



Mealybugs

A pest of a different scale

Background

Mealybugs are a specific type of scale insect from the family Pseudococcidae. They often secrete a thin covering of mealy wax across their body, hence their common name. Like other scale insects, mealybugs are sucking pests that can be present across all of Australia on many host plant species. Some species of mealybugs are very serious pests of particular plant species, others are not. Some species may feed on a large number of host plant species, others only on a small number. Mealybugs are most often present on leaves and stems, particularly in tight, protected spaces. However, some mealybugs feed on roots. For information on other types of scale insects, refer to the [scale insect factsheet](#) available on the NGIA website.

There are a number of mealybug species that may be commonly encountered in production nurseries; these include longtailed mealybug (*Pseudococcus longispinus*), obscure mealybug, (*P. affinis*), citrus mealybug (*Planococcus citri*), ground mealybugs (*Rhizoecus* spp.) and many others. Some native mealybug species are common problems on native plants, e.g. *Melanococcus albizziae* can kill *Acacia* and *Australicoccus grevilleae* can cause significant damage to *Grevillea*. It is likely that at least one mealybug species will feed on most plant species found in a production nursery, at least from time to time. It is beyond the scope of this factsheet to detail the biology and host range of every mealybug species that could be present in production nurseries across Australia. This factsheet is necessarily general, providing information typical across the group; exceptions will occur. It is recommended to have mealybug species that are encountered in your nursery identified to facilitate the management of the pest more specifically. Identification is particularly important when the infestation is widespread, when management actions have failed or when they reoccur frequently. Furthermore, some species of mealybugs are serious pests overseas, but are not present in Australia.



Fig. 1. Adult, egg masses and immature citrus mealybug individuals, photo by the United States National Collection of Scale Insects Photographs, bugwood.org.

Description

Mealybugs are small, oval, soft-bodied insects that are often covered in a white powdery wax. The powdery wax sometimes extends off the body as long marginal filaments. While most species of mealybugs are white, off-white or light grey, some species are yellow, pink or orange. The mouthparts of all mealybugs are hair-like, being extremely long and thin. If individuals are carefully removed from plants when they are feeding, these mouthparts can be observed under a microscope.

Adult females are similar to nymphs, but larger. Females are often about 3-6 mm in length. Females lay egg sacs or masses that are covered by cottony secretions, similar in appearance to cotton wool. Adults generally have longer marginal filaments than nymphs, however they can be broken off naturally. Eggs within the mass tend to be yellow to orange. However, not all mealybugs lay eggs, longtailed mealybug produces live young (crawlers). In most instances, only females and nymphs will be observed on plants. Males, when they occur, are small gnat-like insects (about 2 mm long), with two pairs of wings.

Upon hatching, first instar nymphs (crawlers) are very small, often less than a millimetre long, and are reasonably mobile. Crawlers have the least amount of wax present on their bodies and are the most vulnerable to mortality from pesticides and environmental conditions.

Life cycle

Mealybugs are slow moving and feed on plant sap. Mealybugs tend to live in aggregations, often on the underside of leaves, on stems around petioles and branches and other concealed areas, e.g. in dense foliage, where fruit are touching or leaves overlap and near flower buds and growing tips. Mealybugs feeding on grasses and grass-like plants are often present under the leaf sheath. Some species may be on above ground parts and on roots, other species are solely root feeding (see section below on root feeding mealybugs).

Unlike most other scale insects, subsequent nymphal stages and adults have functional legs, and are generally able to move short distances. Nymphs are similar to females, but smaller, and will moult through three to four nymphal instars. However, male nymphs can be more elongated than female nymphs and have four to five nymphal stages. Males also have a pupal stage before emerging as an adult.

Generally, mealybugs complete their life cycle in 1-3 months, depending upon temperature and host plant. Cooler temperatures increase the generation time (slow it down), warmer temperatures decrease it (speed it up). Therefore, 4-10 generations can occur each year. Temperatures of about 25°C and high relative humidity are optimal for many mealybugs. Mealybugs tend to be present continuously, but may be less active in relatively cool conditions. Their populations often reach peaks in spring and autumn and it is common to see all stages on a plant at the same time (e.g. egg masses, nymphs and adults simultaneously).

Male mealybugs do not feed and only survive for a few days to mate with females. However, many species of mealybugs do not have males; females reproduce asexually. Females of most species lay their eggs into a waxy mass with at least 50-100 eggs, some species may lay up to about 600 eggs in their life time. Females of some species can survive for 10-20 days without a host plant. Eggs tend to hatch in 5-10 days, but may be



Fig. 2. Citrophilus mealybug (*Pseudococcus calceolariae* - above - photo by USDA ARS, Bugwood.org) and *Pseudococcus* sp. mealybugs on hoop pine.

longer during unfavourable environmental conditions. Crawlers may remain under the egg mass for some time before moving away, perhaps up to several weeks.

Damage

Feeding may occur on all plant parts. High populations slow plant growth and cause premature leaf or fruit drop and twig dieback. At first, plants may appear to lack vigour, leaves then yellow and may drop. Feeding on growing tips and buds can cause distorted growth as they inject toxins into the plant. At high populations plants can completely wilt and die. The white fluffy growth can also cause plants to be cosmetically unsaleable. Furthermore, mealybugs produce honeydew, a sticky, sugary solution, on which black sooty mould grows and can be unattractive. Ants often attend mealybugs to harvest the honeydew. This may cause mealybug infestations to be even more troublesome as it may reduce predation and parasitism by natural enemies.

Root feeding mealybugs

The most common root feeding mealybugs are from the genus *Rhizoecus*, although others occur. They can remain undetected on roots for quite a long time without specific monitoring. These species appear as cotton-like masses on infested roots. Their bodies do not have long wax filaments, like that of many foliage feeding mealybugs. Their biology is similar to mealybugs discussed above, however, crawlers are the main source of spread between plants. Crawlers may move out of drainage holes with water, and they may be dispersed with plant debris and on equipment.

Damage from root feeding mealybugs is similar to those above ground. However, they are often very difficult to detect at low populations and therefore build to high populations. Highly infested plants must often be thrown out. Note that root mealybugs can sometimes be present on weeds in pot plants, but not on the actual nursery plant. Therefore some discernment is required, as such situations do not require plants to be discarded.

Mealybugs as virus vectors

Mealybugs are known vectors of several plant viruses, including *Banana streak virus*, *Grapevine leafroll associated virus* and *Pineapple mealybug-wilt associated virus*, all of which occur in Australia. Other viruses vectored by mealybugs also occur overseas. They are not particularly good vectors as they crawl, rather than fly, from plant to plant, unless they are distributed by wind currents or ants. Consequently, spread of virus from mealybugs tends to be slow; these viruses can be spread through other means.

Host range

As a group mealybugs attack a very broad range of plants including fruits and vegetables, indoor plants and outdoor ornamentals like annuals, perennials, shrubs, palms, grasses and trees. In other words, almost all plant species present in a nursery can be fed upon by at least one mealybug species. Some mealybug species have a very wide host range and are more likely to be encountered in a production nursery. For example, citrus mealybug has been reported across plants from about 50 plant families and can be a pest on

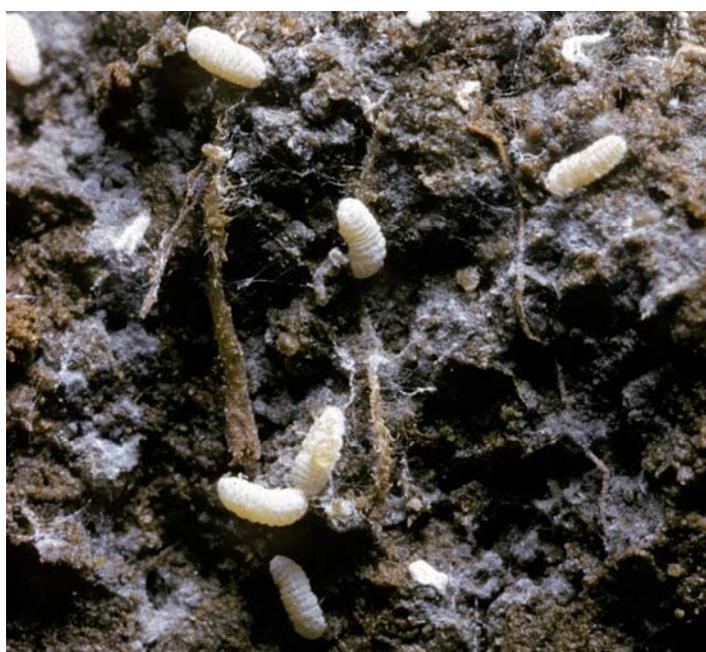


Fig. 3. Mealybug infestation causing stunting of seedling avocado (above) and roots infested with *Rhizoecus* mealybugs (below - photo by USDA ARS, bugwood.org).

begonia, boronia, cactus, calathea, canna lily, citrus, coleus, croton, cycads, cyclamen, dahlia, eriostemon, narcissus, tulip and many other plant species. Long tailed mealybug is reported from about 30 plant families and can be a pest of bromeliad, bulbs, citrus, custard apple, fern, fuschia, grapefruit, grape, hibiscus, Japanese maple, olive, orchid, palm, passionfruit, pine, pomefruit, stonefruit, *Zamia* and many other species. Fortunately, not all mealybugs have a very wide host range. For example, *M. albizziae* has only been reported feeding on *Acacia* spp. and banana.

As stated earlier, it is important to have mealybugs identified. This will allow you to investigate the host range of the species, its biology and information known on specific management of the pest.

Monitoring

Monitoring in nurseries is essential for all pests, diseases and general plant health. Monitoring provides essential information for making management decisions. In any given time, it will detect the presence and numbers of mealybugs, their natural enemies (predators and parasitoids) and other pests and diseases. Regular monitoring can be used to determine the change in numbers, i.e. whether populations are increasing or decreasing. This information is extremely valuable and informs how effective each management action has been.

Monitoring for mealybugs should include visual observations including turning over leaves, looking for black sooty mould and the presence of ants on plants. Plant beating (gently but firmly hitting foliage against a uniform coloured tray) can also be effective for species that can be dislodged from the plant. However, some species may not be monitored effectively in this way. Plants that have mealybug damage or are otherwise unhealthy, should be examined more carefully. Use a x10 or x20 hand lens where necessary and examine areas that mealybugs are likely to hide on the plant (joints between branches and other crevices). Detecting root mealybugs always involves taking plants out of pots and checking root health. This should be completed as part of regular plant health monitoring.

Once mealybugs have been observed, check for the presence of egg masses and crawlers. This is important as it indicates that populations will increase quickly if management actions are not taken. The proportion of different life stages present, most notably crawlers, may also change the exact actions taken; crawlers are susceptible to pesticides, but other stages are more tolerant.

Management of mealybugs

Management of mealybugs should focus on preventing infestations and managing populations before they cause economic loss. Mealybugs are notoriously difficult to control once established as they hide in cryptic areas of the plants and tolerate many pesticides. Fortunately mealybugs can be managed effectively if nursery managers are proactive. These management actions include cultural, chemical and biological control options.



Fig. 4. Pink hibiscus mealybug (*Maconellicoccus hirsutus*) on stems and leaves of hibiscus, photos by Florida Department of Agriculture and Consumer Services, Buwood.org

Cultural management practices minimise infestations by mealybugs (and other scale insects).

- Always inspect new stock carefully, particularly host plant species that are prone to attack from mealybugs (and other pests and diseases). Inspect all plant parts, including roots for any signs of pests.
- Monitor plants regularly, including roots. Plant species that are prone to mealybugs (or other pests) should be monitored more consistently. Refer to monitoring section.
- Remove plants with heavy infestations, taking care to reduce spread of mealybugs while doing so. If infestations are limited to a particular branch and it can be pruned, remove this plant material and monitor closely to ensure the rest of the plant is clean.
- Remove crop debris and disinfest the growing area after removing a consignment of plants that have had mealybugs with a suitable product, e.g. farmcleanse, bleach or similar product. Mealybugs can survive for weeks on crop debris and in egg masses that have fallen off plants. This practice will also reduce other pests and diseases that may be lingering from previous crop cycles.
- When only a small number of plants are present with a low rate of infection, squash mealybugs and egg batches. Squashing large numbers of mealybugs may irritate skin, but can be avoided by using rubber gloves. The presence of a small number of individuals should prompt regular and rigorous inspections of the consignment.
- Avoid movement of infested plant material within the growing area.
- Avoid staff movement in areas known to be infested with mealybugs and other pests. If necessary, disinfest clothing and equipment after working in such areas.
- Provide an optimal growing environment, including appropriate nutrition, water, growing media and other conditions; weak plants are more susceptible to damage at lower populations of pests.
- Control ants as they spread crawlers and protect mealybugs from natural enemies.
- Thoroughly disinfest recycled pots to avoid transferring eggs and nymphs from crop to crop.
- Only propagate from clean mother stock plants. In other words, do not take cuttings from plants that have mealybugs (or other pests) present. Even one crawler on a cutting (which is virtually impossible to detect) will multiply the problem significantly.
- Keep the growing area and surrounds free of weeds.
- Ensure adequate plant spacing. This allows greater air movement and increases pesticide coverage. It also reduces ideal environments for mealybugs to develop and increases the ease of detection.

Biological control

There are a number of natural enemies that can be used to manage mealybugs including commercially available predatory insects and naturally occurring parasitoid wasps and predators. There are also a range of fungi and bacteria that may infect and kill mealybugs, although these are less likely to substantially reduce populations unless they become very abundant. Almost all pesticides will negatively impact predator populations. It is recommended to seek advice from the biological control agent producer prior to releasing a predator for the first time so that their release is optimised. If pesticides have been applied, ensure that a sufficient time period has been elapsed before releasing predators. This information can be found online or from the biological control agent producer.



Fig. 5. *Cryptolaemus montrouzieri* larva (below) feeding on a mealybug (photo by Sonya Broughton, WA Ag, Bugwood.org).

Cryptolaemus - *Cryptolaemus montrouzieri*

Cryptolaemus (pronounced: Crip-toe-lee-mus mon-tro-zere-ee) is an Australian native ladybird that is widespread and feeds on a range of mealybug species. It is commonly known as the mealybug destroyer. Both larvae and adults feed on mealybug, and can be used to control mealybug infestations, hence its common name. Adults are about 4mm long, oval in shape with an orange head and black wing covers. Adults and small larvae only feed on eggs and very small mealybug nymphs; larger larvae feed on larger mealybugs including adults. Larvae are covered with white waxy filaments, making them very similar in appearance to mealybugs, but are more mobile and appear to have banding along their body. When carefully removed from the plant, they can be turned over to see their well-developed legs and chewing mouthparts. Females can lay up to 10 eggs per day directly into mealybug egg masses and up to about 500 eggs over their lifetime. The lifecycle of *Cryptolaemus* takes about 4-7 weeks from egg to adult, depending upon temperature and food source. They will also consume some soft scales when more preferred food is not available. It is commercially available from Bugs for Bugs.

Green lacewings – *Mallada signata*

The green lacewing has a relatively wide host range, feeding on aphids, spider mites, various scales, mealy bugs, moth eggs and small caterpillars as well as whitefly species. Pollen and nectar can also be ingested. Larvae, but not adults, are predacious. Adults have a green body and hold their transparent wings tentlike over their body and feed on pollen and nectar. Females live for 3-4 weeks and lay up to 600 eggs. Almost all lacewing species are predators and often lay their eggs on thin white stalks with a bulbous white egg at the end; most species lay multiple eggs in the same area, most often in a straight or roughly straight line or in a horseshoe arrangement. Green lacewing larvae grow to nearly 1 cm in length before pupating and typically place the remains of their prey on top of spines protruding from their back. In fact, research suggests that green lacewing larvae with trash-packages are more active and forage more efficiently, while those without trash-packages are more likely to become inactive. After about 12 days, larvae pupate and emerge as adults about 9 days later. Females must be about 7 days old before laying their first egg.

Green lacewing is well adapted to relatively warm conditions and very sensitive to persistent and or broad spectrum chemical applications, although reduced risk pesticides have a relatively minor negative effect on this insect. Green lacewing is commercially available from Bugs for Bugs.



Fig. 6. *Cryptolaemus montrouzieri* adult (above - photo by Dan Papacek), green lacewing adult (middle - photo by Sonya Broughton, WA Ag, Bugwood.org), green lacewing larva (below—photo by Dan Papacek, Bugs For Bugs).

Citrus mealybug parasite – *Leptomastix dactylopii*

Originally from South America, this small brown wasp (about 3mm long) has distinctive, long antennae, similar in length to the rest of its body. It is a parasitoid wasp, laying its eggs in citrus mealybug only. This species is extremely efficient in finding and parasitising citrus mealybug, even at low densities, but will not attack other species of mealybugs.

Adults live for about a month and can lay about 80 eggs over her lifetime. Females lay their eggs in large mealybug nymphs or adults that have not started to lay eggs. Larvae develop inside mealybugs, which probably stop feeding and will not lay eggs to be laid once parasitised. Eventually, the mealybug changes to a 'mummy', being oval, bloated and legless. Adults wasps emerge from mealybugs after about 2-3 weeks, starting their life cycle over again. This species is available commercially from Bugs for Bugs.



Fig. 7. *Leptomastix dactylopii* adult

Chemical control

Mealybugs are difficult insects to manage using pesticides alone. Contact products tend to slough off their waxy body and they may be tolerant to systemic products. If pesticides are to be used to manage mealybugs it is recommended to apply contact products only when there is a high proportion of crawlers present. Crawlers are very susceptible to many pesticides, including oil-based products. If high populations of large mealybugs are present a systemic product will be required, perhaps combined with an oil or detergent-based product if this will not cause a phytotoxic reaction to the plant. Also, consider modifying the way that pests are managed, such that monitoring is conducted more frequently; increase the use of cultural management options.

Consecutive weekly pesticide applications will almost always be required if using pesticides to manage mealybugs. Even then, total control may not be achieved. It is always recommended to rotate between active ingredients from at least three different mode of action groups. This will reduce the likelihood of inducing pesticide resistance substantially.

Pesticides will almost always significantly reduce predator populations. Some products can be active against predators for months after application, but have limited or negligible impact on pest populations after the initial application. Therefore, carefully consider whether it is necessary to apply pesticides, particularly when they have a long residual impact on predator populations. Cryptolaemus and green lacewing are very effective predators that should be considered instead of applying pesticides.

With that said, there are a number of insecticides that are registered against mealybugs relevant to production nurseries. Some products have a general nursery stock registration, others may only be registered on a subset of species grown in the nursery production sector. Table 1 summarises products specifically registered against mealybugs. However, mealybugs are scale insects. Therefore products registered against scale insects may be legally applied to mealybugs (refer to the [scale insect factsheet](#) available at the NGIA website). Always ensure that you read the label and that it fits your exact situation; not all active ingredients listed in Table 1 are registered in all states or on all nursery plants. Refer to the nursery [pesticide application best practice manual](#) for more information.

Further reading

Llewellyn, R. (Ed). 2000. *The Good Bug Book*, second edition. Integrated Pest Management Pty Ltd., Richmond, NSW.

Goodwin, S., M. Steiner, R. Parker, L. Tesoriero, G. Connellan, E. Keskula, B. Cowper, A. Medhurst, and C. Rodriguez, C. (2000) *Integrated Pest Management in Ornamentals: Information Guide. Horticulture Series: Agrilink, your growing guide to better farming*. Manual. Agrilink Series QAL0004, Queensland Horticulture Institute. Brisbane, Queensland. Available at: <http://era.daf.qld.gov.au/2208/6/005-ipm.pdf>

Table 1. Active ingredients registered against mealybugs relevant to Australian production nurseries. Also see general registrations against scale insects in the scale insect fact sheet.

Mode of action group	Active ingredient	Example product name	Registration information	Mobility ¹	Toxicity to beneficials ²
1A	Carbaryl	Bugmaster	Mealybugs on raspberry only	C	H – 4+ weeks residual
1B	Chlorpyrifos	Lorsban	PER14547 Pseudococcus mealybugs on persimmon only; PER14240 all mealybugs on bananas; mealybugs on apples and pears, coffee, duboisia, pineapple, cucurbits and grapes, citrus mealybug on citrus. Labels vary.	C	H – 2-4 weeks residual
1B	Diazinon	Diazinon	All mealybugs on nursery plants.	C	H – 2-3 weeks
1B	Fenthion	Lebaycid	All mealybugs on ornamental crops.	S	H – 2-4 weeks, probably longer
1B	Methidathion	Suprathion	All mealybugs on ornamentals, trees and shrubs in nurseries, also selected fruit crops.	C	H – at least 3-4 weeks
1B	Methomyl	Lannate	Citrus mealybug on citrus only.	S	H – at least 1 week, probably much longer
1B	Omethoate	Folimat	All mealybugs on selected ornamentals and native plants.	S	Probably H, probably with a moderate to long residual period
2B	Fipronil	Regent	PER12983 Root mealybugs on non-food nursery stock. Drench or granular formulation.	S	H – at least 2 weeks, probably longer
3A	Beta-cyfluthrin	Tempo	Mealybugs on azaleas, hibiscus, pelargoniums and roses only	C	Probably H with at least 2-4 weeks residual
3A	Bifenthrin	Fivestar	Longtailed mealybug on Carnations and other ornamental plants and pears; labels vary	C	Probably H with at least 2-4 weeks residual
4A	Acetamiprid	Crown	Citrus mealybug on palms, orchids and other ornamental plants; PER13831 Mealybugs on date palms only as drench or foliar application	S	H – probably for 2-4 weeks, perhaps longer
4A	Clothianidin	Samarai	Longtailed and tuber mealybug on apples and pears.	S	H – probably for at least 3 weeks.
4A	Imidacloprid	Confidor	PER13794 all mealybugs on date palms and ginger only; all mealybugs on shrubs, plants and ornamental trees; citrus mealybug only on ornamental plants. Labels vary.	S	Foliar spray: H – at least 2-4 weeks Drench: L – no residual
4C	Sulfoxaflor	Transform	Certain mealybugs on citrus, grape and pome fruit.	S	Not known
9C	Fonicamid	Mainman	Tuber mealybug on apples only.	S	L – no residual
16	Buprofezin	Applaud	PER14769, all mealybugs and scale insects on nursery stock and non-bearing fruit trees	T	L-M – 2-3 weeks residual for <i>Cryptolaemus</i> , no residual for green lacewing or <i>Leptomastix</i> .
NA	Paraffin/petroleum oil	Various	Specific mealybugs on particular crops. Labels vary.	C	L-M – no residual
NA	Potassium salts of fatty acids	Natrasoap	All mealybugs on most nursery plants	C	Not known, probably L-M with a short residual period

¹ C = contact, S = systemic, T = translaminar; L = low, M = moderate, H = high.

² Information was obtained from the [Kopert](#) and [Biobest](#) side effects website and Llewellyn (2000).

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