

Miscellaneous Biological Controls

'Californicus' [*Neoseiulus (=Amblyseius) californicus*]

'Californicus' is a predator of spider mites; it is a predatory mite, similar to 'Fallacis' and 'Cucumeris' in appearance and life cycle.

- Adults are pear-shaped, light tan mites, less than 0.5 mm (1/50 inch) long.
- They are well adapted to high temperatures (up to 30-33°C/85-90°F) as long as relative humidity is over 65%.
- They feed on pollen and spider mites and survive well even when pest populations are low if there is a pollen source.
- Recommended release rate on peppers is 1 predator/m² (10 ft²) in infested areas or once flowers are producing pollen.

For other applications see: IPM for Plantscapes sheet 470.

'Chilocorus' (*Chilocorus nigritus*)

Both adults and larvae of the lady beetle 'Chilocorus' feed on all stages and many species of soft scales (Coccids).

- Adults are small, shiny black lady beetle, 5 mm (1/5 inches) long, with an orange head. Larvae are hairy, with yellowish orange and black bands.
- Optimum conditions are moderate temperatures of 22-25°C (72-77°F).
- The complete life cycle takes about one month. Females lay eggs in small groups under dead scales; the eggs hatch in 3-10 days. The larvae feed on scales for 2-3 weeks. Adults emerge from pupae in 5-8 days.
- Recommended release rate for most uses is 2 adult beetles/m² (10 ft²).
- It may take 2-3 months before Chilocorus provides adequate control of scales because of its long life cycle.

For applications see: IPM for Plantscapes sheet 470.

'Cotesia' (*Cotesia marginiventris*)

'Cotesia' is a parasitic wasp that lays its eggs in early stage caterpillars. It attacks a wide range of species, including cabbage moth (*Mamestra brassicae*), beet army worm (*Spodoptera exigua*) and cabbage looper (*Trichoplusia ni*) Adult parasites are good searchers, able to find caterpillars throughout a greenhouse after release.

- Females lay 25-35 eggs over a 2-6 day life span. When the eggs hatch, the wasp larvae feed inside the caterpillar, eventually killing it when the larvae exit to spin cocoons and pupate. Cotesia populations have more males than females (4:1 is a common ratio).
- Monitoring is difficult because parasitized caterpillars are difficult to find, often dropping to the lower part of plants when attacked.
- Research in BC showed good control of cabbage loopers in greenhouse peppers using release rates of 4000 wasps/ha (1600 wasps/acre), which would be about 1000 females/ha (400/acre). Other release rate studies suggest:
 - Greenhouse cucumber: 1-2 releases of 2500 wasps/ha (1000 wasps/acre)
 - Greenhouse pepper & tomato: 1-2 releases of 7500 wasps/ha (3000 wasps/acre).
- Use of Cotesia would be compatible with Trichogramma (see Sheet 270), which parasitizes caterpillar eggs.

'Degenerans' (*Amblyseius degenerans*)

'Degenerans' is a predatory mite that can be used control thrips. This predator will also feed on spider mites, insect eggs, pollen and honeydew. It does best in crops, such as peppers, where a good pollen source is available and will not establish on greenhouse cucumber or tomato plants. It is a large, dark-coloured mite, 1 mm long (1/25 inch).

NOTE: Degenerans feeds on eggs and larvae of the aphid predator Aphidoletes and the spidermite predator Persimilis and can contribute to aphid and mite outbreaks on crops such as pepper. If there is a history of aphid or mite problems avoid using Degenerans and use the thrips predators Cucumeris (sheet 220) and Orius (sheet 222)

- The life cycle is similar to 'Cucumeris'. Degenerans feeds on pollen and can become established on peppers as soon as flowers have pollen. When pollen is present Degenerans will rapidly increase and spread throughout the greenhouse.
- Release as soon as plants are flowering and pollen is present, at a rate of 0.2 Degenerans/m² (10 ft²).
- Degenerans are best released in clumps at the end and middle of rows as females require repeated mating for egg laying. They will gradually spread out through all plants over a period of 6-8 weeks.
- Degenerans is more susceptible to pesticides than Cucumeris (see Sheet 180)

'Dicyphus' (*Dicyphus hesperus*)

The predatory bug, *Dicyphus hesperus* is similar to *Macrolophus caliginosus*, a predatory bug which is being used in Europe to control whitefly, spider mites, moth eggs and aphids. The use of Dicyphus as a biological control agent was first investigated by D. Gillespie (Agriculture and Agri-Foods Canada Research Station, Agassiz, BC). Dicyphus should not be used to replace other biological control agents. It is best used along with other biological control agents in greenhouse tomato crops that have, or (because of past history) are expected to have, whitefly, spider mite, or thrips problems.

- Release Dicyphus as soon as whiteflies are established, early in the season at a rate of 0.25-0.5 bugs/m² (10 ft²) of infested area; repeat once in 2-3 weeks.
- Alternatively, release batches of about 100 Dicyphus adults together in each area where whitefly hotspots are present. Biweekly application of supplementary food (frozen moth eggs i.e. *Sitotroga* sp., *Ephestia* sp.) may also be used to establish Dicyphus earlier in the crop when whitefly levels are very low. Dicyphus needs large numbers of prey to reproduce so releases should only be made in areas where pests have been detected or supplementary food has been added. Mullen banker or nursery plants (see sheet 285) have also been used with success to establish Dicyphus when whitefly levels are low.
- This predator obtains water from plant feeding. Damage to tomato fruit is not usually noticeable and does not appear unless population levels exceed 100 Dicyphus/plant.

'Eretmocerus' (*Eretmocerus californicus*)

Eretmocerus is a tiny parasitic wasp, similar to Encarsia, that is being used along with Encarsia and Dicyphus for control of whiteflies. It parasitizes both greenhouse and silverleaf (or sweet potato) whitefly and appears to be most useful at higher temperatures. At 15C (59F) Parasitized whitefly turn yellow, rather than black. Unlike Encarsia, which are all females, Eretmocerus populations have both sexes and females must be mated to lay eggs; in other respects, the biology and handling is generally similar to Encarsia.

Begin weekly releases in April or when temperature start to exceed 24°C (75°F), at a rate of 1 Eretmocerus/m² (10 ft²) of infested area. In May, increase to 2 Eretmocerus/m² (10 ft²).

'Feltiella' (*Feltiella acarisuga*)

Feltiella is a species of predatory midge. The adults feed on nectar, while the larvae feed on all stages of spider mites. This predator works well at high mite densities and in high humidity conditions (over 60% RH). Adults fly and are able to locate mite colonies from a distance. It is compatible with use of Persimilis and Stethorus.

- Adults are slender delicate midges less than 3 mm (1/16 inch) long, rarely seen because of their small size. Larvae are tiny 3 mm (1/16 inch), orange, legless maggots; they spin cocoons and pupate on the leaf among the spider mite colonies.
- To improve establishment of Feltiella, spray spider mite infested areas with a 2% honey or sugar solution. This attracts the adult females to these areas to feed and lay more eggs.
- Recommended release rates:
Greenhouse Tomato: Apply 1 Feltiella/m² (10 ft²) of infested area, or 250 Feltiella/mite "hot spot", weekly, for 3 weeks.
Greenhouse Pepper and Cucumber: Apply 500 Feltiella/per "hot spot", weekly for 3 weeks

##For other applications see: sheets ?

'Helvolus' (*Metaphycus helvolus*)

This tiny parasitic wasp is effective on a few soft scale species, including soft brown scale, black scale, hemispherical and nigra scale. The tiny adults also feed on the scales directly, causing significant mortality in addition to the scales they parasitize.

- Optimum conditions are warm temperatures of 22-29°C (72-84°F).
- Females lay their eggs in 2nd and 3rd instar scales, which are only 0.5-1.5 mm (1/20 inch) long, and develop inside the scales until the adult wasps emerge.
- Recommended release rates are 5 wasps/m² (10 ft²) or 2-5 wasps per infested plant, as often as needed.

Insect Parasitic Nematodes

Steinernema carpocapsae, *S. feltiae*, and *Heterorhabditis* spp. are beneficial nematodes sold to control fungus gnats and other insects. The nematodes actively seek out insect hosts and do not feed on plants. They enter larvae and release bacteria that kill the larvae. Nematode products (e.g., Microkil®, Biosys®, Nemasys®, etc.) can be applied to the soil through conventional sprayers or through the irrigation system. They move through rockwool, peat, sawdust or soil growing media without difficulty. Nematodes are effective against high populations of fungus gnats but, will not reproduce or remain in the growing media and must be reapplied if reinfestation occurs. They are also very effective controls for root weevil larvae, such as black vine weevil, in landscapes and nurseries. Parasitic nematodes work best when soil or media temperatures are above 12°C (52°F). Avoid over-watering plants for 1 week after applying nematodes as they maybe washed out of the media.

- Apply nematodes when yellow sticky traps average over 50-75 fungus gnat adults/trap, weekly, or while fungus gnat populations appear to be increasing.

- If root diseases are a problem in the crop, apply nematodes sooner to reduce the risk of disease transmission by fungus gnat larvae.
- Three applications, 7-10 days apart, are usually required. Nematode products vary, so always follow product recommendations for rates.
- Calculate application on the actual growing area (i.e., containers or beds) not greenhouse area.

Lacewings (*Chrysoperla rufilabris* and *Chrysoperla carnea*)

The larvae of lacewings are predators of aphids, mites, thrips, moths and other soft-bodied insects; they will also attack other biocontrol agents as well as cannibalize their own species. *C. rufilabris* is preferred for greenhouse crops and plantscapes as they prefer tall plants. Lacewings do not reproduce well in most greenhouse situations, therefore the eggs and larvae are generally used as a one-time control (like a pesticide) rather than with the expectation they will become established.

- Adults are green or brown, 1-2 cm (0.5-.75 inch) long, with transparent, finely veined wings longer than their body. Adults are active at night and feed only on pollen and nectar, which they need in order to lay eggs. Larvae are spindle-shaped, with pincher-like mouthparts.
- Lacewings are sold as eggs glued to cards or as larvae. The larvae are shipped in packing materials to keep them from attacking each other. Although larvae are more work to release because they must be freed from the shipping materials, their survival in the crop is usually better than releasing eggs.
- Recommended release rates are 1 lacewing/50 aphids or 10-50 lacewings/m² (10 ft²), weekly or bi-weekly, until established.

'Leptomastix' (*Leptomastix dactylopii*)

The parasitic wasp, *Leptomastix* only parasitize citrus mealybugs (*Planococcus citri*), therefore correct identification of mealybugs is essential.

- Adults are tiny yellowish brown wasps, 2 mm (1/10 inch) long, with long antennae. The adult wasps feed on honeydew.
- Optimum conditions are temperatures of 24-27°C (75-81°F).
- A complete life cycle takes 2 weeks at 30°C (85°F) and one month at 21°C (70°F). Females lay their eggs in mealybug nymphs and adults. The wasp larva develops inside the mealybug, eventually turning it into a barrel-shaped pupa, from which the adult wasps emerges.
- Recommended release rates are 2 wasps/m² (10 ft²) or 5 wasps/infested plant. Distribute *Leptomastix* evenly among infested plants. To check for effects, look for parasite exit holes in citrus mealybug nymphs.
- *Leptomastix* complements the use of *Cryptolaemus* for citrus mealybug. The lady beetle should be released first to reduce high mealybug populations, followed by *Leptomastix*, which succeeds against low density mealybug populations.
- *Leptomastix* is attracted to yellow sticky traps so remove these from release area.

'Lindorus' [*Rhyzobius* (= *Lindorus*) *lophanthae*]

- Both adults and larvae of this lady beetle feed on California red scale, purple scale, and other armoured scales that have a relatively thin scale cover. Ragged holes chewed in scales is a sign they have been preyed on by lady beetles. Although the females will lay eggs in mealybug masses, mealybugs are not preferred as a host.

- The adult is a small black beetle with an orange head and thorax, 1.5-3 mm (1/16-1/8 inch) long. The larvae are hairless and gray, with cream-coloured bands lengthwise along the abdomen.
- Optimum conditions are moderate temperatures of 22-25°C (72-77°F).
- Females lay eggs in groups of 6-10 for a total of 60-100 eggs in their life time.
- Recommended release rates are 2-6 adult beetles/m² (10 ft²), or 2-5 beetles/infested plant, weekly or bi-weekly, for 3 applications (or as often as needed).
- Excessive amounts of honeydew on leaves hinders the movement of both adults and larvae, therefore spray leaves with water or soap and water to remove honeydew before releasing beetles.

'Occidentalis' [*Metaseiulus (=Galendromus) occidentalis*]

Western Predatory Mite

Similar in appearance and life cycle to 'Fallacis' and 'Cucumeris', this predatory mite is a native species in Canada. It has been released successfully to control European red mite and two-spotted spider mite in fruit trees and ornamentals as well as greenhouses. They can also be used to control citrus red mite in plantscapes.

- Adults are pear-shaped, beige to amber to reddish coloured mites, less than 0.5 mm (1/50 inch) long.
- Occidentalis feeds primarily on spider mite nymphs and adults, but not on eggs; it also feeds on pollen.
- It is difficult to see this predator without a magnifier because it is very small and hides under leaf hairs, therefore watch for a decline in pest populations to indicate the predator is established.
- The predators are well adapted to hot conditions as long as relative humidity is over 50%. It does well under high or low temperatures and is more effective than *Persimilis* in tree top foliage and on hairy leaves.
- Recommended release rates are 1 predator/m² (10 ft²), weekly or bi-weekly, until established in all infested areas.

'Podisus' (*Podisus maculiventris*) Spined Soldier Bug

A member of the stink bug family, Podisus is a general predator on caterpillars and other insect larvae. It has a wide host range, including several important crop pests. Podisus has a long life cycle and will take several months to become established so other biological controls should be used along with it at recommended rates.

- Adults are tan, 8.5-13 mm (5/8-1 inch) long, shield-shaped bugs with prominent spurs on the "shoulders". They have distinct dark line on the membranous tip of each forewing, which forms one dark streak when the wing tips overlap.
- Young nymphs are wingless and round, red and black; older nymphs are marked with red, black, yellow-orange, and cream bands and patches. Both adults and nymphs have long, sharp beaks, which fold back under their bodies when they are not feeding. They pierce their prey, inject a toxin and then suck the body contents.
- A complete life cycle takes 29 days at moderate temperatures. Eggs are whitish or gold, barrel-shaped and laid in clusters of 20-30 on leaves and twigs. Females lay several hundred eggs over a life span of 2-3 months. Sex ratio in the population is about 1:1. Individual Podisus adults have been reported to eat over 100 late instar fall armyworm larvae.
- To monitor, inspect leaves for dead caterpillars, which may appear to be pierced or with the body contents sucked out.

- Recommended release rates to control caterpillars:
 - General rate: 0.5 bug/m² (10 ft²) over total area
 - Low rate: 1 bug/m² in “hot spots”, twice, two weeks apart
 - High rate: 5 bugs/m² in “hot spots”, twice, two weeks apart.
- When caterpillar populations are mixed ages, the suggested release pattern is evenly throughout the greenhouse. Early in the season, caterpillars generations may not overlap, therefore release Podisus only in “hot spots”.