Flatmites in Production Nurseries

Flat mites are small and tend to go unrecognised by many nursery managers despite causing significant damage. Also known as false spider mites, flat mites are closely related to spider mites and feed in a similar manner. They cause damage similar to broad mites and thrips, including slight to severe leaf deformation, twisted new growth and corky lesions on stems, leaves, flowers and fruit.

Most species cannot be seen without a hand lens and very small species may require a microscope. The majority of pest species found in Australian production nurseries come from the genus Brevipalpus *and tend to be flat and red. A small number of species are known to transmit viruses, e.g.* Orchid fleck virus *and* Citrus leprosis virus, *the latter of which is not known to be present in Australia. Some species in this group are a significant biosecurity threat (e.g. red palm mite).*

Russetting and leaf distortion on *Viburnum* caused by *Brevipalpus* flat mites

DESCRIPTION AND LIFECYCLE

All flat mites are herbivores, but only a few groups have species that are economic pests. *Tenuipalpus* and *Brevipalpus* are the largest genera and have most of the economically damaging species. Mites generally range in size from 0.2–0.4mm long and almost always require a hand lens or microscope to be observed. Like spider mites, flat mites have specialised mouthparts used to suck the contents of plant cells. However, flat mites do not produce silk. They tend to have elaborate dorsal ornamentation and ridges on their back. Adults are typically orange to red in colour, though some may have very little colour at all. Eggs are generally ovoid in shape and orange to red in colour. Larvae and nymphs tend to be light orange in colour, but this darkens with each stage. Larvae, nymphs and adults tend to be relatively flat and wide. The most common species found in Australian production nurseries are *B. obovatus*, *B. californicus* and *B. phoenicus*, which are also the species that can transmit plant viruses. It should be noted that *B. obovatus* and *B. phoenicus* have been shown to have cryptic species; individuals across cryptic species appear identical but have different biological traits, most notably different host ranges.

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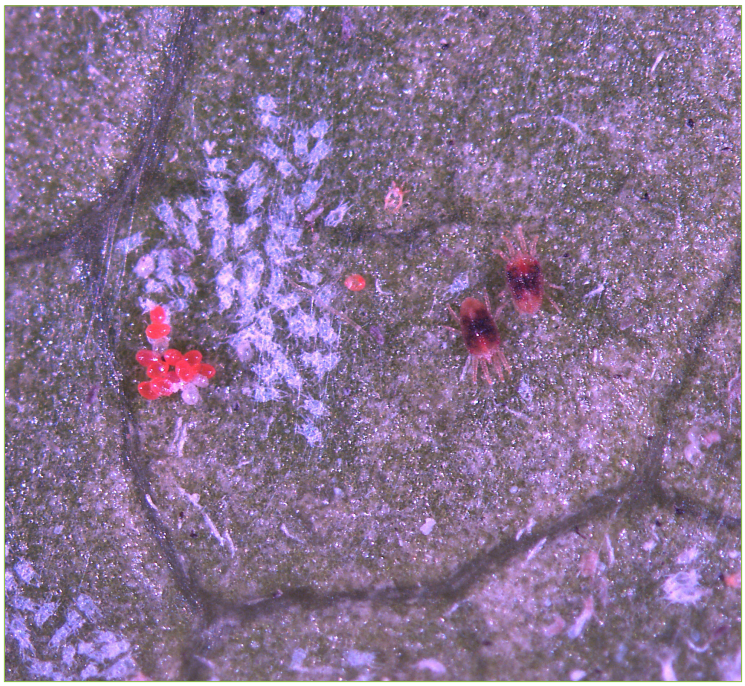
Flat mites have a similar lifecycle to spider mites, having an egg, larva, two nymphal stages and an adult stage. Few species of flat mites have been studied in detail, therefore the biology of some species may differ significantly from the below generalisation. However, many species of flat mites are parthenogenetic (all female); i.e. females can lay eggs without mating and their offspring are always female. Males tend to be rare, if they occur at all. Adult flat mites may live up to two months. Development from egg to adult can take 3–4 weeks. Usually only one egg is laid per day, but this may be higher for some species.



Brevipalpus obovatus adults, eggs and cast off skins

DAMAGE, HOST RANGE AND SPREAD

Flat mite damage can vary substantially between species and plant parts. Feeding on leaves can cause chlorotic stippling (similar to spider mite damage), brownish discolouration or russeting on the underside of leaves that is often along the midrib, cupping of the leaves, reduced leaf size and sometimes leaf senescence. Feeding on growing tips may cause damage similar to broad mites, with distorted new growth and small deformed leaves, perhaps in combination with a corky appearance of the underside of deformed leaves and stems. Some species of flat mites inject saliva into the plant that probably increases the amount of damage to the host beyond the removal of cell contents. Flat mites may also be present under the leaf sheath of grasses and grass-like plants, causing necrotic lesions to occur along leaves, which may reduce growth and increase the likelihood of secondary infection.

Damage caused by *Brevipalpus* flat mites

Many plant species can be damaged by flat mites including various cacti and succulents (including the genus *Euphorbia*), passionfruit, dianella, rhododendron, gardenia, *Aphelandra*, citrus, hibiscus, holly, viburnum, various grass species and pecan. Some species have a relatively wide host range, perhaps being able to survive on as many as a 1,000 host species, though this may sometimes be as a result of many cryptic species each with a narrower host range. Flat mites can be present at low rates without causing any damage, or produce damage similar to that caused by a nutrient deficiency.

Flat mites tend to be slow moving, but can still disperse short distances to nearby plants if the foliage is touching, or be dispersed longer distances in the wind. The most important method of spread is via non-symptomatic planting material. It is also worth noting that there are undescribed flat mites present in Australia that may be present on native plants and may cause damage in some instances.

Damage on *Eucalyptus brandiana* (left) caused by *Raoella* sp. (probably an undescribed species). Note that this species looks very similar to *R. indica* red palm mite.

Deformed growth and corky appearance of *Aphelandra* caused by *Brevipalpus obovatus*.

VIRUSES VECTORED

The three most common and economically important flat mites (*B. phoenicis*, *B. californicus* and *B. obovatus*) are known to vector several viruses, some of which can be very serious (e.g. *Citrus leprosis virus* in North and South America). Probably the most common in Australia is *Orchid fleck virus*. The little research that has been conducted in this area suggests that many ornamental plants could become infected with viruses vectored by these mites. In general, symptoms of plants infected with viruses transmitted by flat mites include: 1) chlorotic and or necrotic spots and ringspots on green leaves and green spots or ringspots on yellow (senescent) leaves, 2) chlorotic and or necrotic spots on stems, 3) chlorotic or brown spots usually depressed on fruits, and 4) brown spots on the flowers. Most of the known viruses vectored by flat mites are not known to be present in Australia.

Orchid infected with *Orchid fleck virus*.

RED PALM MITE

Red palm mite (*Raoiella indica* — genus pronounced ray-oh-ella) is a serious flat mite pest that is not present in Australia. It has a very distinctive appearance that is bright red, circular and has many large hairs present over its body that often appear. They are very small and damage a wide range of palm species including date palm, cocos palm, many ornamental palms and banana. They feed on the lower leaf surface causing them to yellow and die. One of the major reasons that damage is severe is that immature stages insert their mouthparts into stomata. The cast off skin remains stuck in stomata after they moult causing them to be jammed open permanently. As a result, leaves can become dehydrated and die. If this pest is suspected on palms report it to the Exotic Plant Pest Hotline 1800 084 881. Members of this genus are present in Australia and appear very similar to red palm mite (see photo on previous page).

MANAGEMENT

Most insect and mite pests are best managed using a range of options; never rely solely on pesticides. For all mites, ensure that the pest is present and do not rely on symptoms to diagnose the problem. Such habits can sometimes lead to the application of products that are ineffective and may even cause phytotoxicities, particularly if products are applied frequently or at relatively high rates.

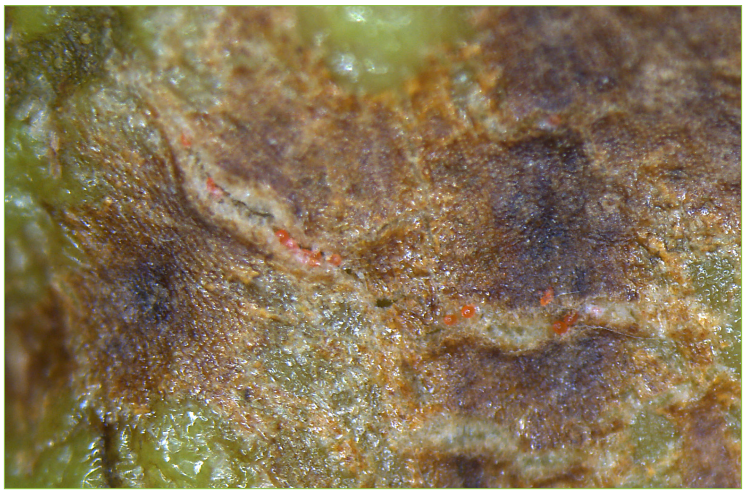
Management actions are best implemented when pest populations are low and have not caused significant damage to the crop. The earlier pests are detected, the easier, quicker, and cheaper they are to treat, and the less likely significant losses will occur. Best practice pest management involves regular monitoring (i.e. at least weekly) for insect and mite pests, diseases, weeds, and other aspects of the production system contributing to plant health. Do not be tempted to rely solely on workers noticing problems while completing their daily duties. This is a good start, but early warning signs of pest and disease problems are likely to be missed by staff focussed on other tasks.

MONITORING

Most species of flat mites require at least a ×10 hand lens to observe and some require a microscope to see them with confidence. Monitor around corky lesions, chlorotic or necrotic spots and deformed growth, particularly on leaves that are relatively young. Look for eggs, which tend to be bright red and caste off skins as these can provide clues as to whether the population is increasing or decreasing. Understanding the extent of any infestation is vital for undertaking appropriate management actions, not just for mites, but all pests and diseases.

If using a microscope, remove leaves or growing tips and inspect. Keep in mind that feeding may have occurred before the leaf has expanded; if mites are not found on damaged mature leaves, inspect younger leaves and growing tips carefully. Treat the plant material with care, it may have pests present that could be spread through the nursery. It is best to place the material in a zip-lock bag to minimise contact with other plants. Be sure to use sufficient magnification that even the smallest flat mites will be observed (ideally ×40 magnification).

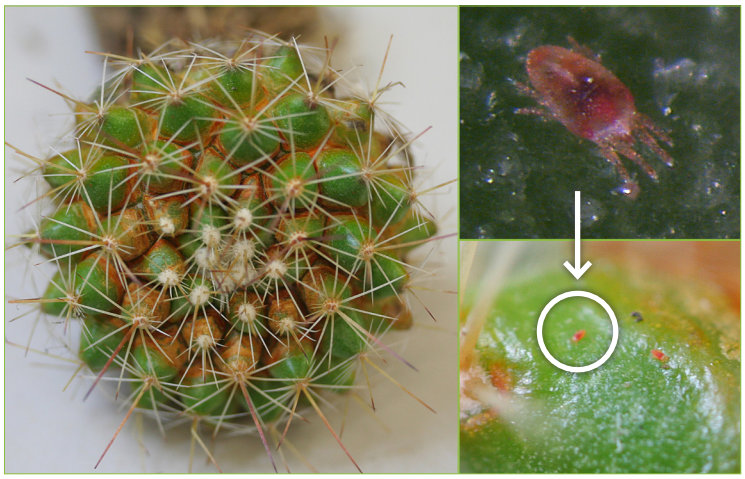
Record monitoring results electronically and use this data to build patterns of risk for your nursery. Keep track of plant species and varieties that are susceptible to flat mites, and the conditions associated with infestations (e.g. warm, dry conditions). In this way, high risk periods and host plants can be identified and greater monitoring effort given where needed. Electronic storage ensures that the data can be searched and sorted easily on different variables and manipulated to produce visual representations (e.g. graphs). This information will be important for analysing the pattern of damage across different seasons, host plant species/ varieties, areas of the nursery and assessing the efficacy of management actions.



Brevipalpus mites under a dissecting microscope may appear as small red individuals amongst the necrotic tissue.

PURCHASING A MICROSCOPE

Your nursery will have the best chance of identifying mites (and other pests and diseases) early if a stereo (dissecting) microscope is used. It should have a good lighting source and a camera. Crisp and clear images will ensure very small mites can be observed and distinguished from leaf hairs and other structures. A basic microscope with a camera can be purchased for less than a thousand dollars. Ensure that it is trinocular or has a camera built in, has a zoom ration between about ×5–×40 (a larger range is helpful but not necessary) and has a light source (LED lamps on a flexible neck also function well). Purchasing from a reputable and professional microscope supplier (e.g. Olympus, Nikon, Zeiss and Leica) will likely cost more, but the microscope will have higher quality hardware and superior camera software. These companies often provide on-site technical support that includes training staff to use the equipment.



Damage caused by *Brevipalpus russulus* on *Echinocactus* (left) and close up of damage (right).

CULTURAL MANAGEMENT

The following cultural management actions will reduce infestations of flat mites.

1. Always inspect incoming stock for pests and diseases, including mites.
2. Remove or quarantine highly infested plants. Plants being thrown out with mites should be placed in a covered bin in an isolated area to reduce the chance of reinfestation. Do not be deceived by their small size, mites can move around the production area relatively easily by hitchhiking on staff.
3. If possible, grow highly susceptible plants under protected cropping that may be modified to exclude a wide range of pests, particularly mites.

4. Reduce staff movements to areas of the nursery that are known to have mite infestations. Visit these areas last and do not re-enter 'clean' areas.
5. Establish patterns of mite infestations in your nursery by identifying time periods that are more at risk, host plant species and varieties that may be susceptible/tolerant to mite damage. If possible, grow varieties that receive less damage from mites.
6. Conserve natural enemies by only spraying pesticides when monitoring indicates that pest mite numbers will reach damaging levels. Preferably, only apply products that have a small impact on predator populations (i.e. avoid applying organophosphate, pyrethroid, neonicotinoid and similar products).
7. If pesticides are required, apply to hot-spot areas and high-risk plants (i.e. not a blanket spray), which will help conserve natural enemies.
8. Many species of pest mites thrive in hot, dry conditions. Overhead irrigation can sometimes decrease the incidence of some mite species. However, overhead watering can increase the incidence of fungal and bacterial diseases, so use strategically.
9. Remove weeds within and around the nursery as they can be alternative hosts for mites.
10. Remove heavily infested plant material before applying pesticides to reduce the population and make subsequent management techniques more effective.
11. 11. Only propagate from clean plant material. Flat mites may be present in very low numbers and may be hidden under leaf sheaths, in growing tips and other hidden areas of plants. If the plant species has a history of infestation, examine at least a subset of the propagation material to ensure that mites are absent. In other words, develop a quality assurance program when propagating that species.

BIOLOGICAL CONTROL

Many mites can be managed with commercially available predators or those naturally occurring in the nursery. Unfortunately, few are effective against growing infestations of flat mites. Applications should be completed when populations are relatively low, otherwise they are unlikely to be managed effectively. The predatory mites californicus, cucumeris and montodorensis may feed on flat mites incidentally, as may the relatively new predator, Doreen. If considering use of any of these species to manage flat mites it is recommended to consult the supplier prior to its release to maximise efficacy. These products are available either through Biological Services and/or Bugs for Bugs. For more information refer to the factsheet on managing beneficial populations in production nurseries.

CHEMICAL CONTROL

The regular, scheduled use of pesticides against any mite pest is not recommended. However, flat mites in particular are challenging without the use of pesticides. The following recommendations will maximise the efficacy of pesticides and reduce the frequency at which applications must be made. These recommendations will also minimise pesticide resistance occurring in pest populations.

1. Put in place as many cultural management strategies as possible and monitor regularly.
2. Preserve naturally occurring predators that may suppress populations incidentally.
3. Remove heavily infested plant material to reduce the number of individuals in the nursery, either prune out or remove whole plants. Discard hygienically, as discussed above, then apply pesticides.
4. Avoid broad spectrum or long residual products that will eliminate predators in the nursery. Pesticide residues can spread easily, particularly when water is recycled, therefore, any products that are highly toxic to predators can negative impact their population in the entire nursery, not just where they are applied.
5. Rotate between multiple mode of action groups whenever possible to reduce the likelihood of inducing pesticide resistance.
6. Apply pesticides to hot spots targeting the plants that are known to have pests. Avoid applications to the entire nursery.
7. Only apply contact products when infestations are not protected by plant material, e.g. when they are on mature leaves. Systemic or translaminar products are required if flat mites are protected in the growing tip or under leaf sheaths.

If monitoring indicates a low-level infestation with negligible damage to plants, then the release of californicus, cucumeris, Doreen or montdorensis predators may be suitable; pesticides may not be required. Refer to Table 1 for a list of products available for use against flat mites in production nurseries.

TABLE 1. LOW RISK PESTICIDES AVAILABLE FOR USE AGAINST FLAT MITES IN PRODUCTION NURSERIES (AS AT DECEMBER 2022).

Other products may be available in certain crops. Check with the APVMA and minor use permits for currently available products. Systemicity of application refers to how the product moves once it contacts the plant; C = contact, T = translaminar, S = Systemic.

MOA	ACTIVE	EXAMPLE TRADE NAME	SYSTEMICITY	NOTES	TOXICITY TO BENEFICIALS
6 & 28	Abamectin & Chlorantraniliprole	Volium targo	T & S	For use against all mites on non-food nursery crops. PER88695 & PER91810	Moderate toxicity when applied. Predators can be released after several days.
6	Emamectin	Proclaim	T	For use against all mites on non-food nursery crops. PER91810	Moderate toxicity when applied. Predators can be released after several days.
12C	Propargite	Omite	C	Brevipalpus spp. on ornamental plants. Qld &WA only. Stringent re-entry requirements.	Low to moderate toxicity. Predators can be released several days after application.
NA	Petroleum oil	Various	C	For use against all mites on non-food nursery crops. PER91810	Increasing toxicity towards predators with regular applications. Predators can be released 1–2 days after application.

This factsheet was written by Andrew Manners and Emily Lancaster (Queensland Government, Department of Agriculture and Fisheries — DAF) as part of the Hort Innovation, Nursery Levy and DAF funded project "Resourcing, supporting, and assessing biosecurity in nursery production (NY20000)" in 2021. It was originally written as part of a mite pest management plan in 2015 as part of NY11001.