average greenhouse temperatures above 22 °C. They should be introduced when whiteflies are first seen and it is often best to apply *Encarsia* bi-weekly until the black (parasitized) scales outnumber the light green (unparasitized) scales. *Encarsia* has been successfully used in managing greenhouse whitefly populations in greenhouses and conservatories for many years. However, in outdoor settings where favourable temperature and light conditions cannot be maintained, its use is limited.

The predatory mite, *Phytoseiulus persimilis* feeds on the two-spotted spider mite and is harmless to people or plants. The optimum temperature for this predator is 21 °C to 27 °C. It feeds on all stages of its host, and can eliminate infestations within 5 to 8 weeks if introduced at the first sign of mites or their damage. Other predatory mites are present in nature and available for purchase that will control various pests including thrips, whiteflies, and spider mites in outdoor crops.

Remember, it is not essential to eliminate all insect and mite pests. A few insects will not cause noticeable harm, and they will provide a food source for maintaining beneficial organisms. It is a good strategy and often required for success, to release the beneficials more than once at regular intervals, starting early in the growing season and continuing releases for some time into the growing season. Releases may need to occur each year, as naturally occurring (baseline) populations of beneficials may not be adequate to control the pest in a timely manner.

The use of biological control agents requires some knowledge, time and work to be successful. The pest must be present in large enough numbers and the environment (temperature and humidity) must be acceptable for the biological control agent. The effort is often well worth it, as the use of biological control can significantly reduce pest numbers and plant damage, with no risk of pesticide injury to plants or other organisms, including people and pets.

For information on how to obtain parasites or predators, contact your local garden centre.

Promoting Beneficials

The following practices will help conserve beneficials in the garden:

- Know your enemies and allies. Be able to distinguish beneficials from pests.
- Use cultural practices to manage pest problems. If insecticide application is needed, use the least harmful ('soft') products such as horticultural oils or *Bacillus thuringiensis*. Apply pesticides only where pests are causing injury (spot treat). Remember that some fungicides and herbicides can also be harmful to beneficials.

- Leave refugia for beneficials. Unsprayed infested plants provide food and freedom from spray residues.
- Cover refugia plants to protect beneficials when spraying harmful pesticides.
- Provide overwintering shelter for beneficials.
- Provide flowering plants which serve as nectar and pollen sources for beneficial flies and wasps. Examples include mustard, daisies, alyssum, wild carrot, yarrow, buckwheat, goldenrod, anise, clover, milkweed, and black-eyed susan.

Protecting Pollinators (Honey bees and wild bees)

Wild bees and honey bees play a key role in the production of many crops; they pollinate plants so the plants produce fruit and seeds. Pollination involves the transfer of pollen grains from the anthers (male flower parts) to the stigma (female flower parts). Honey bees are commonly used in commercial fruit crop production where large numbers of bees are needed during bloom. Nature also offers a wide range of bees that are equally important in the pollination of flowering plants. These include bumble bees, mason bees, leafcutter bees, sweat bees, alkali bees, and many others.

Home gardeners can encourage natural pollinators to visit their gardens by growing a diversity of flowering plants. Grow flowers of different colours and shapes, and provide continuous bloom throughout the season to support a range of bee species.

Virtually all fruit crops consumed by humans are completely dependent on insect pollinators. Without bees, there will be no pollination, resulting in poor fruit set. With such an important role, it is imperative that gardeners and fruit growers protect bees from poisoning when insecticides are used.

Precautions to prevent or reduce bee poisoning when it is necessary to apply insecticides:

- Avoid application of insecticides while blossoms are open.
- Select a liquid formulation. Avoid powder formulations.
- Apply insecticides only in the evening or at night when bees are not foraging.
- Weather conditions can affect bee poisoning. Insecticide residues on plants may last up to twice as long during unusually low temperatures, compared to warm temperatures. If abnormally high temperatures occur in the evening or early morning, then bees may actively forage during these times.
- Do not apply insecticides during windy periods because of spray drift.
- Flowering weeds or ornamentals beneath fruit trees often attract bees. Insecticides applied to the tree may contact flowering plants below and cause bee poisoning. Mow or physically remove flowering weeds before spraying.
- Tell neighbouring beekeepers if you are going to spray insecticides.
- If you keep bees, ask your neighbours to tell you if they are going to spray insecticides.

Select least-toxic insecticides:

- Some commonly used insecticides that are very toxic to bees include: permethrin and cyfluthrin as well as some older insecticides that are no longer sold for home garden use such as carbaryl, diazinon, phosmet and dimethoate. These insecticides should not be applied to blossoming fruit, trees, berries or ornamental plants which are visited by bees.
- Pyrethrins are toxic to bees during and immediately after spraying, but do not last long on the plant.
- Malathion and spinosad are moderately toxic to bees. Avoid spraying blossoming plants, and apply only in the evening when bees are not flying.
- The following insecticides are of low toxicity to bees: Btk, and insecticidal soap.
- All fungicides and herbicides recommended in this guide are non-toxic to bees.
- Always follow all label instructions and precautions when using pesticides.



Pollinator Gallery



Honey bee



Honey bee



Bumble bee



Mason bee (*Osmia* sp.)



Mason bee (*Osmia* sp.)



Mason bee (*Osmia* sp.)



Leafcutter bee on alfalfa (*Megachile rotundata*). Photo courtesy Dr. Shelley Hoover, Alberta Agriculture & Forestry



Leafcutter bees (*M. rotundata*). Photo courtesy Dr. Shelley Hoover, Alberta Agriculture & Forestry



Leafcutter bee (*M. rotundata*) Photo courtesy Dr. Shelley Hoover, Alberta Agriculture & Forestry



Halictid (Sweat) bee



Digger Bee



Butterfly