

Biological Control Agents:

2nd Draft.

Biological control is a technique used to manage living organisms (insects, mites, etc.) and plant diseases (fungi, bacteria, viruses), using a variety of other living organisms. It relies upon four types of “Agents”: **Predators, Parasites & Parasitoids and Pathogens.**

Some pesticides/fungicides/bactericides used can harm beneficial control agents. Therefore it is important to use chemicals that are compatible with bio control agents before spraying.

Predators: Predation is a natural interaction where a predator (the hunter), feeds on its prey (the hunted). Predators directly consume large numbers of “prey” daily. For the orchid grower “prey” is orchid pests like: aphids, mites, scales, caterpillars, grasshoppers, etc.

Praying Mantis. Mantises are one of the best-known predator families. Sadly, they do not discriminate between beneficial and harmful garden insects.

Ladybug beetle. The beetle larvae are voracious predators of aphids, mites, scale insects and small caterpillars.

Ladybird. Species are endemic to Queensland and NSW, Australia. These mostly brown beetles have no spots. Ladybirds target mealy-bugs. Their larva resembles mealy bug, their prey. **Cryptolaemus** are Australian native ladybird beetles. They are very efficient predators of mealy bugs. The adult beetle is ca. 0.4cm long with an orange head and black wing covers. The larvae grow to 1.5cm long and are covered in waxy filaments. The larvae look very much like mealy bugs and are often confused with them. Adult beetles and young larvae feed on mealy bug eggs and young stages. Large cryptolaemus larvae can also consume adult mealy bugs. Cryptolaemus also feed on many other species of soft scales.

Chilocorus ladybird beetles are predators of many species of scale insects. The “Red” is a helmet-shaped ladybird beetle of an orangish color ca. 5 mm long. The “Blue” is smaller and is a deep, metallic blue color. The larvae are voracious feeders. The Chilocorus beetles live for up to 8 weeks.

Montdorensis is an Australian predatory mite that feeds on thrips, whitefly, other small insects and mites as well as on pollen and honeydew. It is a small, pear-shaped mite. The female can lay 3-4 eggs per day, and an adult mite can kill more than a dozen thrips larvae per day. Targets thrips and white flies.

Aphytis are small yellow wasps that are not very mobile and have a life span of two weeks. The adult female wasp lays her eggs under the scale cover. After hatching, the larvae feed on the scale insect, ultimately killing it. Adult wasps also feed on scales directly.

Hover flies or Syrphid flies. The larvae of some hover fly species are “saprotrophs” (eat decaying plant and animal matter) but the larvae of some other species are “insectivores” and prey on aphids, thrips and other plant-sucking insects. Hover flies are harmless to most other organisms despite their mimicry of more dangerous wasps to deter predators. Some adult flies are also known as important pollinators.

Soldier Beetles or Leatherwing. These, almost soft-bodied beetles, are related to the firefly family. The larvae are brown or gray, slender, wormlike and have a rippled appearance due to pronounced segmentation. It targets mostly aphids and soft-bodied insects, as well as caterpillars and grasshopper eggs. The adults are important predators of aphids.

Green & Brown lacewings. Lacewings feed mostly on pollen, nectar and honeydew although some supplement their diet with aphids, mites and other small soft-bodied insects. The females lay eggs in places where aphids are present in large numbers. After hatching the larvae

will mould and start to consume the eggs. They are voracious predators, attacking most insects of suitable size, especially aphids, caterpillars, insect larvae, insect eggs, etc. The larvae are also known under the nickname "aphid lions" or "aphid wolves".

Minute Pirate Bug. The genus Orius consists of omnivorous bugs and belongs to the family Anthocoridae (pirate bugs). The adults are 2–5 mm long and feed mostly on spider mites, thrips and their eggs, occasionally they also feed on pollen.

Nematodes. Nematodes kill slug thereafter feeding and reproducing inside.

Big-eyed bugs. These are true bugs in the order Hemiptera and are considered an important predator of mites and insect eggs. Big-Eyed bugs deposit their eggs individually or in clusters on leaves in close proximity to the targeted prey. Both nymphs and adults are predatory.

Damsel bugs. Soft-bodied, elongate and winged terrestrial predators that prey mostly on aphids.

Hypoaspis. Predatory mites that feed on various larvae of gnats and pupae of thrips.

Occidentalis. Predatory mite that feeds on two-spotted mites, spider mites, thrips and white flies.

Persimilis. Predatory mite that feeds on two-spotted mites.

Predatory Mites: *Phytoseiulus persimilis* targets two spotted spider mites and *Amblyseius californicus* targets numerous species of spider mites

Predatory gall midge: *Feltiella acarisuga* targets numerous species of spider mites.

Predatory Bugs: *Macrolophus caliginosus* targets spider mites, white flies, aphids and thrips.

Parasites and Parasitoids:

Parasitism is a one-sided relationship between two or more unrelated life forms. One, the parasite, benefits at the expense of the other, the host. Parasites are normally smaller than their hosts, show a high degree of specialization, and also reproduce at a faster rate. Micro-Parasites, such as viruses and bacteria, can be directly transmitted between hosts of the same species.

Parasitoids are parasitic organisms that spend part of their life cycle attached to or inside a single host. Unlike parasites, parasitoids ultimately kill, and in most cases consume their host.

The main difference between parasites and parasitoids: **Parasitoids normally kill their host but Parasites do not.**

Parasitoids lay their eggs on or in the body of a host, which is then used as a food source for the developing larvae and ultimately, the host is killed.

Most parasitoids are wasps or flies and usually have a very narrow host range. They are one of the most widely used biological control agents.

Aphidius. Tiny wasp, which parasitizes many aphid species. The wasp is about 2-3mm long and black with brown legs and resembles black winged ants. Adult wasps deposit an egg into the aphid. The aphid continues to move and feed for days as if nothing happened. Only when the egg hatches, the larva begins feeding on the aphid eventually killing it. The parasitoid within the aphid body and at this stage it is called a "mummy". Eventually, the wasp will chew a hole through the back of the mummy and will emerge as an adult wasp to start a new life cycle.

Tachinid Fly. It parasitizes a wide range of insects, adult and larval beetles, true bugs, caterpillars, grasshoppers, and others. The larvae of most Tachinid fly species are parasitoids, developing inside a living host, ultimately killing it; however, there are a few that are parasitic and do not kill the host. Tachinid larvae are endoparasites and feed on the host tissues.

Chalcid wasp. It belongs to the order Hymenoptera and is among the smallest of insects (<3 mm). The tiny wasps are dark-colored metallic blue or green and are mostly parasitoids, attacking the egg or larvae of their host. Preferred prey: eggs/larvae of greenfly, whitefly, leafhoppers, aphids and scale insects.

Leptomastix is a highly specialized, small brown wasp ca. 3mm long with distinctive antennae. The wasp is a very efficient parasitoid and can easily seek out mealy bugs in their natural hiding places. The larvae develop fully within the mealy bug, emerging 15-20 days later as adult wasps.

Pathogens: For hundreds of years, bacteria, fungi and viruses have been used to control a variety of plant pathogens, caused by other bacteria, fungi, viruses, nematodes and pests. The most common forms of action are: parasitism, competitive exclusion, production of metabolites, etc. Some fungi can exhibit all of these modes of action.

Bacteria: Bacteria used for biological control infect insects via their digestive tracts, so insects with sucking mouthparts like aphids and scale insects are difficult to control with bacterial biological control.

Bacillus thuringiensis is the most widely applied species of bacteria used for biological control, with at least four sub-species used to control Lepidopteran (moth, butterfly), Coleopteran (beetle) and Dipteran (true flies) insect pests.

Other useful bacteria:

Bacillus sphaericus used as pesticide.

Bacillus subtilis used to control botrytis.

Fungi:

Fungi that cause disease in insects are known as entomopathogenic fungi. There are at least fourteen species known that attack aphids.

Beauveria bassiana. Used to manage a variety of insect including: whiteflies, thrips, aphids and weevils.

Paecilomyces fumosoroseus. Used to manage thrips and aphids.

Metarhizium spp. Used to control beetles, grasshoppers, spider mites.

Lecanicillium spp. Used against white flies, thrips and aphids.

Coniothyrium minitans to control *Sclerotia* spp

Cryptococcus albidus to control Botrytis

Candida oleophila to control Botrytis

Trichoderma harzianum to control *Sclerotium rofsii*, *Pythium* spp *Rhizoctonia* spp
Botrytis spp

Beneficial insects:

Some species of bee are beneficial as pollinators. Bees are also known to be predatory or parasitic, killing pest insects.