

Interior Plantscapes and Tropical Gardens

Guidelines for Biological Control

Interior plantscapes are areas where plants are grown in an indoor setting. In addition to traditional conservatories, this includes shopping malls, sports facilities, restaurants, and public offices. The plants used in such settings are usually a variety of tropical and foliage plants, with a corresponding variety of possible pests. Common pest problems include soft and armoured scales, mealybugs, spider mites, thrips, aphids, whiteflies and black vine weevils.

Using biological control is becoming increasingly popular in interior plantscapes because few pesticides are registered for indoor use and because of public concern over air quality and use of pesticides in such environments.

Most plants used in interior plantings are produced outdoors or under shade in warm climates. This means that they can arrive with pest infestations. Ideally, plants should be isolated for a period of acclimatization before they are set out in the permanent location. During this time they can be watched for developing pests and treated if necessary. Unfortunately, this is often not possible and plants may be moved to the plantscape shortly after arrival.

Challenges for adapting the use of biological controls to plantscapes:

Pests may be present in low numbers that are not detected, or in soil stages that are not visible.

Pesticide history of newly received plants is often unknown; plants may have residues that inhibit the establishment of biological controls.

Plantscapes may have existing pest problems which will move onto the newly introduced plants.

Prepare a Pest Management Plan

To manage pests successfully, it is a good idea to prepare a plan for preventing pest introductions and using biological controls (for more details see Sheet 160).

Identify all present pest problems in each plantscape, as well as potential pests that commonly occur on particular plants used in your plantscapes.

Inspect new plant material carefully for insect and disease problems upon arrival.

Obtain a list of pesticides applied within the last 6 weeks from the supplier.

Set up a monitoring schedule to inspect plants in the plantscape (usually done weekly in warm months, less often in cool months).

Keep records for each plantscape of:

pest species and outbreaks (specific plants, environmental conditions, dates),

biological controls used (species, timing of release, dates),

pesticide applications (products, rates, application methods, dates), and

cultural and pest prevention practices.

Prepare a budget for managing pests. It is important to know ahead of time whether the price of controlling pests is likely to cost more than renovating the plantscape by removing and replacing problem plants.

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Determine which biological control agents to use. Identify target pests, review information on biological control agents and choose species suited to the situation. Choose a distributor and work with them to determine delivery methods, timing and instructions on using the biological controls.

Correct imbalances between pests and biocontrols, using compatible pesticides to spot spray, if necessary, to reduce pest populations.

Have patience. If pest populations are relatively low, biological control agents will quickly develop a balance with the pest populations. Bear in mind, however, that although many biological control agents become quickly established, it can take months to show their effects. This is because it takes that long to for slow-growing plants to replace damaged leaves.

If a severe outbreak exists, treat plants with registered pesticides, wait for the residues to diminish and then reapply biological controls. In this case, it will take longer to establish biological control of pests. Generally avoid using residual pesticides in the month before introducing biological controls.

The following guidelines contain practical tips for achieving good results using biological controls against pests in interior plantscapes. Recommended release rates for each biological control are shown in Table 1. More detailed information on pests and biological controls can be found in the separate information sheets for each species.

SOFT SCALES & ARMoured SCALES

Black scale, hemispherical scale, brown scale and nigra scale are soft scale (Coccidae) that attack many foliage plants. California red scale and purple scale are examples of common armoured scales (Diaspididae). Some biological controls attack only particular species of scales, therefore correct identification of scale is essential (for more on scales, see Sheet 350).

Monitoring Tips

Close examination with a hand lens is necessary to detect scales. They often go unnoticed until the honeydew they produce is conspicuous, or until plant growth is stunted or distorted.

Release Biological Controls

Scale outbreaks often occur in early January or February, therefore biological controls should be released in summer or by late November.

Predatory lady beetles feed on most soft scales whereas the wasp 'Helvolus' parasitizes a limited number of soft scale species.

'Rhyzobius': Both larvae and adults of the small lady beetle *Rhyzobius (=Lindorus) lophanthae* (see Sheet 280) feed on California red scale, purple scale, and other armoured scales with a relatively thin scale cover. Optimum conditions are moderate temperatures of 22-25°C (72-77°F). 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.

'Harmonia': The multicoloured Asian lady beetle, *Harmonia axyridis*, is an important

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predator of scales. It was originally used in China where releases of 200 adult *Harmonia* per tree were reported to reduce pine scale by 87%. This predator is now mass-produced by biocontrol companies and is available as larvae and adults (see Sheet 244).

'Hippodamia': Other field collected species, of lady beetles such as *Hippodamia convergens* (see Sheet 244) may provide adequate control if they are released in large numbers. Introductions of 10,000 to 30,000-1000 beetles at one time are recommended to provide temporary control in plantscapes. Field collected beetle tend to migrate to windows and disperse out open vents and windows. An insectary reared *Hippodamia convergens* is now available from some suppliers and will more reliably reproduce and cycle in plantscapes.

'Helvolus': The tiny parasitic wasp *Metaphycus helvolus* (see Sheet 280) is effective on a limited number of soft scale species, including soft brown scale, black scale, hemispherical and nigra scale. Females lay their eggs in immature scales; optimum conditions are warm temperatures of 22-29°C (72-84°F).

'Aphytis': One parasite available for armored scale is *Aphytis melinus*; it will attack California red scale, San Jose scale, ivy scale and oystershell scale. Females lay their eggs under the immature scale; optimum conditions are similar to *Helvolus*. *Aphytis* parasites are quite delicate and often do not survive well if shipped long distances.

Other Measures

Prune out and destroy severely infested branches before releasing biological controls. Mist plants with water to remove honeydew. Spray infested plants with insecticidal soap to reduce scale numbers before releasing biological controls. Soap is most effective on the crawler stage of scales.

MEALYBUGS

The most common species of mealybug in interior plantscapes is citrus mealybug. Other species that may occur are long-tailed, obscure, citrophilus, grape and ground or root mealybug. They damage plants by sucking the sap and their feeding causes distortions, stunting and yellowing of foliage. They also produce honeydew, which supports the growth of unsightly sooty molds on leaves (for more on mealybugs, see Sheet 350).

Monitoring Tips

Monitor the progress of biological controls by inspecting the new growth for signs that mealybugs are disappearing

Release Biological Controls

Mealybug Destroyer: The lady beetle *Cryptolaemus montrouzieri* (see Sheet 250) is most effective when mealybug numbers are high and when conditions are warm and humid. They are most active in sunlight and are not as effective during dull winter months. Several releases may be necessary, particularly during winter months.

'Leptomastix': The females of the tiny wasp *Leptomastix dactylopii* (see Sheet 280) lay their eggs in mealybug nymphs and adults. They parasitize citrus mealybugs only,

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however, therefore correct identification of mealybugs is essential. Optimum conditions are temperatures of 24-27°C(75-81°F).

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 is effective for low density mealybug populations.

Other Measures

Prune out heavily infested branches and destroy before releasing biological controls. It may be necessary to control ants, which protect mealybugs from predators in order to collect honeydew.

SPIDER MITES

Two-spotted mite, *Tetranychus urticae* (see Sheet 300), is the most common spider mite in plantscapes; it feeds on a wide range of plants. Citrus red mite, *Panonychus citri*, is less common, has a smaller host range, but can be damaging when it occurs; in addition to citrus, this mite attacks palms, figs, ginger and bananas. In plantscapes, spider mites are often a problem on foliage in the warmest and driest areas, such as in summer at the top of tall plants nearest the glass. Their feeding causes white stippling on the leaves and, in severe infestations, the leaves turn brown and collapse.

Monitoring Tips

Inspect leaves under 10-15 X magnification for signs of spider mite infestation.

Release Biological Controls

'**Persimilis**': The predatory mite *Phytoseiulus persimilis* (see Sheet 200) is an effective control for two-spotted spider mites. It also feeds on citrus red mite, although may not provide sufficient control. Introduce Persimilis at the first sign of spider mite damage, in all infested areas. Distribute them on middle and upper foliage, preferably in early morning. Monitor progress by inspecting new growth weekly to determine whether spider mite damage continues to occur.

'**Occidentalis**': The predatory mites, *Amblyseius fallacis* and *Galendromus* (= *Typhlodromus*) *occidentalis* (see Sheet 280) are more effective predator of citrus red mite than Persimilis and can be used to control two-spotted spider mites. It does well under high or low temperatures and is more effective than Persimilis in tree top foliage and on hairy leaves. It feeds primarily on spider mite nymphs and adults, but not on eggs. It is difficult to see this predator because it is so small, therefore watch for a decline in the citrus red mite population to indicate the predator is established.

Other predator mites: At low two-spotted spider mite densities, *Amblyseius californicus* (see Sheet 280) and *Amblyseius fallacis* (see Sheet 201) persist better than other species as they feed on pollen and a variety of small insects and mites. On woody ornamental plants, introduce Fallacis predatory mites as well as Persimilis for control over a longer period.

Other Measures

Mist plants frequently to raise humidity, but do not hose down the foliage, which would dislodge predators. This slows the feeding and reproduction of spider mites while

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making conditions more favourable for predatory mites.

If spider mites populations are high, spray with insecticidal soap or fenbutatin oxide (Vendex®) to reduce numbers, before releasing Persimilis; check compatibility table (see Sheet 180) before using other pesticides.

THRIPS

Several species of thrips causes problems in plantscapes, including western flower thrips (*Frankliniella occidentalis*) and onion thrips (*Thrips tabaci*) (see Sheet 320), banded greenhouse thrips (*Hercinothrips femoralis*), echinothrips (*Echinothrips americanus*) and other flower thrips. Thrips damage leaves and flowers by sucking the cell contents, leaving a silvery, stippled and distorted appearance. Western flower thrips can also transmit Tomato Spotted Wilt Virus, which kills some ornamentals and pesticide resistant strains of this species are common.

Monitoring Tips

Use yellow or blue sticky traps at a rate of 1 trap/50 plants.

Use a 10-15 X lens to examine leaves and flowers for thrips or signs of damage.

Release Biological Controls

The following three species of biological controls are compatible and can be used together to control flower thrips, onion thrips and greenhouse thrips. Echinothrips is difficult to control biologically due to its larger size, although Orius will feed on all stages.

'Hypoaspis': This soil-dwelling mite (see Sheet 230) feeds on the immature stages of thrips in the soil or growing media. Hypoaspis alone cannot control thrips infestations, but it contributes to the effectiveness of biological control when used with other predators.

'Cucumeris': The predatory mite *Amblyseius cucumeris* (see Sheet 220) feeds on immature stages of thrips as well as pollen. Cucumeris is available in a loose bran carrier, which is sprinkled onto leaves, and in slow-release bags, which are hung on plants. Release predators at the first sign of thrips, or, ideally, before thrips are present on susceptible plants. It usually takes 4-6 weeks before changes in thrips numbers caught on traps will be noticeable as a result of releasing Cucumeris.

'Orius': The minute pirate bug, *Orius* spp. (see Sheet 222) feeds on all stages of thrips. Orius is only effective from March to September because they do not reproduce

if day length is less than 16 hours. Unless supplementary light is used, they should be released in March, or as soon as thrips are detected, where thrips numbers are the highest in the greenhouse. Release at least 500 Orius at one time to establish a breeding population.

Other Measures

Spot treatments with insecticidal soap can be used to suppress thrips "hot spots" before releasing biological controls.

APHIDS

Green peach aphid, *Myzus persicae* (see Sheet 340), can be a serious problem in plantscapes. Foxglove aphid, *Aulacorthum solani*, and potato aphid *Macrosiphum euphorbiae*, may also occur. Aphids reproduce quickly on favoured host plants, causing

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distorted foliage; they also produce honeydew, which coats leaves and allows sooty moulds to grow.

Monitoring Tips

Use a 10-15 X lens to inspect plants, weekly, for developing aphid colonies.

Release Biological Controls

All three biological control agents listed below can be used together for long term control.

Release 'Aphidius' parasitic wasp (*Aphidius matricariae*) for control of green peach aphid and *Aphidius ervi* for control of potato aphid (see Sheet 242), at low rates as soon as low numbers of aphids are detected.

Release 'Aphidoletes' aphid midges (*Aphidoletes aphidimyza*) (see Sheet 240) between March 15 and August 15, weekly, for all species of aphids (except gall forming species) until aphids are controlled. For heavy infestations release a minimum of 2000 aphid midges, weekly, in each aphid "hot spot".

Release the lady beetle, *Harmonia axyridis*, to control all species of aphids. If the aphid infestation is widespread, also release field-collected *Hippodamia convergens* as well (for more on both lady beetles, see Sheet 244).

Other Measures

Prune out heavily infested branches; wash aphids off plants with a strong spray of water or apply insecticidal soap sprays before releasing biological controls.

Control ants, which may be protecting aphid colonies from predators.

WHITEFLIES

The most common whitefly in plantscapes, is greenhouse whitefly (*Trialeurodes vaporariorum*) (see Sheet 310). The feeding of immature whiteflies drops sticky honeydew onto foliage below, which become covered with unsightly sooty mould. In high numbers whiteflies also reduce the vigour of plants.

Monitoring Tips

Use yellow sticky traps to monitor for whiteflies.

Plants highly attractive to whitefly, such as Lantana, Jerusalem cherry or Fuchsia can be used as indicator plants to detect early infestations of whitefly.

Release Biological Controls

The biological controls listed below are compatible and can be used together.

'**Encarsia**': *Encarsia formosa* is a tiny wasp (see Sheet 210) that parasitizes immature stages of whitefly. It is sold as parasitized scales glued to cards, from which the adult wasps emerge. As the wasp develops inside, greenhouse whitefly scales gradually turn black. Encarsia are less effective during cool weather and overcast periods and short days of winter.

'**Delphastus**': *Delphastus catalinae* is a small, black, 1.4 mm (1/15 inch) long, lady beetle (see Sheet 244). Both adults and larvae feed on whitefly eggs and immature stages. Delphastus is sold as adults and should be applied as soon as whitefly are detected. Delphastus works well with Encarsia because it avoids feeding on parasitized whitefly scale.

Other Measures

If adults whiteflies populations are over 10/leaf, spot spray new growth (where adults congregate) with insecticidal soap. Strong sprays of water can also be used to "blast" adult whitefly and "strip" whitefly scale from the undersides of leaves.

BLACK VINE WEEVIL

Black vine weevils are dark brownish gray, 8 mm (1/3 inch) long "snout beetles"; they are all females and they cannot fly. The adults are active at night; they chew half-circle notches in the edges of leaves of various ornamentals. The larvae feed in the roots of rhododendron, azalea, yew and other ornamentals and can stunt or kill plants.

Monitoring Tips

Check leaves for signs of new notches from May onward, which indicates adults are present and will soon begin laying eggs.

Release Biological Controls

Insect parasitic nematodes: These nematodes (see Sheet 280) are very effective at controlling root weevil larvae in plantscape conditions. They must be applied after the eggs have hatched and larvae are present in the soil, usually from July onward. Three soil drenches of nematodes mixed in water, 7-10 days apart, are usually required. Nematode products vary, so always follow product recommendations for rates.

Other Measures

At night, when adults come out to feed, knock them off of plants onto ground sheets where they can be collected and destroyed.