Integrated pest management in ornamentals information kit

Reprint – information current in 2000

REPRINT INFORMATION – PLEASE READ!

For updated information please call 13 25 23 or visit the website www.deedi.qld.gov.au

This publication has been reprinted as a digital book without any changes to the content published in 2000. We advise readers to take particular note of the areas most likely to be out-of-date and so requiring further research:

- Chemical recommendations—check with an agronomist or Infopest www.infopest.qld.gov.au
- Financial information—costs and returns listed in this publication are out of date. Please contact an adviser or industry body to assist with identifying more current figures.
- Varieties—new varieties are likely to be available and some older varieties may no longer be recommended. Check with an agronomist, call the Business Information Centre on 13 25 23, visit our website www.deedi.qld.gov.au or contact the industry body.
- Contacts—many of the contact details may have changed and there could be several new contacts available. The industry organisation may be able to assist you to find the information or services you require.
- Organisation names—most government agencies referred to in this publication have had name changes. Contact the Business Information Centre on 13 25 23 or the industry organisation to find out the current name and contact details for these agencies.
- Additional information—many other sources of information are now available for each crop. Contact an agronomist, Business Information Centre on 13 25 23 or the industry organisation for other suggested reading.

Even with these limitations we believe this information kit provides important and valuable information for intending and existing growers.

This publication was last revised in 2000. The information is not current and the accuracy of the information cannot be guaranteed by the State of Queensland.

This information has been made available to assist users to identify issues involved in ornamental horticulture. This information is not to be used or relied upon by users for any purpose which may expose the user or any other person to loss or damage. Users should conduct their own inquiries and rely on their own independent professional advice.

While every care has been taken in preparing this publication, the State of Queensland accepts no responsibility for decisions or actions taken as a result of any data, information, statement or advice, expressed or implied, contained in this publication.

Queensland Government

Know your **Pests**

What can you expect to learn from this section?

The key pests that you are likely to find in your ornamental crops. A key pest refers to an insect or mite that has the potential to cause severe damage to plants. It may be nationally important, or only locally important. It may be seasonal or all year round.

The pests are listed in order of their relative importance to the ornamentals industry.

We have provided information that will increase your awareness of major pest problems on your property. This includes information on pest biology and behaviour, and guidance on control. Appropriate cultural, chemical and biocontrol methods are recommended to help you prevent infestations, or to manage them when they occur. For more information refer to Section 10, Further reading.

Coloured photographs *of each of these pests can be found in the companion publication* Pests, Diseases, Disorders and Beneficials in Ornamentals: Field Identification Guide, *see* Section 10, Further reading page 7.

Contents

Directory of pest species

Mites

Two-spotted mite (red spider mite): *Tetranychus urticae* (Card reference 12)

Bean spider mite: *Tetranychus ludeni* (Card reference 14)

Southern red mite: *Oligonychus ilicis* (Card reference 16)

Broad mite: *Polyphagotarsonemus latus* (Card reference 18)

Cyclamen mite: *Phytonemus pallidus* (Card reference 20)

False spider mite: *Brevipalpus* spp. (Card reference 22)

Eriophyid mite: Gall, bud, rust and erinose mites (Card reference 24)

Card reference

Pests, Diseases, Disorders and Beneficials in Ornamentals: Field Identification Guide, see Section 10 page 7

Importance/risk

Mites are a high risk if not detected early and treated.

Two-spotted mite and broad mite are key pests in an IPM program. Resistance to chemicals is a major problem in two-spotted mite.

Pest	Family	State
Two-spotted mite (red spider mite)	Tetranychidae (spider mite)	Key pest in all States
Bean spider mite	Tetranychidae (spider mite)	Minor pest in all States except WA
Southern red mite	Tetranychidae (spider mite)	Minor pest in NSW
Broad mite	Tarsonemidae	Key pest in QLD, NSW; minor pest in SA
Cyclamen mite	Tarsonemidae	Key pest in NSW; minor pest in WA
False spider mite	Tenuipalpidae	Minor pest in QLD, NSW, VIC, SA, NT
Eriophyid mites	Eriophyidae	Key pest in QLD; some plants more susceptible

Two-spotted mite is a major pest because of its broad host range, efficient reproductive capacity, short generation time and increasing resistance to several pesticides. It can cause a great deal of damage under hot, dry conditions and may go unnoticed until widespread.

Bean spider mite is a minor but common pest of ornamentals.

The Nursery Papers 1999#10 Section 10 page 8

Southern red mite is a serious pest for host plants. It was recently introduced to Australia and has a limited host range.

Broad mite is a key pest of ornamentals in warm, humid environments. It tends to be seasonal.

Cyclamen mite is an important but sporadic pest on some types of ornamental plants in New South Wales. The mites are a high risk on African violets and cyclamen.

False spider mites are a minor pest. They include bunch mite *(Brevipalpus californicus)* and passionvine mite *(Brevipalpus phoenicis)*. The damage may go unrecognised because the mites are small and do not produce webbing.

Eriophyid mites are of minor importance, though some plants are more susceptible than others. Most eriophyid mites are host specific.

Host range

This host range is not necessarily complete, but represents published information and known records available at the time of publication.

Two-spotted mite and bean spider mite: almond, apple, apricot, beans, capsicum, carnation, cucurbit, cymbidium, dieffenbachia, eggfruit, fuchsia, gerbera, hollyhock, marigold, nasturtium, parlor palm, peach, pear, plum, rockmelon, rose, strawberry, tomato, violet and many others. Weed hosts: broadleaved weeds.

Southern red mite: azalea, camellia.

Broad mite: begonia, camellia, capsicum, chrysanthemum, citrus, croton, dahlia, eggplant, fig, French bean, fuchsia, gerbera, hibiscus, ivy, lemon, mandarin, silverbeet, zinnia. Weed hosts: potato weed.

Cyclamen mite: African violet, aphelandra, azalea, begonia, capsicum, cyclamen, dieffenbachia, fig, fuchsia, geranium, gerbera, gloxinia, impatiens, ivy, lantana, marigold, petunia, rhododendron, strawberry, tomato, violet, verbena, zinnia.

False spider mite: azalea, fuchsia, gerbera, grape, orchid, palm, privet, rose.

Eriophyid mites: banksia, camellia, citrus, eucalypts, ferns, *Ficus* sp., grapevine, hakea, hibiscus, lychee, mango, melaleuca, rhubarb, tomato, wattle.

What to look for

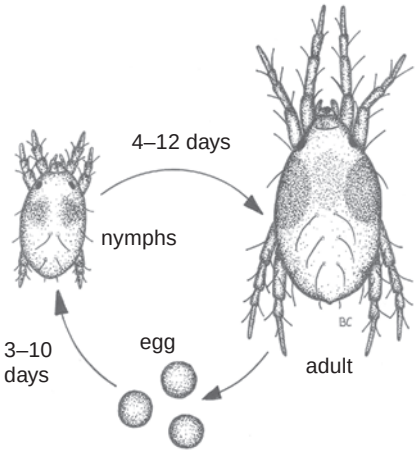
Damage

Two-spotted and bean spider mite: All stages feed on the plant by piercing the cells on the underside of the leaves, causing the cells to die and producing a speckled effect. Early signs may be small areas of feeding damage. As the population increases, feeding damage worsens, producing larger, bleached areas. If unchecked, the entire leaf surface is damaged. Leaves will fall and the plant will die.

Check the middle and lower leaves of the plant for infestations. Two-spotted mite spins small lines of web which, in heavy infestations, can cover the leaves. In heavy infestations they may also inhabit the upper leaf surface and be seen clustering on the webs.

Southern red mite: These mites feed on the upper and lower surfaces of leaves, leaving a bronzed appearance. Leaves become stippled, turn grey and fall prematurely.

Broad mite: Broad mite infestations are found in the growing tips of plants. All stages of broad mite feed on the upper and lower surfaces of newly emerged leaves and flowers. The mites inject a toxin while feeding, so only a few mites are needed to cause damage. Broad mites are so small, they often go undetected until damage is severe. Symptoms are often confused with herbicide damage. Plant symptoms include brittle, curled and puckered (malformed) young leaves. New growth is inhibited and the shoot apex may die. Damaged plants are unsaleable and may die. If left unattended, broad mite will stunt plant growth. Flowers may be deformed and discoloured, and buds can fall. Broad mite moves from plant to plant by crawling, wind, or riding on flying insects such as whitefly.



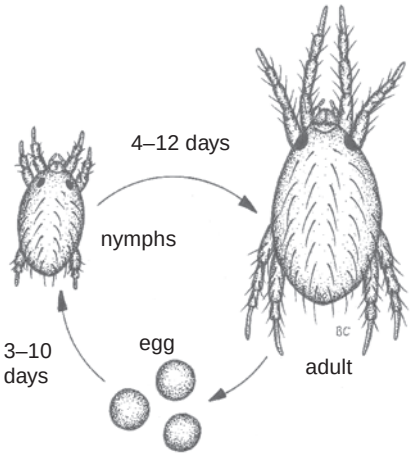
Life cycle of two-spotted mite

Cyclamen mite: These mites are rarely found on open leaf surfaces, preferring darkened, humid areas of immature leaves and buds in the growing tips. Plant symptoms include distortion of the growing tip, resulting in a thickening of the crown or meristematic (growing point) tissue. Damaged plants are unsaleable. Damaged buds do not develop and plants may not produce flowers or fruit. Flowers are distorted and discoloured.

False spider mite: Leaves first show flecking where mite toxins have killed plant cells. This can lead to leaf bronzing, defoliation and browning of stem tissue. Mites are usually found along leaf veins and damage is worst here. Damage can appear similar to that caused by two-spotted mite but without the webbing.

Eriophyid mites: These small mites attack young leaves, shoots, flower buds and fruit. Their feeding can produce galls, 'velvety' hairs in blisters on the underside of leaves, rust-like damage and short multiple shoots depending on species. Damaged plants are unsightly and unsaleable.

The eggs are laid in the bud. After hatching, gall mites inject salivary compounds into the leaf surface as they feed. This stimulates the plant to form a gall or blister made of millions of hairs, with the mite living inside it. The gall's velvety growth can be yellow, reddish-brown or black. Leaves can develop pimples, and can twist and curl. Rust mites cause leaf and fruit discolouration only.

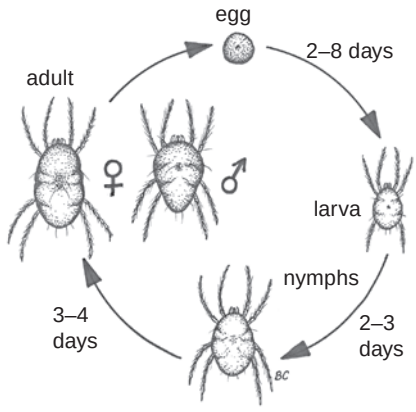


Life cycle of bean spider mite

Description

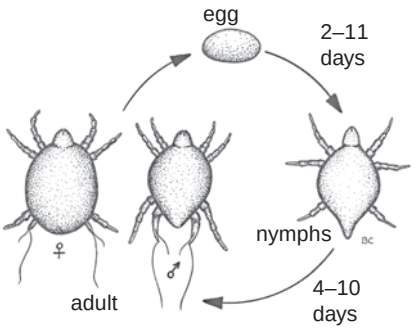
Two-spotted mite: Adult female mites are about 0. 5 mm long. Males are smaller and narrower towards the posterior. Adults and juveniles are oval, yellowish-green, with two dark green or black patches (or 'spots') on their backs. Eggs are small, round and white. During winter, females may lose their spots and turn bright orange. Two-spotted mite disperses by crawling or spinning a fine web, which carries the mite aloft in a breeze. Clothes brushing against infested plants will pick up the webbing and distribute mites around the crop.

Bean spider mite: Adult female mites are oval, about 0.5 mm long and dark red. Males are slimmer and taper posteriorly. Juvenile mites can be a lighter greenish colour with dark patches on their backs, similar in appearance to the two-spotted mite. Eggs are small, round and have a reddish tinge. Bean spider mite disperses by crawling or spinning a fine web, which carries the mite aloft in a breeze. Clothes brushing against infested plants will pick up the webbing and distribute mites around the crop.



Life cycle of southern red mite

Southern red mite: Adults are deep purple-red, lighter at the head end and have a pale spot in the middle of their body. They are very similar to two-spotted mite. Juvenile mites are similar to the adults. Eggs are red, spherical and have a fine hair-like structure in the centre.

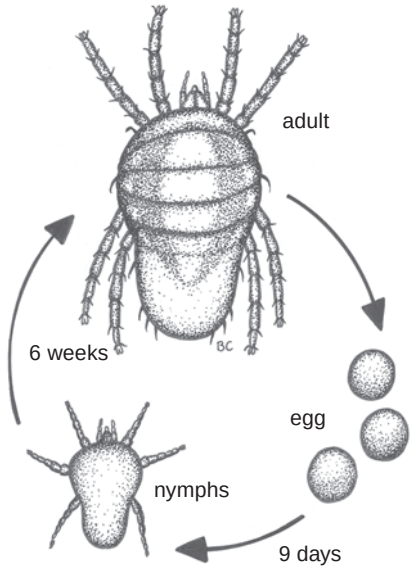


Life cycle of broad mite and cyclamen mite

Broad mite: Adults are oval, translucent white to yellow-green and very small (0.25 mm). Males are slimmer and taper posteriorly. Males have long hind legs used for carrying the female pupa on their backs, the male mating with the adult female when she emerges. Immatures are pale and have a distinguishing white stripe along the dorsal midrib. Eggs are 0.1 mm, oval and white, and covered in stipules (small bumps).

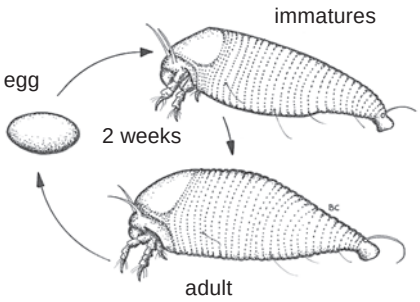
Cyclamen mite: Cyclamen mites are difficult to distinguish from broad mites unless examined under a microscope. Adults are oval, translucent white to yellow-green, and are small (0.25 mm). Males are slimmer and taper posteriorly. Eggs are 0.1 mm, oval and white. Unlike broad mite eggs, cyclamen mite eggs have a smooth surface.

False spider mite: These mites do not produce webbing. They are slow moving and crawl to new plants. They are usually found on the leaf undersurface. They have a flat appearance when lying against the leaf, with their front legs extended past their head and back legs extended past the rear end. They are small (0.5 mm), black, and are usually not found in large populations. Juvenile mites are smaller versions of the adults. The eggs of false spider mites are about 0.1 mm, elliptical and usually bright red or pink. They are laid near main veins on the leaf undersurface.



Life cycle of false spider mite

Eriophyid mite: Eriophyid mites are 0.1 to 0.3 mm long and can only be seen with a microscope. The mites are worm-like with a rounded head end and tapering posterior. They are white, yellow to orange and have two pairs of legs. Juvenile mites are a smaller version of the adults.

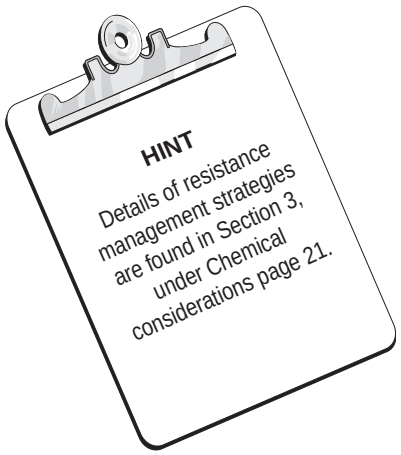


Life cycle of eriophyid mite

Action

Cultural/physical

- Avoid introducing infested plant material onto the property. Avoid handling infested material, and brushing clothes against infested plants.
- Avoid transporting infested plants or taking cuttings from infested plants.
- Monitor plants by plant inspections. Be aware of the first appearance of the mites, and early symptoms, and act immediately.
- Water-stressed plants are prone to mite outbreaks. Irrigation directed to the leaf undersurface can reduce infestation of spider mites.
- Avoid growing susceptible plants in favourable conditions, for example hot, dry areas, which favour spider mite development.
- Plant resistant varieties wherever possible. Umbrella plants and cocos palms are resistant to two-spotted mite and bean spider mite.
- High volume, high pressure water sprays can dislodge mites from foliage and temporarily suppress populations.



Chemical

- Use insecticides selectively and alternate classes of pesticides to prolong use and to avoid development of resistance.
- Avoid indiscriminate use of broad-spectrum insecticides, which kill natural enemies and have a long-lasting residual effect.
- For effective control, ensure good coverage to undersurface of leaves.
- Be aware of the specific activity of miticides and use appropriately. For example, clofentezine is mainly an ovicide with some effect against larvae, while fenbutatin oxide controls only crawling stages. Tebufenpyrad can kill eggs and crawling stages. The chlorinated chemicals dicofol and endosulfan are most effective against broad mite and cyclamen mite.
- Synthetic pyrethroids can cause mite 'flare ups' due to adverse effects on beneficials.
- Frequent exposure to pesticides can result in the development of resistance.

Biological

- **Commercially available.** For two-spotted mite and bean spider mite—predatory mites: *Phytoseiulus persimilis* (suppliers Beneficial Bug Company, Bio-Protection and Horticultural Crop Monitoring) and *Typhlodromus occidentalis* (supplier Biological Services).

  P. persimilis is considered more effective against two-spotted mite than bean spider mite.
- **Naturally occurring.** Phytoseiid predatory mites, predatory thrips, ladybird beetles, midges and pathogenic fungi.

Whiteflies

Greenhouse whitefly: *Trialeurodes vaporariorum* (Card reference 26)

Silverleaf whitefly: *Bemisia argentifolii* (Card reference 28)

Ash whitefly: *Siphoninus phillyreae* (Card reference 30)

Spiralling whitefly: *Aleurodicus dispersus* (Card reference 32)

Card reference

Pests, Diseases, Disorders and Beneficials in Ornamentals: Field Identification Guide, see Section 10 page 7

Importance/risk

Whiteflies are major and common pests of ornamentals.

Pest	State
Greenhouse whitefly	Key pest in NSW, VIC, SA; minor pest in QLD, NT
Silverleaf whitefly	Key pest in QLD, NT; minor pest in WA
Ash whitefly	Key pest in SA
Spiralling whitefly	Key pest in northern QLD

Greenhouse whitefly transmits lettuce infectious yellow virus, which infects petunia and zinnia.

Silverleaf whitefly spreads tomato leaf curl gemini virus complex in ornamental and vegetable crops.

Ash whitefly and **spiralling whitefly** are included as potentially serious pests of outdoor ornamentals in Australia. Ash whitefly has been discovered in South Australia and New South Wales and spiralling whitefly has been detected on Thursday Island and northern Queensland. Ash whitefly is considered a serious pest of outdoor ornamentals in Europe and North Africa. Spiralling whitefly is a pest in the USA.

The Nursery Papers 1999#07, 1997#009 Section 10 page 8

Host range

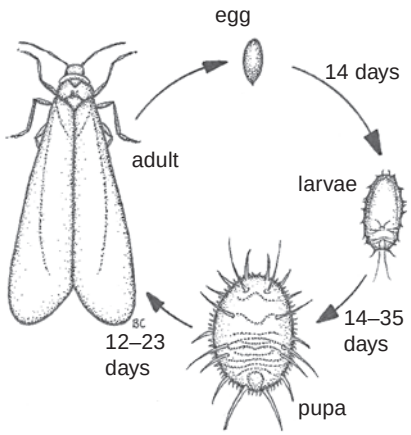
Greenhouse and **silverleaf whitefly** have a combined host range of more than 700 plant species. Some of the more susceptible ornamentals and weeds are listed.

Greenhouse whitefly: ageratum, alstroemeria, bean, begonia, boronia, fuchsia, gardenia, geranium, gerbera, hibiscus, honeysuckle, hydrangea, marigold, mint bush, poinsettia, rose, tomato, verbena.

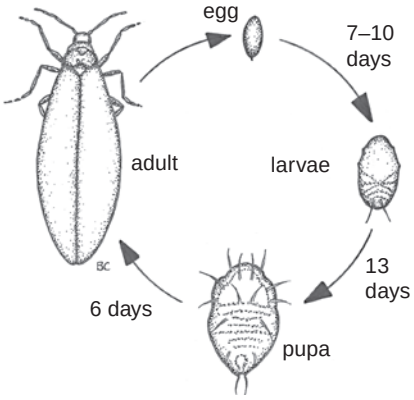
Silverleaf whitefly: bearded iris, canna lily, chrysanthemum, crepe myrtle, euphorbia, hibiscus, lantana, manderilla, petunia, poinsettia, rose, salvia, verbena.

Ash whitefly: apple, apricot, ash, citrus, hawthorn, lilac, magnolia, olive, crepe myrtle, peach, pear, pomegranate, privet, quince.

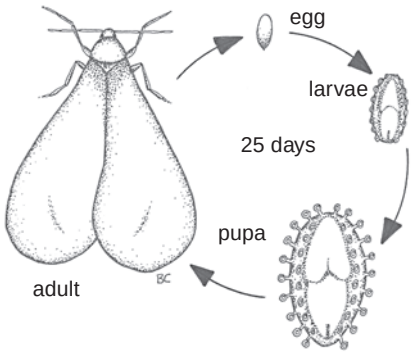
Spiralling whitefly: avocado, banana, capsicum, citrus, custard apple, eggplant, guava, macadamia, mango, papaya, poinsettia, plumeria, rose.



Life cycle of greenhouse whitefly



Life cycle of silverleaf whitefly



Life cycle of ash whitefly

What to look for

Damage

Whiteflies feed on the plant by sucking sap. Feeding damage by adults and immatures causes yellowing of leaves and premature leaf death. Whiteflies excrete honeydew, which encourages growth of black sooty mould on leaf surfaces. Heavy infestations will detract from the plant's appearance and reduce plant vigour. Silverleaf whitefly damage produces yellow speckling on hibiscus leaves. Unchecked infestations on poinsettias cause the stems and bracts of red poinsettia varieties to turn whitish-yellow.

Description

Whiteflies are easy to distinguish from other insects. Adults are small, white, delicate insects about 1.5 mm to 2 mm long. They are not strong fliers. When disturbed, they tend to flutter around the plant and resettle quickly on leaf surfaces, except silverleaf whitefly, which flies greater distances. Heavy infestations on plants appear as white 'clouds' when disturbed. Adults are usually found feeding and resting on the undersurface of leaves, mostly on the upper leaves. Eggs and early nymphal stages (1 to 3) are generally found on young foliage. Older leaves tend to have a mixture of stages, with the older stages more prominent.

Greenhouse whitefly is more readily identified by examining the late instar or 'red eyed' pupal stage with a hand lens (10x) or microscope. The pupae are oval with wall-like sides and a circle of small hairs on the upper edge. The eggs are bullet shaped, purplish and inserted vertically into the leaf in circles. Greenhouse whitefly holds its wings in a deltoid (triangular) manner.

Silverleaf whitefly pupae are flatter, yellowish, tapered toward the rear, and lacking the circle of small hairs on the upper edge like greenhouse whitefly pupae. The eggs are bullet shaped, scattered, brownish and inserted vertically into the leaf. Silverleaf whitefly holds its wings tent-like over its body, the yellow body being visible between the wings.

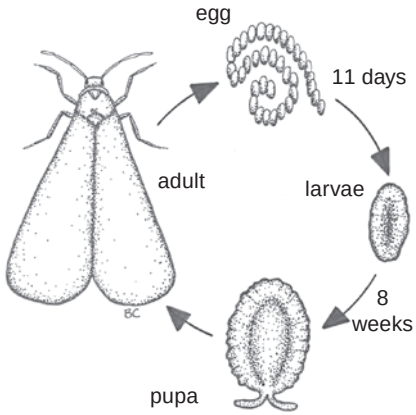
Ash whitefly pupae have tufts of white wax that run in a band down the length of the body and distinct spines tipped with beads of white wax. The immature stages appear more like fungi on the underside of affected leaves.

Spiralling whitefly nymphs produce copious amounts of wax around the margins of the body and the pupal stage has long ribbons of wax which are two or three times the width of the body. The eggs are laid on the leaf surface in the waxy spirals produced by the female.

Action

Cultural/physical

- Inspect new plant material before introducing it to the main growing area.



Life cycle of spiralling whitefly

- Old plant residues shelter whitefly infestations. To avoid carry-over to new crops, remove and destroy plant debris and plant material infected with virus.
- If practical, completely clean the production area at the end of the crop. Remove all plant material, including weeds, for a week or more.
- Plant resistant varieties where possible.
- In greenhouses, use physical barriers, such as screens with pore size 400 micrometres (μm) or less, to prevent adult whiteflies moving from infested areas.
- Regularly remove weeds from the production area and around greenhouse doorways as they can support large populations of whiteflies.
- Group plants susceptible to whiteflies to maintain regular monitoring and treatment.
- Monitor whitefly populations by using sticky traps and plant inspections to detect early infestations.
- Target the susceptible immature stages for biocontrol methods.

Chemical

- Use insecticides selectively and alternate classes of insecticides to prolong use and to avoid development of resistance.
- Thoroughly cover leaf surfaces, especially the underside, for efficient control.
- Target susceptible stages, usually adults and early nymphs.
- Soaps and oil sprays can give effective control.
- Consider using systemic sprays for persistent infestations.

Biological

- **Commercially available.** For greenhouse and silverleaf whitefly—parasitoid wasp: *Encarsia formosa* (supplier Biological Services).
- **Naturally occurring.** Parasitoid wasps and pathogenic fungi.

Sticky traps can be hung above the crop. Adjust their position as the crop grows

Thrips

Western flower thrips: *Frankliniella occidentalis* (Card reference 34)

Onion thrips: *Thrips tabaci* (Card reference 38)

Greenhouse thrips: *Heliothrips haemorrhoidalis* (Card reference 40)

Cuban laurel thrips: *Gynaikothrips ficorum* (Card reference 42)

Plague thrips: *Thrips imaginis* (Card reference 44)

Gladiolus thrips: *Thrips simplex* (Card reference 46)

Card reference

Pests, Diseases, Disorders and Beneficials in Ornamentals: Field Identification Guide, see Section 10 page 7

Importance/risk

Western flower thrips (WFT) and onion thrips are key species in an IPM program.

Special mention must be made of western flower thrips. It was unknown in Australia before 1993, when it was recorded in WA. Later that year it was identified in the Eastern States. It is now widespread.

Western flower thrips:

- can seriously damage plants and flowers by direct feeding
- is a key transmitter of tomato spotted wilt virus (TSWV), which can only be spread by thrips
- has high levels of resistance to many insecticides, making it difficult to control using chemicals.

more info

The Nursery Papers 2000#01,1997#012 Section 10 page 8

A resistance management strategy for WFT is available to assist ornamental producers to control WFT and to retain the activity of those chemicals that do exert some effect (see this section, page 14).

Pest	State
Western flower thrips	Key pest in all States
Onion thrips	Key pest in QLD, NSW, VIC
Greenhouse thrips	Key pest in NSW, VIC
Cuban laurel thrips	Generally only important where *Ficus microcarpa* var. *hillii* is grown
Plague thrips	Key pest in NSW, VIC, SA, WA; minor pest in NT
Gladiolus thrips	Key pest in QLD, SA; minor pest in NT, NSW

Host range

Greenhouse, onion, plague and **western flower thrips** attack a wide range of plants including most commercially produced ornamentals.

Cuban laurel thrips feed primarily on *Ficus microcarpa* var. *hillii*, and other thick-leaved figs.

Gladiolus thrips prefers gladiolus but may also feed on calla lily, carnation, iris, montbretia, red hot poker, tiger flowers.

What to look for

Damage

Adults and larvae feed by piercing plant surfaces and sucking out cell contents. Distortion, wilting and scarring from thrips feeding is not always immediately apparent, but becomes obvious when the affected leaves, flowers or fruits develop.

Feeding generally results in silvering or russetting of foliage or flowers, resulting in loss of value of the crop. Flower growth is stunted and distorted.

more info
Spotted wilt
Section 6 page 28

Onion thrips and western flower thrips both transmit TSWV. Only immature thrips pick up the virus, while adults and immatures can transmit the disease. Only a small number of thrips carrying the virus is needed to infect plants.

Greenhouse thrips characteristically leaves drops of black excreta on foliage, reducing the value of plants.

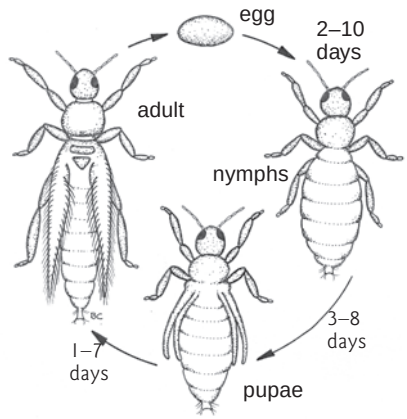
Cuban laurel thrips produces a curling or rolling of infested foliage, thereby lowering the value of the crop. Heavily infested plants may have leaves with a silvered, bronzed appearance. Plants may be stunted and deformed.

Plague thrips can cause rapid damage to flowers when large numbers are blown into a crop in a short period of time.

Gladiolus thrips causes silvering of leaves and flowers. Feeding on buds can produce deformed flowers and corms can be damaged.

Description

Thrips are soft bodied, small (1 to 2 mm long), elongate insects. Adults have two pairs of narrow wings fringed with long hairs. Immature stages are white or yellow and adults can be pale to dark coloured. Eggs are generally laid in leaves. Larval stages and adults can be found on leaves, flowers, buds and sometimes stems. Most thrips pupate in soil under the plants they have been feeding on, though gladiolus and onion thrips can pupate on the plant. Adult thrips are coloured differently, depending on the species; in some cases colour can vary within a species.



Generalised life cycle of thrips

Western flower thrips adult females are yellowish on the head and thorax and brown on the upper abdomen, giving a two-tone appearance. They may darken during winter. In females the wings are shorter than the end of the abdomen. Males are smaller and pale yellow. Immatures are wingless, pale yellow with distinctly bright red eyes.

Onion thrips adults are pale yellow to dark brown (similar in appearance to western flower thrips, but smaller). Their wings extend to the end of the abdomen in females. Immatures are similar to adults, but wingless and yellowish.

Greenhouse thrips adults are black with yellowish legs, antennae and wings. Immatures are white or pale yellow and wingless. The nymph often carries a dark brown drop of excreta on the end of its abdomen.

Cuban laurel thrips adults are large, dark yellowish brown to black. Immatures are translucent white and wingless. Older larvae have a dark tip on the end of their abdomen, which they point vertically. They are found in curled leaves. Eggs are laid on the leaf surface.

Plague thrips adults are yellow to light brown and smaller than western flower thrips. Immatures are similar to adults, but wingless and yellowish.

Gladiolus thrips adults are dark brown or black with light coloured wings and legs. Immatures are similar to adults but wingless and a lighter colour.

Action

Cultural/physical

- Remove weeds, particularly flowering ones such as Paterson's curse, wild mustard, clover and capeweed within and around crops. Weeds can act as a refuge for thrips and tomato spotted wilt virus.
- Plant virus-tolerant cultivars where available.
- Quarantine new plants and check for thrips before introducing these plants onto the property. Deal through reputable suppliers of plant stock.
- Select propagating material from clean sources.
- Remove and dispose of plant residue including unwanted blooms that may contain thrips or be infected with virus before planting the next crop. Place the plant material in black plastic bags, seal immediately and leave in the sun to solarise (heat up) to prevent thrips from continuing their breeding and development cycles.
- Remove plants that will attract thrips (for example plants in garden beds) from around the production area.
- Use insect-proof screening on greenhouse vents.
- Never move from an infested area to a clean area. Avoid wearing pale coloured clothing, such as white, yellow or blue, as thrips are attracted to these colours.
- Use sticky traps to monitor thrips activity.
- Remove any plants showing symptoms of TSWV immediately.
- Use indicator plants to detect new arrivals of thrips.

more info
Spotted wilt
Section 6 page 28

more info
Indicator plants
Section 4 page 14

Chemical

- Monitor thrips and any biocontrol agents in the crop before deciding to spray.
- Resistance is a major factor in your decision to use chemical controls against all thrips species, especially WFT. It is important to rotate insecticides monthly from a different chemical group to reduce the development of resistance, when spraying is necessary.
- The following is a resistance management strategy for WFT, which can be applied to the use of chemicals against any thrips infestation that is found breeding in your crops.

Apply a series of three sprays of the same chemical, three to six days apart depending on the temperature (time of the year), for thorough control. This duration allows eggs and pupae that were not exposed to chemicals at the time of the first spray to develop into active life stages and be exposed to later sprays.

If you spray an organophosphate this month for example, then you should spray with a product from a different chemical group next month. You should change again in the following months if your monitoring shows that thrips are still active.

Contact your local department of agriculture for information on the National Strategy for the Management of Western Flower Thrips and Tomato Spotted Wilt Virus.

Biological

- **Commercially available.** For western flower thrips pupae—predators: *Stratiolaelaps (Hypoaspis) miles* (suppliers Biological Services and Greennem).
- **Naturally occurring.** Phytoseiid predatory mites, predatory bugs, parasitoid wasps and fungal pathogens.

Aphids

Green peach aphid: *Myzus persicae* (Card reference 50)

Cotton aphid: *Aphis gossypii* (Card reference 52)

Potato aphid: *Macrosiphum euphorbiae* (Card reference 54)

Lily aphid: *Aulacorthum circumflexum* (Card reference 56)

Foxglove aphid: *Aulacorthum solani* (Card reference 58)

Rose aphid: *Macrosiphum rosae* (Card reference 60)

Chrysanthemum aphid: *Macrosiphoniella sanborni* (Card reference 62)

Cowpea aphid: *Aphis craccivora* (Card reference 64)

Card reference

Pests, Diseases, Disorders and Beneficials in Ornamentals: Field Identification Guide, see Section 10 page 7

Importance/risk

Aphids are a high risk if not detected and treated.

Several species are key pests in an IPM program. A large number of minor pest species are also found in a variety of crops.

Pest	State
Green peach aphid	Key pest in QLD, NSW, VIC, WA
Cotton aphid	Key pest in QLD, NSW, VIC; minor pest in NT, WA
Potato aphid	Minor pest in QLD, VIC
Lily aphid	Key pest in NSW
Foxglove aphid	Key pest in NSW
Rose aphid	Key pest in QLD, VIC
Chrysanthemum aphid	Key pest in QLD, NSW
Cowpea aphid	Key pest in WA; minor pest in VIC

Green peach aphid transmits cucumber mosaic virus, turnip mosaic virus and more than 100 other plant viruses.

Cotton aphid transmits cucumber mosaic virus, onion yellow dwarf, citrus quick decline, lily symptomless disease and lily rosette. Cucumber mosaic virus causes flower break (that is mottling of flowers and streaking of flower colour) and distortion on cyclamen, lisianthus and vinca.

Chrysanthemum aphid transmits vein mottle virus and chrysanthemum virus B.

Aphids affect growing tips. If the right conditions exist for pest populations to build up, plants can become rapidly damaged, making them unsaleable. Plants may die if severe aphid infestations remain untreated.

Host range

Green peach aphid: apricot, camellia, capsicum, cucurbit, dahlia, hollyhock, Iceland poppy, lupin, nectarine, peach, plum, potato, primrose, rose, snapdragon (*Antirrhinum* spp.). Weed hosts: capeweed, dock, sowthistle.

Cotton aphid: begonia, camellia, chrysanthemum, cosmos, dahlia, gardenia, hibiscus, hollyhock, lilac, orchid.

Potato aphid: bulbs, rose.

Lily aphid: chrysanthemum, lily.

Foxglove aphid: chrysanthemum, common violet, daphne, geranium, ivy, primrose, viburnum.

Rose aphid: rose.

Chrysanthemum aphid: chrysanthemum.

Cowpea aphid: bean, chrysanthemum, clover, cowpea, lupin, other leguminous plants.

What to look for

Most aphid species are typically found on the growing tips of plants. Although most common on shoot tips and flower buds, they can also be found on leaves and stems. A few species can be found on the roots of potted stock. Aphid outbreaks typically start with winged aphids arriving on the wind and producing large numbers of live young in 'hot spots' in the crop.

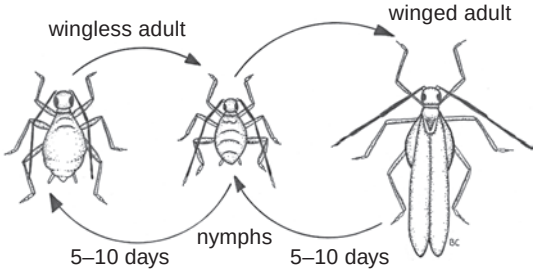
Damage

Immatures and adults cause damage. Aphids live in colonies formed from the young of a single female, though it is not unusual to find single or small numbers at the ends of shoots. As these aphids feed on and inject toxic saliva into developing plant tissues, small numbers can be damaging to the plant's appearance. Their feeding produces shoot, leaf and flower distortion, wilting and retarded growth.

Aphids excrete honeydew, which attracts ants. Ants can move aphids around and protect them from natural enemies. Honeydew encourages the growth of black sooty mould that can spread over plant foliage, reducing plant vigour and making plants unsaleable. In heavy infestations, foliage may be covered with whitish skin casts as aphids moult.

Description

Aphids are pear-shaped, soft-bodied insects. They range in size from 1.5 to 3.5 mm and may be winged or wingless. They have long legs and antennae. Under most conditions adult females produce live young on a continual basis all year.



Generalised life cycle of an aphid

Green peach aphid wingless adults and nymphs are light green to pink. Winged females have a black patch on the upper surface of the abdomen, and a dark head and thorax.

Cotton aphid wingless adults and nymphs vary from light yellow to greenish black. They can be distinguished from other aphids by the dark, long cornicles (tubes) projecting from the rear of the body. Winged females are black.

Potato aphid wingless adults and nymphs vary from pink to green and have long cornicles (tubes) projecting from the rear of the body. Winged adults are pink with a yellowish head and thorax.

Lily aphid adults and nymphs vary from yellow-green to black and have a horseshoe shaped dark mark on their backs.

Foxglove aphid wingless adults and nymphs vary from yellow-green to brown. They have light green cornicles (tubes) projecting from the rear of the body. Winged females are light brown with dark stripes on the abdomen.

Rose aphid adults and nymphs range from green to reddish-green.

Chrysanthemum aphid nymphs have brick red bodies, with the outer two-thirds of the legs and the antennae grey. The adults are shiny, dark brown to black.

Cowpea aphid nymphs are rounded in body shape, and light brown-grey. Adults are shiny, dark brown to black with dark red eyes.

Action

Cultural/physical

- Use clean plant material or cuttings as aphids reproduce rapidly and can establish very quickly in crops.
- Remove weeds, which can provide alternative hosts, in and around the nursery and greenhouse.
- Avoid the use of excessive nitrogen as it promotes the lush plant growth that aphids prefer.
- Control ants as these spread and protect aphids from natural enemies.
- Use resistant/tolerant plant species if available.
- Consider using insect screening on greenhouse vents.
- Use sticky traps to monitor aphid activity.

Chemical

- Specific aphicides that will reduce impacts on non-target organisms are available.
- Beware of resistance. Green peach and cotton aphids have developed resistance to several organophosphates. Newer systemic aphicides, applied as spot sprays or root drenches, can be used with biocontrol agents.
- Insecticidal soaps and horticultural oils are effective.
- Spot treatment is the preferred chemical application method where appropriate.
- Check for predators, for example lacewings, and signs of parasitism, for example aphid mummies, before spraying. Many naturally occurring or commercially produced biocontrol agents are susceptible to chemicals.

Biological

- **Commercially available.** Predatory green lacewing—*Mallada signata* (supplier Bugs for Bugs).
- **Naturally occuring.** Predatory green and brown lacewings and ladybird beetles, parasitoid wasps that mummify the aphid (mummies may be brown or black), pathogenic fungi such as *Beauveria, Aschersonia* and *Verticillium* spp. (look for white or yellow growth on the body).

Caterpillars

Corn earworm: *Helicoverpa armigera* (Card reference 66)

Native budworm: *Helicoverpa punctigera* (Card reference 66)

Cluster caterpillar: *Spodoptera litura* (Card reference 68)

Loopers: *Chrysodeixis* sp. (Card reference 70)

Lightbrown apple moth: *Epiphyas postvittana* (Card reference 72)

Cutworms: *Agrotis* spp. such as *Agrotis infusa* (bogong moth), *A. ipsilon* (black cutworm) and *A. munda* (brown or pink cutworm) (Card reference 74)

Card reference

Pests, Diseases, Disorders and Beneficials in Ornamentals: Field Identification Guide, see Section 10 page 7

Importance/risk

Caterpillars are key pests in ornamentals in some States and a minor pest in others.

Pest	State
Helicoverpa spp.	Key pest in NSW, VIC, WA
Cluster caterpillar	Key pest in NSW, VIC
Loopers	Key pest in NSW, VIC, NT, WA
Lightbrown apple moth	Minor pest in SA, WA
Cutworms	Minor pest in all States

Host range

Broad range of ornamentals, indoor plants, field crops, broadleaf weeds, fruit crops and vegetables (beans, brassicas, corn and tomato).

What to look for

Damage

Only the caterpillars (larval stage) cause damage by feeding on foliage, tender stems, buds and flowers. The adults do not feed on plants but feed on nectar. Chewing damage by the larvae destroys seedlings, kills terminal growth, interferes with flower set, and may cause ragged leaves and unsaleable plants.

Look for holes in leaves, buds and stems, and larval droppings (frass) on plants or on the ground.

Helicoverpa larvae are also found inside flower or leaf buds. These damaged buds turn brown and die. The terminal growth is continually pinched and flower setting destroyed.

Cluster and **looper caterpillars** usually chew leaves. Cluster caterpillars (young larvae) feed in clusters, skeletonising the leaves. Older larvae are solitary.

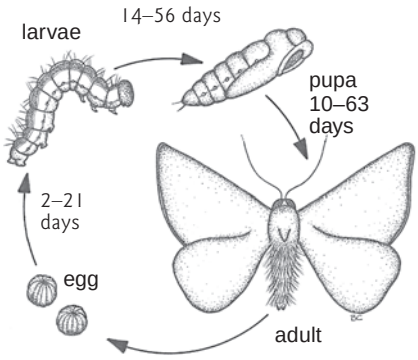
Lightbrown apple moth feed on buds, flowers and leaves. They feed in protected shelters by webbing or rolling leaves or flowering parts together. Heavy infestations can kill small seedlings.

Cutworm larvae chew through the stems, near the base of young seedlings. They also chew holes in leaves, and buds and fruit near the ground. Cutworms feed during the night, and hide in the soil near damaged plants during the day.

Description

***Helicoverpa* caterpillars** grow to about 40 to 50 mm long. They are yellow-green to red-brown and have some darker markings or stripes along their body. The adults have a 40 mm wingspan, and have grey to reddish brown forewings with darker markings.

Cluster caterpillars grow to about 40 to 50 mm long. They are green to brown with two rows of dark triangles along either side of the body. The adult moths have dark forewings and silvery-white hindwings.



Generalised life cycle of a caterpillar

Looper caterpillars are 30 to 40 mm long and move in a looping motion. They range from green to brown. Looper and *Helicoverpa* adults are active at night and fly towards lights.

Lightbrown apple moth larvae are slender and green, and when disturbed they tend to wriggle vigorously and drop down on silken threads. Lightbrown apple moth adults are bell-shaped and vary in colour. Females are pale brown, about 20 mm long. Males are smaller and show variable colour pattern.

Cutworm moths can be up to 40 mm long and vary in colour from black, brown to dark grey. They have characteristic markings on their forewings. The eggs are usually white, round and about 0.5 mm in diameter. The larvae are soft bodied, up to 40 mm long, and vary in colour from pale green to dark brown or black. They tend to curl up when disturbed.

Action

Cultural/physical

- It is important to carefully monitor for eggs, larvae and adults before deciding whether to buy beneficials or to spray. Use pheromone lures to monitor adult activity. The lures are used to identify moths and get an indication of population size. They are not used as a control method.
- In greenhouses, screen vents to prevent adults entering.
- For small infestations, caterpillars may be hand-picked off the plant. Also remove groups of cluster caterpillar.
- Remove alternative weed hosts.
- Bring clean plant material into the property. Seedlings and cuttings may carry eggs or very small caterpillars, and soil may support pupae.
- Infested plant material and debris should be destroyed to prevent development of the pest.
- Spreading wood ashes around the base of the plant and soaking with water can create a barrier to cutworm larvae.

Chemical

Small caterpillars are easier to kill and should be targeted. This is particularly important when using the bacterium *Bacillus thuringiensis*. Where larger caterpillars (more than 13 mm long) or larger numbers of caterpillars exist, consider applying synthetic insecticides. Thorough chemical spray penetration of foliage is essential for good control.

Biological

- **Commercially available.** Bacterium *Bacillus thuringiensis* (supplier chemical resellers) for the control of all species of early larval stages of leaf-eating caterpillars. The aizawai (Xentari™) strain is more effective than the kurstaki strain against cluster caterpillar.

  For *Helicoverpa* caterpillar, loopers and cluster caterpillar—the parasitoid wasp *Trichogramma pretiosum* (supplier Bugs for Bugs).

  For lightbrown apple moth—the parasitoid wasp *Trichogramma carvarae* (supplier Bugs for Bugs).

  For *Helicoverpa* caterpilllar, cluster caterpillar and cutworms—the entomopathogenic nematode *Steinernema carpocapsae* (supplier Ecogrow).
- **Naturally occurring.** Predatory bugs and ladybirds against eggs and larvae; parasitoid wasps and flies against eggs, larvae and pupae; pathogenic fungi, nuclear polyhedrosis and granulosis viruses.

Flies

Fungus gnats (sciarids): *Bradysia* spp. (Card reference 76)

Shore flies: *Scatella australiae* (Card reference 78)

Cineraria leafminer: *Chromatomyia (Phytomyza) syngenesiae* (Card reference 80)

Card reference

Pests, Diseases, Disorders and Beneficials in Ornamentals: Field Identification Guide, see Section 10 page 7

Importance/risk

Fungus gnats and shore flies have become important pests in ornamental plants for the direct and indirect damage they can cause.

Pest	State
Fungus gnat	Key pest in all States
Shore fly	Minor pest in all States
Cineraria leafminer	Minor pest in VIC, SA

Host range

Fungus gnats: wide host range including most seedlings and cuttings, mature plants such as carnation, gerbera, poinsettia, and most hydroponic crops.

Shore flies: bedding plants.

Cineraria leafminer: chrysanthemum, cineraria, gazania, gerbera, *Helichrysum*, nasturtium. Weed hosts: capeweed, prickly lettuce, sowthistle.

What to look for

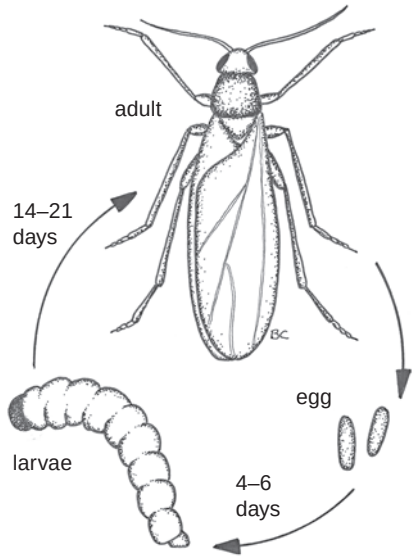
Fungus gnat adults are weak fliers and are usually seen running on the soil surface. The larvae are found on or near the surface of potting mixtures and in seedling stems and roots.

Shore fly adults resemble tiny house flies. They have a characteristic short flight, appearing almost to jump. They are often incorrectly identified as fungus gnats.

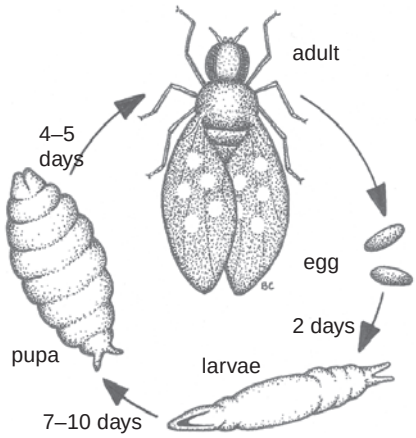
Cineraria leafminer larvae leave tunnels in leaf tissue, giving leaf surfaces the appearance of silvery streaks.

Damage

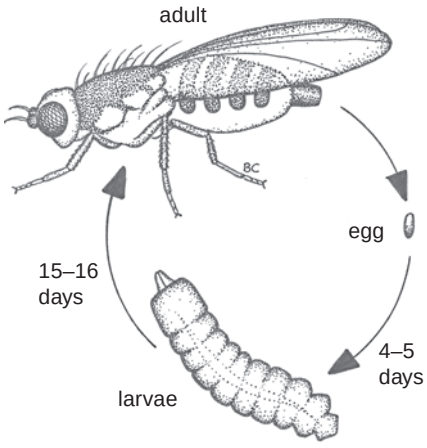
Fungus gnat adults do not feed on plants and are short-lived. Larvae of fungus gnats feed on root hairs, roots and organic matter in the soil. They often feed in clusters. Large larvae will enter stems just below the soil surface. Seedlings and cuttings are most susceptible to attack. Heavy infestations will cause wilting due to root damage and secondary attack by pathogens. Larvae also feed on the callus of cuttings, preventing striking or slowing down root development.



Life cycle of fungus gnat



Life cycle of shore fly



Life cycle of cineraria leafminer

The adults and larvae of fungus gnats are potential carriers of the soil-borne root diseases *Pythium, Rhizoctonia, Thielaviopsis (Chalara)*, and *Fusarium*, and the plant leaf disease *Botrytis*.

Shore flies cause 'fly spotting' damage from excrement on foliage. Large numbers of these flies are a nuisance indoors to staff and may be a deterrent to some customers. Shore fly adults and larvae are carriers of root pathogens such as *Pythium* and *Phytophthora*.

Cineraria leafminer larvae feed by tunnelling through leaf tissue, giving leaf surfaces the appearance of silvery streaks. Plants appear unsightly. Severe infestations will cause wilting and plants may die if most of the leaves are destroyed.

Description

Fungus gnat adults are delicate flies with long legs and antennae, and a single pair of wings. They are similar in appearance to a small mosquito. Fungus gnat wing veins have a distinctive Y-pattern near the end of the wing. The larvae have a white to translucent, worm-like body and a small black head. They are about 5 to 8 mm long.

Shore fly adults are brown-black with a stout body and five pale spots on a single pair of smoky-coloured wings. They resemble very small house or fruit flies. The larvae are white maggots with no distinct head. They are found in the top layer of potting mix feeding on algae.

Cineraria leafminer adults are small, black, inconspicuous flies. They fly slowly, making short, hopping flights. The larvae are cream to yellow, headless and legless. They pupate within the leaf.

Action

Cultural/physical

Fungus gnat and shore fly

- Avoid over fertilising to discourage growth of algae on mats, benches, soil and ground.
- Keep areas below benches and on walkways free of water and spilled potting mix.
- Avoid excessive watering. Improve drainage. Disinfect surfaces and paths to remove algae.
- Avoid using potting media high in organic matter, such as peat, which favours fungus gnats.
- Use yellow sticky traps to monitor adult populations.
- Monitor larval populations of fungus gnats by placing skinless, 2.5 cm diameter by 1.25 cm thick potato discs on potting media. Leave disc for at least four hours before counting larvae on and under the disc. Make sure the disc surface in contact with the potting media is always moist.
- Poorly composted potting media can be infested with fungus gnat larvae.

Cineraria leafminer

- Cineraria leafminer-infested material may be pruned off and destroyed.

Chemical

- Many commercially used chemicals are not effective against fungus gnats and shore flies. Cultural control, such as reducing areas of poor drainage and algal growth, is far more effective than chemical use.
- Adults and larvae of fungus gnats are targeted separately.
- Media must be thoroughly drenched if applying a chemical agent against larvae.

Biological

An increasing number of properties, particularly growers of greenhouse crops, are successfully using biocontrols against fungus gnats. Shore flies and leafminers are more difficult to manage.

- **Commercially available.** For fungus gnat larvae—entomopathogenic nematode: *Steinernema feltiae* (supplier Ecogrow) and predatory mites *Stratiolaelaps (Hypoaspis) miles* (suppliers Biological Services and Greennem).
- **Naturally occurring.** Predatory mites, beetles and parasitoid wasps.

Mealybugs

Citrus mealybug: *Planococcus citri* (Card reference 82)

Longtailed mealybug: *Pseudococcus longispinus* (Card reference 84)

Root mealybug: *Rhizoecus falcifer*

Card reference

Pests, Diseases, Disorders and Beneficials in Ornamentals: Field Identification Guide, see Section 10 page 7

Importance/risk

Mealybugs are key pests of ornamentals in several States.

Pest	State
Citrus mealybug	Key pest in QLD, NSW; minor pest in NT
Longtailed mealybug	Key pest in NSW, VIC WA; minor pest in NT
Root mealybug	Key pest in SA, NT

Host range

Citrus mealybug: begonia, boronia, cactus, calathea, canna lily, citrus, coleus, croton, cyclamen, dahlia, eriostemon, narcissus, tulip.

Longtailed mealybug: bromeliad, bulbs, citrus, custard apple, fern, fuchsia, grapefruit, grape, hibiscus, Japanese maple, olive, orchid, palm, passionfruit, pine, pomefruit, stonefruit.

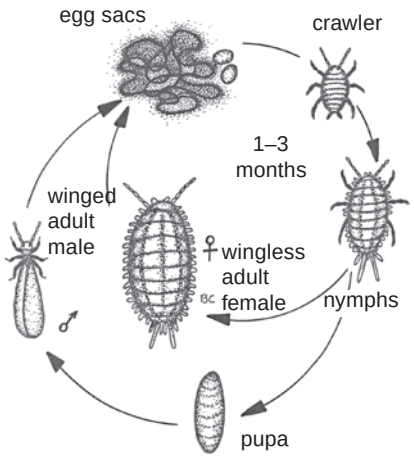
Root mealybug: brachycome, bromeliad, cactus, delphinium, fern, orchid (wide range of indoor and outdoor species), palm.

What to look for

Damage

Both adult and nymphal stages feed on stems, crowns, flowers, fruits and roots. Mealybugs shelter at the base of stems, in crevices and cracks on the plant. Root mealybug feeds on roots and root hairs. Citrus mealybug is also recorded feeding on roots.

Mealybugs damage plants by sucking the sap from plant tissue. They also inject toxins into the plant, causing distorted growth. Mealybugs cause further damage by excreting honeydew, which encourages growth of black sooty mould. Ants may be present feeding on the honeydew. This makes the plant look unsightly. Mealybugs also disfigure plants by producing fluffy, white wax filaments that cover egg sacs. Unchecked infestations in soft foliage plants will cause the plants to wilt and die. Large infestations will make the plant unsaleable.



Life cycle of citrus mealybug

Description

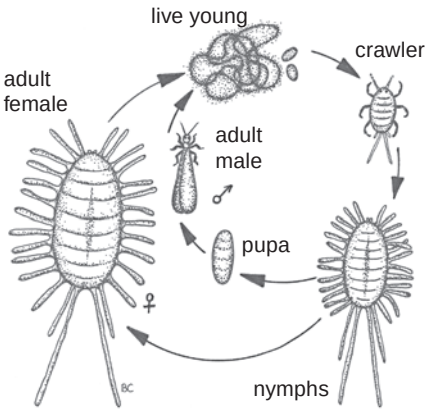
Mealybugs are small, oval, soft-bodied insects. They are usually covered by a cottony or mealy wax secretion, which can extend as marginal filaments. Wingless females produce egg sacs which are covered by a cottony secretion (looks like spots of cotton wool on the plant) to protect the eggs. Longtailed mealybug produces live young rather than eggs. Generally, both adult and nymphal stages are mobile. Adult males are the only winged stage.

Nymphs are called 'crawlers' and can disperse to suitable feeding sites on the plant and spread to other plants by wind or on clothing. Nymphs are the most fragile stage and easiest to control. Ants are often associated with mealybugs as they feed on the honeydew produced by the pest.

Citrus mealybug is pinkish and covered with a white waxy meal except for a strip along the back (diagnostic feature). It has short filaments along the edge of its body and slightly longer ones at the rear.

Longtailed mealybug is pinkish and covered with a white waxy meal. It has long filaments along the edge of its body and a pair of very long filaments at the rear.

Root mealybug does not have an above-ground stage. Cotton-like masses on infested roots contain both eggs and adults. Nymphs will crawl from pot to pot via drainage holes or be transferred in irrigation water.



Life cycle of longtailed mealybug (two to three months)

Action

Cultural/physical

- Maintain plants in good condition by providing adequate nutrition and water, as weakened plants are susceptible to attack.
- Avoid movement of infested plant material within the greenhouse and into the greenhouse on purchased material.
- Check roots of wilted plants as these plants can harbour mealybugs.
- Control ants as these spread crawlers and protect the mealybugs from natural enemies.
- Thoroughly disinfest recycled pots to avoid transferring eggs and nymphs from crop to crop.
- Routinely check roots of susceptible plants. If root mealybug is found, thoroughly disinfest surrounding gravel including beneath plastic and weed mat.

Chemical

- Spraying is often difficult because mealybugs are found in sheltered places. In the greenhouse there may be overlapping generations of adults and nymphs.
- Systemic pesticides are generally more effective than contact-acting ones because the mealybugs are protected by their waxy coating.
- Pesticides have difficulty in penetrating the waxy egg sac. Use a wetting agent with any chemical to assist coverage.
- Soil drenching must be thorough to have any impact on root mealybug.

Biological

- **Commercially available.** Predatory ladybird beetle: *Cryptolaemus montrouzieri* (supplier Bugs for Bugs), green lacewing: *Mallada signata* (supplier Bugs for Bugs) and parasitoid wasp: *Leptomastix dactylopii* for citrus mealybug (supplier Bugs for Bugs).
- **Naturally occurring.** Predatory ladybird beetles, green and brown lacewings and parasitoid wasps.

Hard or armoured scales

Oleander scale (ivy scale): *Aspidiotus nerii* (Card reference 86)

White louse (citrus snow scale): *Unaspis citri* (Card reference 88)

Rose scale: *Aulacaspis rosae* (Card reference 90)

Fern scale: *Pinnaspis caricis*

Latania scale: *Hemiberlesia lataniae*

San Jose scale: *Quadraspidiotus perniciosus*

White palm scale: *Phenacaspis eugeniae*

Card reference

Pests, Diseases, Disorders and Beneficials in Ornamentals: Field Identification Guide, see Section 10 page 7

Importance/risk

Heavy infestations damage twigs and branches, reduce tree vigour and may kill plants.

Pest	State
Oleander scale	Minor pest in QLD, VIC
White louse	Key pest south-east QLD, VIC; minor pest in NT
Rose scale	Key pest in VIC, TAS
Fern scale	Minor pest in QLD
Latania scale	Key pest in QLD
San Jose scale	Minor pest south-east QLD, VIC, WA
White palm scale	Minor pest in QLD

Host range

Oleander scale: boxwood, ferns, grape, ivy, oleander, olive, orchid, persimmon.

White louse scale: citrus, Rutaceae.

Rose scale: blackberry, loganberry, raspberry, rose.

Fern scale: known to infest only ferns.

Latania scale: avocado, banana, grevillea, hakea, kiwifruit, liquidamber, macadamia, pawpaw poplar, privet, tamarisk, willow.

San Jose scale: apple, apricot, hawthorn, peach, pear, plums, quince, tree lucerne.

White palm scale: geebung, lillypilly, magnolia, NSW Christmas bush, palms, protea, viburnum, waratah.

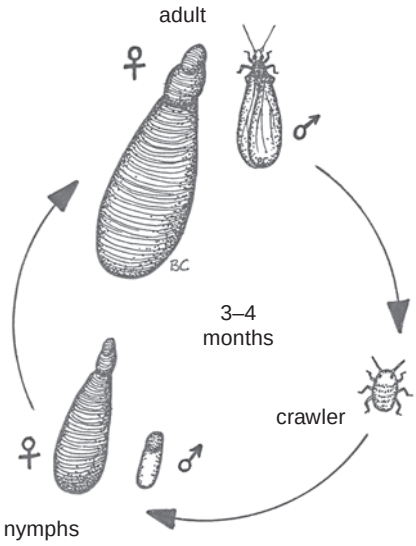
What to look for

Damage

Armoured scales suck sap and heavily infested plants may look water stressed. Feeding causes yellow and brown blotches or streaks on leaves, leaf drop, and dieback of twigs and stems. Some armoured scales attack fruit, causing blemishes. Serious infestations, if not controlled, can kill the plant. Infestations of white louse scale on leaves and stems resemble shredded coconut.

Rose scale will mainly infest the stems of rose plants and in heavy infestations will attack young growth.

Fern scale causes fronds of birdnests, elkhorn and staghorn to develop yellow spots and die back.



Life cycle of white louse scale

Description

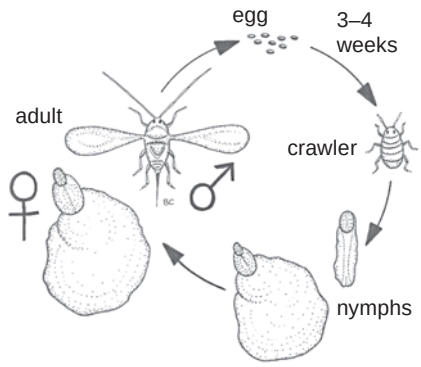
Armoured scales are circular, oval or mussel-shaped and smaller than soft scales. They have a hard, waxy covering over their bodies. Depending on the insect's stage of development, the covering may be separated from the body of the scale. There are many species that resemble each other and a specialist is needed to identify them.

Armoured scales ***do not*** produce honeydew and so are not associated with sooty mould.

Most hard scales have more than one generation a year. Females can produce between 20 and 400 eggs and a life cycle may take between 60 and 120 days. Crawlers move a short distance from where they have hatched to find a suitable feeding site within a day or two of hatching. Wind can spread crawlers to other plants.

Oleander scales are flat, circular and white-yellow. The male armour is smaller and elongated compared to the female.

White louse male scales are white, 1 mm long, narrow and rectangular with three longitudinal ridges. Females are mussel-shaped, 2 mm long and dark brown.



Life cycle of rose scale

Rose scale females are about 2 mm across, circular, flat and greyish white. The males are about 0.7 mm long, orange-red and have a distinct spine.

Fern scale females are oyster-shaped, up to 2.5 mm long and light brown to yellow-brown. Males are white, downy and have three ridges along their back.

Latania scale females are circular, 2 mm across, convex and dirty white with a large pale brown marking in the centre. The male is smaller and more slender.

San Jose scale females are circular, 2 mm across and pale grey to black. Males are smaller and oval. Scales can overlap.

White palm scale females are white, pear-shaped and up to 2.5 mm long. The males are smaller and are covered in white cotton-like matter.

Action

Cultural/physical

- Avoid introducing infested plant material (stock, buds, grafts or cuttings) into the property. Check neglected plants.
- Minimise movement of infested material in the property. Use clean stock.
- Reduce movement of staff through infested areas, as crawlers may be carried on clothes and equipment.

Chemical

- Oil sprays have been used to control scale insects by smothering them but these sprays do not kill eggs. Recent developments have given rise to more effective light spraying oils for horticultural use.
- Oil applications should be timed to reach the crawlers, which are the most susceptible stage. To determine when crawlers are hatching, set traps of double-sided sticky tape. Tightly encircle infested twigs or branches with tape and examine it with a hand lens to identify crawlers. Crawlers will appear as yellow or orange specks. Check the tapes weekly.
- Do not spray oils during fog or rain, or during or before hot weather (above 34°C). Some plants are susceptible to damage from spray oils; check product label for appropriate use.
- Avoid indiscriminate use of broad-spectrum sprays that kill natural enemies and have a long lasting residual effect.
- Treat isolated infestations by spot spraying, pruning or hand-picking to remove scales.

Biological

- **Commercially available.** For all scales—predatory green lacewing: *Mallada signata* (suppler Bugs for Bugs) nymphs feed on crawlers of scales.

  For oleander scale and white louse scale—predatory ladybird beetles; red chilocorus *Chilocorus circumdatus* and blue chilocorus *C. baileyi* (supplier Bugs for Bugs).

  For oleander scale alone—parasitoid wasps: *Aphytis lingnanensis* (supplier Bugs for Bugs) and *A. melinus* (supplier Biological Services).
- **Naturally occurring.** Predatory green and brown lacewings, predatory beetles and mites, scale-eating caterpillars, parasitoid wasps and pathogenic red-headed fungi.

Soft scales

Soft brown scale: *Coccus hesperidum* (Card reference 92)

Pink wax scale: *Ceroplastes rubens* (Card reference 94)

White wax scale: *Ceroplastes destructor* (Card reference 96)

Hemispherical scale: *Saissetia coffeae* (Card reference 98)

Black scale: *Saissetia oleae* (Card reference 100)

Card reference

Pests, Diseases, Disorders and Beneficials in Ornamentals: Field Identification Guide, see Section 10 page 7

Importance/risk

Soft scales are common pests of ornamentals. They can be difficult to control because mature scales are resistant to pesticides and correct timing is necessary to target crawlers.

Pest	State
Soft brown scale	Key pest in QLD, NSW, VIC, NT
Pink and white wax scales	Key pest in NSW; minor pest in QLD, VIC, NT, WA
Hemispherical scale	Minor pest in QLD, NSW, VIC, NT
Black scale	Key pest in QLD, NSW, VIC, NT, WA

Host range

Soft brown scale: citrus, coffee, fern, gardenia, orchid, various foliage plants.

Pink wax scale: avocado, citrus (especially mandarin), coffee, custard apple, fern, holly, ivy, lillypilly, mango, pittosporum.

White wax scale: Euonymus (spindle tree), gardenia, *Hebe* spp., hibiscus, lillypilly, *Parahebe* spp., persimmon, pittosporum, umbrella tree, veronica.

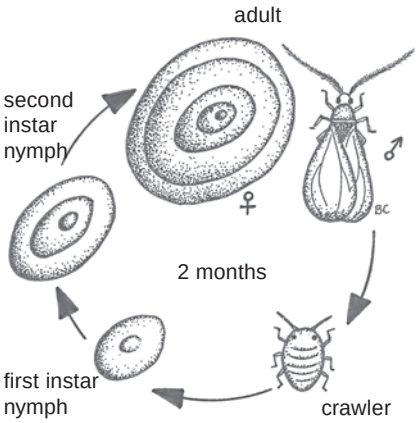
Hemispherical scale: avocado, citrus, European olive, fern, orchid, olive, palm, persimmon, various foliage plants.

Black scale: mostly hardwood plants such as apple, apricot, ash, citrus, daphne, fig, hibiscus, holly, magnolia, oleander, olive, passionfruit, pear, photinia, plum, poplar, quince, tamarisk.

What to look for

Damage

All stages feed on the plant by sucking sap. The adults and young stages are found on branches, twigs, stems, stalks and leaf midribs. Adults are immobile and tend to be clustered in small colonies on various parts of the plant. Newly hatched crawlers move around for 12 to 24 hours to young growth for feeding



Life cycle of soft brown scale

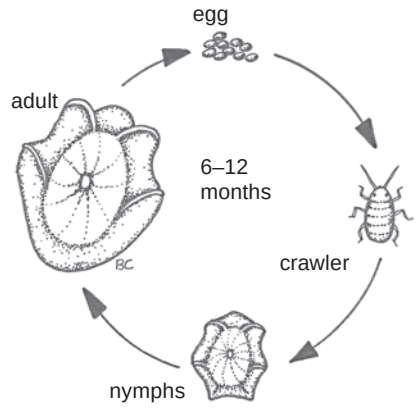
and then settle permanently. Crawlers also move from plant to plant by wind dispersal and on clothing and equipment.

Soft scales feeding on young tissue can produce distorted foliage and yellowing of leaves. Heavy infestations can cause twigs and branches to die back.

Soft scales produce honeydew, which encourages the growth of sooty mould fungus. This fungus causes the plant surfaces to blacken and heavily infested plants lose their leaves, and become unsightly and unsaleable. Ants and honeydew may indicate the presence of soft scales. Ants feed on the honeydew, protect the scales from natural enemies and help disperse the crawlers from plant to plant.

Description

Adult females are 2 to 5 mm long and oval to circular. The protective covering cannot be detached from the body. The upper surface of adults usually has a soft or hard, waxy layer whose shape may change according to the feeding site. The protective cover tends to be wide and almost round when scales feed on leaves and narrow to oval when scales feed on twigs.



Life cycle of white and pink wax scale

Soft brown scale is flat, oval-shaped, yellow-green or yellow-brown and often has dark mottled patterns on the top. The colour darkens with age. Second instar nymphs have a longitudinal ridge along the top of the body.

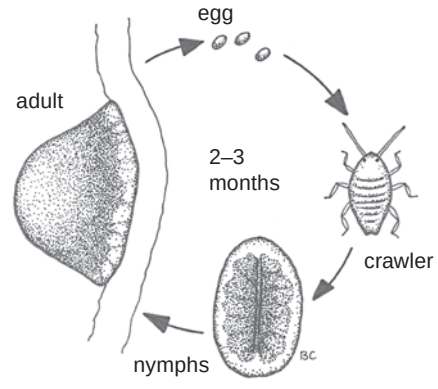
Pink wax scale is pink to red with a hard wax covering which is smooth to globular in shape. The scale has two lobes on either side, and a depression on top.

White wax scale is white with a hard wax covering which is smooth to globular in shape. The scale has two lobes on either side, and a depression on top.

Hemispherical scale is glossy light to dark brown, rounded in appearance and has a smooth surface. The nymphs have a raised H-pattern on the back.

Black scale is dome shaped and black or dark brown with a rough appearance. Adults have an H-pattern ridged on the back.

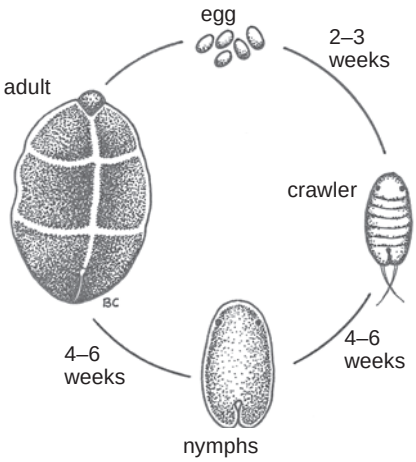
Action



Life cycle of hemispherical scale

Cultural/physical

- Avoiding handling infested material.
- Avoid introducing infested stock, buds, grafts or cuttings into the property or greenhouse.
- Do not neglect small infestations. Unattended stock plants are often a source of scales and you should include these plants in your monitoring.
- Avoid indiscriminate use of broad-spectrum insecticides, which kill natural enemies and have a long lasting residual effect.
- Provide wind shelter to limit spread of crawlers.
- Check for sooty mould and honeydew on plants. Increased ant activity is a good indication of the presence of honeydew-producing insect pests



Life cycle of black scale

such as soft scale. Control ants to prevent spread of soft scale around the property.

- Heavily infested plants should be discarded.
- Prune or hand-pick isolated infestations on plants, or wash with soap, to remove scales and sooty mould.

Chemical

- Spray with horticultural grade oil or another registered product, when young crawlers are seen on leaves and twigs. Later stages have a protective waxy layer, which makes them resistant to insecticides and spray oils. Some plants are susceptible to damage by oil sprays. Check the label for appropriate use.
- Turn mature scales over and check for viable eggs. Monitor for egg hatch, and treat when crawlers are present.

Biological

- **Commercially available.** For hemispherical, soft brown and pink wax scales—predatory ladybird beetle: *Cryptolaemus montrouzieri* (supplier Bugs for Bugs).
- **Naturally occurring.** Predatory ladybird beetles, lacewings, parasitoid wasps, scale-eating caterpillars and pathogenic fungi.

Bugs

Green mirid: *Creontiades dilutus* (Card reference 102)

Azalea lace bug: *Stephanitis pyrioides* (Card reference 104)

Leafhoppers: Various (Card reference 106)

Harlequin bug: *Dindymus versicolor* (Card reference 108)

Card reference

Pests, Diseases, Disorders and Beneficials in Ornamentals: Field Identification Guide, see Section 10 page 7

Importance/risk

Bugs can cause considerable damage to some cultivars.

Pest	State
Green mirid	Minor pest in QLD, NSW, VIC
Azalea lace bug	Key pest in QLD, NSW; minor pest in SA, VIC
Leafhoppers	Key pest in all States
Harlequin bug	Key pest in VIC; minor pest in WA

Host range

Green mirid: chrysanthemum, gerbera.

Azalea lace bug: azalea, rhododendron.

Leafhoppers: dahlia, marigold, a large range of native plants.

Harlequin bug: abutilon, *Alyogone*, dahlia, fig, grape, hibiscus, kurrajong, pome and stone fruit, strawberry, *Thomasia*, violet, wisteria.

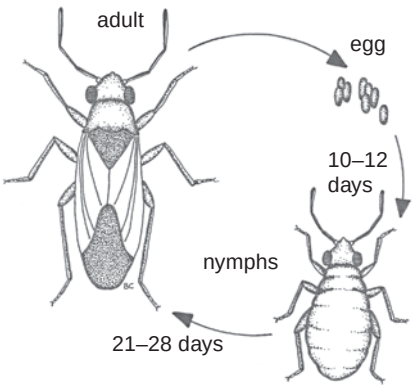
What to look for

Damage

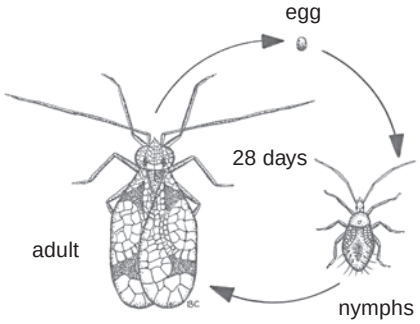
Green mirid nymphs and adults feed on buds and young shoots by sucking sap. Damaged plant tissue blackens and dies, causing tip kill. Green mirids have been found to feed on gerbera flowers and in terminal growth in chrysanthemums.

Azalea lace bug nymphs and adults feed by sucking sap from the lower leaf surface. The upper surfaces of damaged leaves have a bronzed, speckled appearance, which resembles thrips and spider mite damage. Severely damaged leaves turn yellow and drop. The undersurface of leaves is covered with black spots of excreta and nymphal skins.

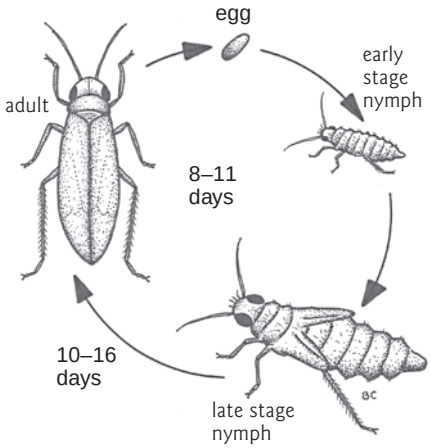
Leafhopper nymphs and adults feed on the leaf undersurface, producing a stippled, speckled effect on the upper surface of leaves. When disturbed, they will hop sideways. Damage looks similar to that caused by two-spotted mite. Some leafhoppers can transmit viruses.



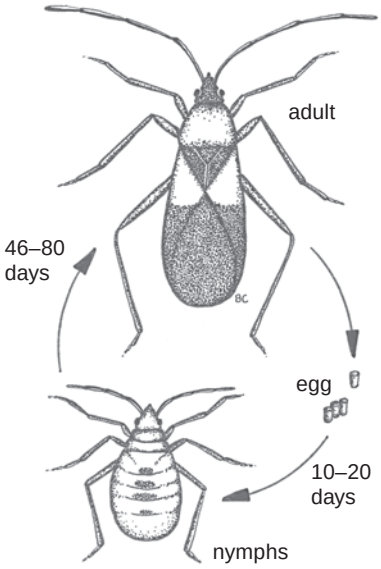
Life cycle of green mirid



Life cycle of azalea lace bug



Life cycle of leafhopper



Life cycle of harlequin bug

Harlequin bug nymphs and adults feed on plants by sucking sap, especially from young plant tissue. Feeding in swarms causes wilting and fruit damage.

Description

Green mirid adults are green and brown, slender and grow to about 7 mm long. The nymphs are wingless and yellow to green. Both adults and nymphs have long antennae. They are very mobile and quickly hide if disturbed.

Azalea lace bug adults are slow movers, about 3 to 4 mm long, brown with lace-like wings. The immatures are pale, wingless and with dark spines around the sides of the body. They have a black marking across the thorax and abdomen. Both adults and nymphs are found on the underside of leaves.

Leafhopper adults are elongate, wedge-shaped and about 3 to 4 mm long. Colour varies from green, yellow to brown, depending on species. Nymphs are similar to adults in shape but are smaller, paler and wingless.

Harlequin bug adults are about 12 mm long, strikingly coloured with black and reddish-orange markings. Nymphs are wingless and brighter than the adults. These bugs swarm on tree trunks, fences and sheds to shelter during cold weather.

Action

Cultural/physical

- Avoid the movement of infested material around the property to minimise spread.
- Azalea lace bugs prefer warm sunny positions. Avoid placing broadleaf azalea cultivars in these areas as they are particularly susceptible to damage.
- Keep plants well watered as water stressed plants are more susceptible to leafhopper attack.
- Screen greenhouse and shadehouse to limit entry.

Chemical

- Use insecticides selectively and alternate classes of insecticides to prolong useful life and to avoid development of resistance.
- Thoroughly cover leaf surfaces, especially the underside, for efficient control.
- Outbreaks often come in swarms after prevailing weather conditions (for example high heat and strong winds), so action needs to be taken immediately upon arrival of bugs.
- Consider using systemic sprays for persistent infestations.

Biological

- **Commercially available.** None at present.
- **Naturally occurring.** Predatory assassin bugs, damsel bugs and spiders.

Beetles and weevils

African black beetle: *Heteronychus arator* (Card reference 110)

Redshouldered leaf beetle (monolepta beetle): *Monolepta australis* (Card reference 114)

Hibiscus beetle: *Aethina (Olliffura) concolor* (Card reference 116)

Black vine weevil: *Otiorhynchus sulcatus* (Card reference 118)

Sugarcane weevil borer (cane weevil borer): *Rhabdoscelus obscurus* (Card reference 120)

Garden weevil: *Phlyctinus callosus* (Card reference 122)

Vegetable weevil: *Listroderes difficilis* (Card reference 124)

Native scarab beetles (white curl grubs): *Sericesthis geminata* (pruinose scarab), *S. nigra* (small pasture scarab), and *S. nigrolineata* (dusky pasture scarab) (Card reference 112)

Card reference

Pests, Diseases, Disorders and Beneficials in Ornamentals: Field Identification Guide, see Section 10 page 7

Importance/risk

Beetles can be significant pests in many States.

Pest	State
African black beetle	Key pest in NSW, WA
Redshouldered leaf beetle (monolepta beetle)	Key pest in south-eastern QLD
Hibiscus beetle	Key pest in QLD, northern NSW
Black vine weevil	Key pest in VIC, SA
Sugarcane weevil borer (cane weevil borer)	Key pest along the eastern coast of QLD, northern NSW
Garden weevil	Minor pest in VIC
Vegetable weevil	Key in NSW, WA; minor pest in VIC
Native scarab beetles	Key pest in NSW; minor pest in QLD, VIC, TAS

Host range

African black beetle: cabbage, cauliflower, couch, dahlia, grape, marigold, petunia, potato, rose cuttings, stock seedlings, sweet corn.

Redshouldered leaf beetle: avocado, citrus, eucalypt, lychee, macadamia, mango, pepper tree, rose, tea-tree, wattle.

Hibiscus beetle: serious pest of hibiscus.

Black vine weevil: asparagus fern, azalea, begonia, conifer, cyclamen, gloxinia, hydrangea, impatiens, orchid, many woody ornamentals.

Sugarcane weevil borer: serious pest of commercially grown palms and sugarcane.

Garden weevil: azalea, camellia, protea, waratah. Weed hosts: capeweed, dandelion, dock, sorrel.

Vegetable weevil: cineraria, Iceland poppy, pansy, vegetables. Weed hosts: capeweed, mallow.

Native scarab beetles: eucalypt and some other potted ornamentals, including some *Cyprus* spp.

What to look for

Both adults and larvae of these beetles cause damage by feeding on leaves, stems, flowers, buds, roots and trunks. Adults of some species produce characteristic notching of leaf margins. Look for unthrifty seedlings, wilted and loose plants, as roots may have been destroyed. Large larvae may bore into crowns and corms. Larvae can girdle crowns of ornamentals and feed on root systems.

Damage

African black beetle larvae are root feeders. Young larvae feed on organic material and older larvae feed on roots and stems of seedlings at or just below ground. Adults are active at night and feed on stems of seedlings and host plants at or just below ground level.

Redshouldered leaf beetle adults feed on flowers, leaves, buds and fruit. The growing tips of heavily attacked trees will look scorched. Swarming beetles cause heavy infestations that may be contained to a few trees. Migrating adults are the main cause of damage. The larvae are known to feed on roots of plants such as pasture grasses.

Hibiscus beetle adults and larvae are found sheltering in flowers. They are usually pollen feeders, but will chew petals. Feeding causes premature flower senescence.

Black vine weevil adults are active at night and feed on stems of seedlings and host plants at or just below ground level. They can chew large ragged pieces from leaf margins and will consume whole leaves, leaving only midribs and main veins. Larvae are root feeders and will ringbark the main stem just below the surface.

Sugarcane weevil borer adults are active at dusk and dawn and congregate to feed on the inside of the young, sheathing, leaf base of palms. Adults are also found at the base of fronds. Larvae feed in the main stem of palms, killing seedlings and young plants. In older palms, they feed on leaf bases and damage may extend into the trunk. Emergence holes cause trunk splitting and make the plants unsaleable by downgrading them aesthetically. Heavy larval infestations can weaken the trunk and cause trees to collapse and die. Most of the trunk damage is found up to 1 m above ground. Infestations are noticed by oozing sap from feeding/emergence holes in leaf bases and staining of the trunk.

more info
The Nursery Papers
1998#002
Section 10 page 8

Garden weevil adults feed on leaves, flowers, buds and fruit. They chew small, round holes with ragged edges on leaf surfaces, and deep rounded holes on the surface of stems. They feed at night and shelter during the day under plant debris or in plant crevices. Larvae feed on roots and live in the soil. Young plants are more susceptible to ring-barking by adults and root damage by larvae.

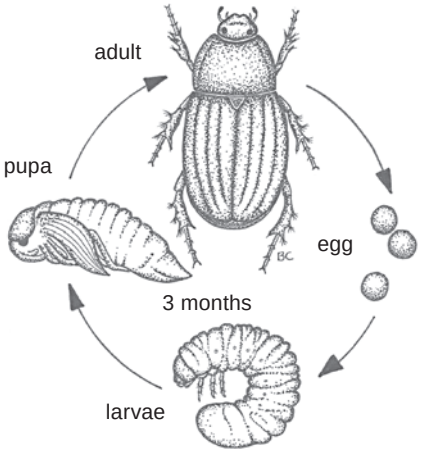
more info
The Nursery Papers
1997#011
Section 10 page 8

Vegetable weevil adults and larvae chew irregular holes in leaves. Larvae also feed on stems and fleshy roots. Severe infestation will cause defoliation. Adults hide in the soil near the base of the plant during the day and when disturbed go very still, feigning death. Larvae tend to be found on the lower surface of leaves. Young larvae shelter and feed on new growth. Older larvae tend to burrow in soil by day and feed at night.

Native scarab larvae (early stages) feed on decaying organic matter in the soil, but the third stage larvae feed on plant roots, which can lead to the plant being stunted, wilted or dead. Adults do not usually affect potted plants.

Description

African black beetle adults are shiny black, about 12 mm long. Larvae are C-shaped 'curl grubs' up to 25 mm long.



Life cycle of African black beetle

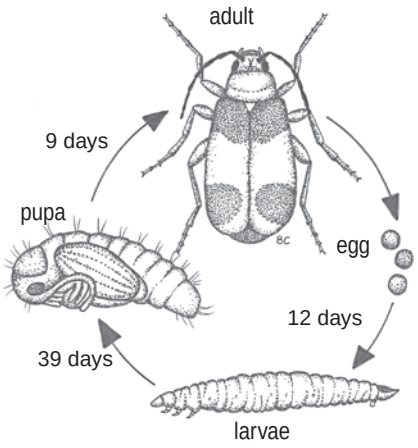
Redshouldered leaf beetle adults are 6 mm long, yellow, with a red band across the top of the wing covers and a red spot on each wing cover towards the back. Larvae are pale, about 5 mm long.

Hibiscus beetle adults are dull black and oval, about 3 mm long.

Black vine weevil adults are brownish-black with faint yellow spots and 10 to 12 mm long. They don't fly. The head has a short snout that curves underneath. Larvae are white, legless with a brown head and up to 10 mm long.

Sugarcane weevil borer adults are 10 mm long, tan to almost black with about six distinct light and dark markings on the wing covers. The head has a short snout that curves underneath. Larvae are white, legless and hold their body in a C-shaped position. They are 8 mm long, with a dark reddish-brown head.

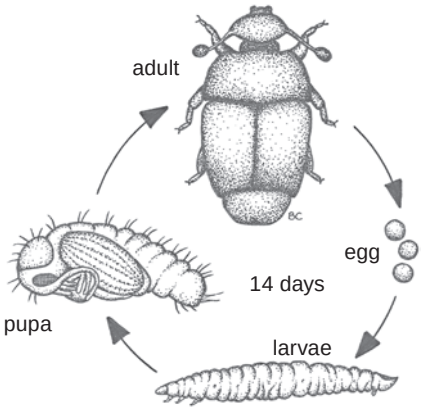
Garden weevil adults are dull greyish-brown, 5 to 7 mm long. The head has a short snout that curves underneath. They have a bulbous abdomen with a pale stripe across the lower end. Larvae are white to cream, 6 mm long. They have a distinct orange-brown head and long body hairs.



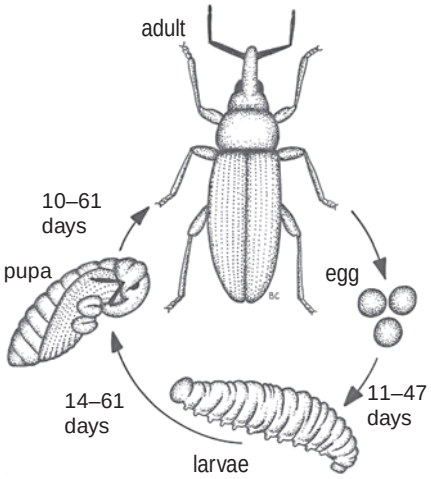
Life cycle of redshouldered leaf beetle

Vegetable weevil adults are dark brown to greyish-brown, square, about 8 to 12 mm long. The wing covers have V-shaped markings. The head has a short snout that curves underneath. Larvae are slender and vary from creamy white to greenish-yellow, depending on the host plant. They grow up to 14 mm long and are C-shaped.

Native scarab beetle adults are 10 to 16 mm long, with oval-shaped bodies that vary in colour from a matt black to a metallic brown. They usually have short hairs on the underside of the body, and their antennae end in a club shape. The larvae grow to 20 mm long and 5 mm wide. Their bodies are whitish, with a brown-orange head, and when resting they are C-shaped.



Life cycle of hibiscus beetle



Generalised life cycle of a weevil

Action

Cultural/physical

- Reduce favourable hiding places used by adults during the day by removing litter on the soil surface. For sugarcane weevil borer remove old foliage around leaf bases.
- Use clean potting mix to prevent larvae/pupae from being introduced. Avoid spreading infested soil or potting mix around the property.
- Use clean plant material from established properties. Avoid buying plant stock from localities that are known to have the pest. Check root area of incoming stock. For example, sugarcane weevil borer is mostly likely to be found in sugarcane growing areas. Adults of black vine weevil do not fly and are likely to be spread by the movement of infested material.
- For sugarcane weevil borer, avoid using bagasse in a potting mix or as mulch around the base of potted palms as female cane borers are attracted to this material.
- Destroy any infested plant material and debris.
- Trap adult black vine weevils in burlap placed around the base of plants. Shake out every day over a bucket of soapy water.
- Use Tanglefoot® or other adhesive substance to trap adult weevils as they climb onto benches. Apply to table legs to trap weevils active at night, especially black vine weevil, whose adult does not fly.

Chemical

- Target adult beetles by spraying late in the day or at night to control the species active at that time.
- Soil drenches will be needed for larvae of soil inhabiting species.
- Check for the use of registered products for specific species.

Biological

- **Commercially available.** For black vine weevil and garden weevil—entomopathogenic nematodes: *Heterorhabditis bacteriophora* and *H. zealandica* (supplier Ecogrow).
- **Naturally occurring.** Various predatory wasps, flies and beetles, various parasitoid fly species.

Slugs and snails

Black-keeled slug: *Milax gagates*

Brown slug: *Deroceras parnormitanum*

Common garden snail: *Helix aspersa*

Green snail: *Helix aperta* (Western Australia)

Reticulated slug: *Deroceras reticulatum*

Sand dune snail (white Italian snail): *Theba pisana*

Vineyard snail, (common white snail): *Cernuella virgata*

White bradybaena snail: *Bradybaena similaris*

Card reference

Pests, Diseases, Disorders and Beneficials in Ornamentals: Field Identification Guide, see Section 10 page 7

Importance/risk

Slugs and snails are minor pests but infrequent control may lead to persistent problems.

Cutflowers in Western Australia must be inspected and certified free from green snails before sale to eastern states.

Host range

Seedlings, cuttings, leafy succulent perennials, annuals (begonia, bulbs, daffodil, fern, gazania, gerbera, lily, orchid), white cedar. Snails will feed on flower buds and flowers of orchids and daffodils.

What to look for

Damage

Damage is similar to that of chewing insects, except shiny, slimy trails are visible. Young snails tend to skeletonise leaves and older snails chew holes in foliage or young succulent stems. Growing tips can be destroyed and severely damaged plants are unsaleable. Feeding by slugs and snails may destroy seedlings.

Description

Snails and slugs are active at night and on cloudy or foggy days. During the day they seek shelter from the heat in cool, moist, shady places such as under boards, benches, stones, debris, pots, and leafy weeds and broadleaf plants growing close to the ground. Look for silvery, slimy trails and excrement casts, which are long and curly, and adhere to feeding sites. During cold weather, snails and slugs hibernate in the topsoil. Slugs and snails are egg layers.

Action

Cultural/physical

- Eliminate hiding places where snails and slugs shelter and breed. Remove debris, boards, and rocks.
- Use trickle irrigation instead of sprinkler irrigation, where possible, to provide unfavourable conditions for breeding and sheltering by reducing humidity and moist surfaces.
- Hand removal of snails and slugs is effective if done regularly. Start daily and continue weekly once the population has decreased. Draw out snails and slugs by watering an infested area in the afternoon. Pick snails and slugs after dark, collect them and destroy by crushing or dropping in boiling water or storing in the freezer.
- Snails and slugs can be trapped under boards or pots positioned on benches or the ground. Use an easy to handle board (30 cm x 30 cm) or pots standing on 3 cm chocks to allow snails and slugs to crawl underneath. Check the traps daily and remove accumulated pests. Do not use salt to destroy snails and slugs, as it will increase potting mix salinity.
- Beer-baited traps have been used to trap and drown slugs and snails. The traps only attract those nearby. They need to be replaced regularly to maintain a level deep enough for drowning and refilled with fresh beer, as flat beer is not as effective. The traps must be vertical to prevent the snails and slugs from crawling out.

Chemical

- Monitor snails and slugs before spraying or baiting. Chemical control is effective when used in combination with other control methods.
- Baits are hazardous to children and domestic pets. Do not clump or pile baits into mounds. Use commercial bait traps to reduce hazards and protect bait from moisture. Irrigate before applying bait or apply in cool, damp weather when snail and slug activity is high and before planting seedlings. Avoid widespread applications and apply to moist, protected locations and along areas where snails and slugs have to cross from protected areas to feeding sites.

  Metaldehyde baits cause snails to dehydrate and are effective when hot, dry weather follows baiting. Do not water heavily for at least three to four days after applying these baits as snails may re-hydrate and recover. Metaldehyde breaks down rapidly under direct sunlight and is safer to use with biocontrol agents than methiocarb formulations.
- If snails/slugs are feeding on tree foliage or high above ground, spraying is more effective.
- Spread copper around the legs of benches.
- A new product containing chelated iron in small pellets is now available.

Biological

Commercially available. None.

Naturally occurring. Predators of snails and slugs include birds, rats, frogs, nematodes and lizards. The larvae of a sciomyzid fly parasitises garden snails.