Managing Gall Inducing Insects in Production Nurseries

BACKGROUND

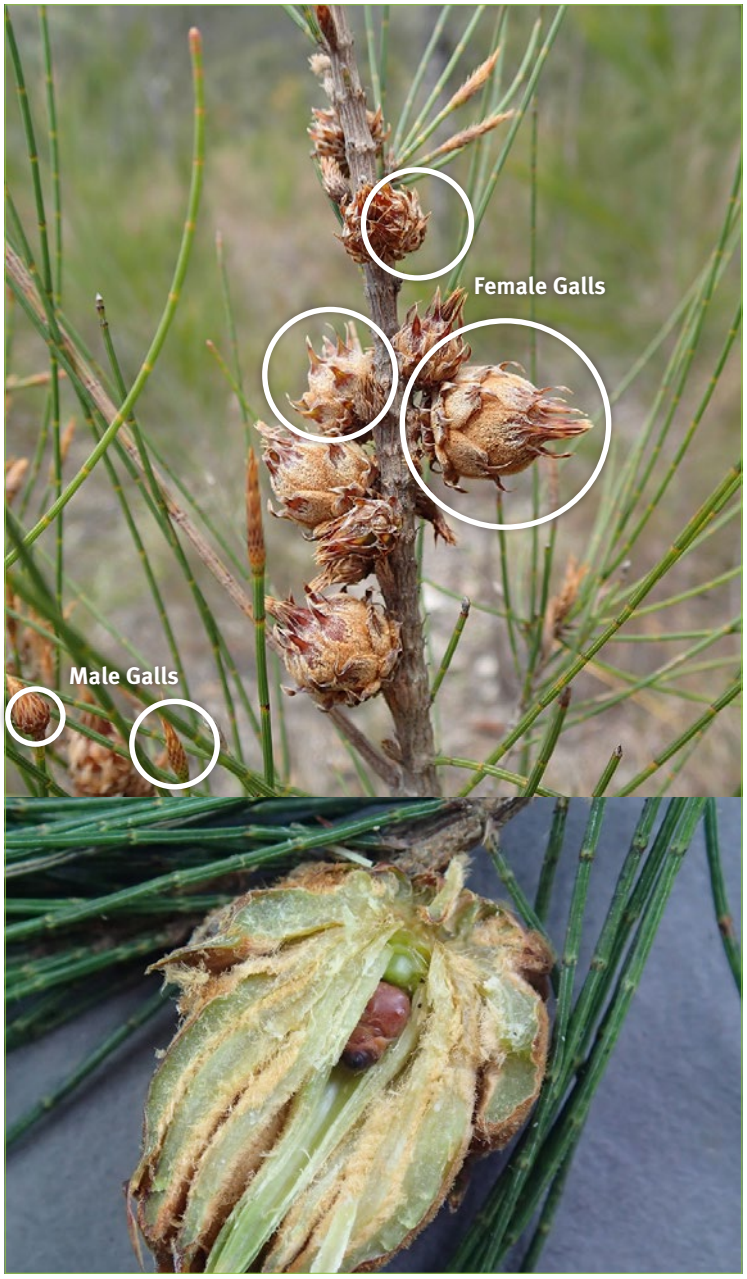
This pest management plan has similar content to the gall insect fact sheet, but has additional recommendations on pesticide rotations and more detailed management actions.

The most common gall inducing insect groups in Australia include aphids, midge flies and gall wasps. There are a variety of other groups that also sometimes produce galls, in particular thrips, psyllids and scale insects. However there are also some moths, sawflies, beetles, whiteflies and other insects that may occasionally produce galls. Some galls are produced by other organisms, most notably erinose mites and some fungal pathogens. The most common groups of gall-inducing insects will be discussed in this management plan, including some examples of the types of galls they may produce. Non-insect gall-inducing organisms are not covered, however, erinose mites and examples of the galls they produce are covered in the mite pest management plan available at the NGIA website.

There are about 13,000 known species of insects that produce galls on plants around the world. Gall-inducing insects tend to be specialist plant feeders, only feeding on one, or a small number of closely related host plant species. The interaction between the host plant and gall-inducing insect is very complex. Each species produces a very specific type of gall, which can sometimes be used to identify the causal insect. However, sometimes more than one species can produce galls of similar appearance on the same plant.

FURTHER READING

Blanch, Rosalind (2012) *Life in a Gall: the Biology and Ecology of Insects that Live in Plant Galls*. CSIRO Publishing, Collingwood, Vic, Australia.



Galls caused by the scale insect *Cylindrococcus spiniferus* on *Allocasuarina* (never *Casuarina*). The large galls are those of females and the small galls on the tips of branchlets are those of males (above). The gall has been cut open to reveal the burgundy coloured female (below). Both images by Lyn Cook, University of Queensland.

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The insect injects specific compounds into the plant that causes cells to multiply, changing the normal growth habit of the plant. In other words, the insect induces the plant to grow the gall as a consequence of insect feeding, not because of the damage caused by feeding itself. Galls may increase in size as the insect develops. Galls are often ornate and could even be described as beautiful in certain cases. In other cases, galls can cause a great deal of damage and the plant may not be saleable as a result of feeding from very few individuals.

GENERAL MANAGEMENT

Production nurseries tend to provide ideal environments for the development of gall forming species. Plants are often actively growing for relatively long periods of time and produce soft, lush growth. Gall forming species often lay their eggs (nymphs in the case of aphids) on new, unexpanded developing foliage. As a result a small number of individual insects can infest the growing tip, and cause damage that makes plants unsaleable within short periods of time (sometimes only a few weeks). Detecting these initial pest populations is often difficult and relies on careful, regular plant inspections. Such inspection may not be cost effective unless targeted appropriately during the critical stages in the lifecycle of both the pest and plant.

Correct identification of gall forming pests is essential to effective management. Many gall forming pests are only reproductively active during discrete periods of the growing season. This allows managers the opportunity to protect new growth during these high risk times. This can be achieved by growing plants in an insect proof structure or by using pesticides. Gall forming pests that are present throughout much of the year may be more difficult to control, particularly if they are very cryptic in nature.

The following recommendations are relevant to all groups of gall forming insects.

- Monitor all incoming susceptible crops. Do NOT accept consignments infested with gall forming pests.
- Most gall forming insects are specific to a small group of plant species. Assess plant species and varieties available and consider their susceptibility or resistance to key pests, e.g. psyllid resistant varieties of *Syzygium* are readily available.
- In some cases, gall damage may be attractive, particularly on native plants and may be acceptable in certain situations, particularly if plants are for revegetation purposes and infestation does not alter the growth form of the plant.
- If minor damage can be sustained, conserve natural enemies that can sometimes become very abundant in production nurseries and assist in reducing pest populations.
- Once plant damage has occurred, it will remain on or in the plant unless pruned. Remove damaged foliage and dispose of it hygienically. Insects may be present within galls and may emerge some weeks after foliage is removed and fly back into the crop. Plant material should be disposed of carefully in a manner that causes the death of any pest insects present. The exact method may vary with the pest. Bagging plant material and leaving it in the sun for an hour or two on a hot day may be sufficient for some situations. Pasteurisation or physical removal of infested plant material from the nursery (preferably deep buried) are other options.
- Some species may pupate in the soil, e.g. some species of gall midge flies and thrips. Therefore reinfestation may occur if suitable plant material is available when adults emerge from the soil or growing media. Remove crop trash in which pests may pupate.
- Regular pesticide applications may be necessary for a period of time. Refer to each section below for specific recommendations
- If possible, grow susceptible plant lines in a geographic region that is not within the pest's distribution. This is sometimes possible for nurseries with multiple sites in different states or by buying them in and only storing them for a short period of time in the nursery. This can be acceptable in cases where the species is primarily a nursery pest and is not present in gardens or the natural environment, e.g. Dianella gall midge fly.
- In certain cases it may also be possible to grow short term lines during seasons when the pest is not active.

In most cases management will rely heavily on breaking the lifecycle of the pest and growing plants in such a way as to stop reinfestation. Some of these groups of pests are very difficult to manage cost effectively and the only solution may be to discontinue growth of the affected plant lines. Consider the above recommendations on a case-by-case basis.

USE OF PESTICIDES

Regardless of the group of galling insects, timing and mode of action of pesticide application is critical. In general, systemic or translaminar products are required when insects are surrounded by plant tissue (see breakout box on pesticides); contact products will not be effective. Ensure that insects are present in plants at the time the application is to take place. While this sounds obvious, it is not always straight forward when dealing with insects that are often very small and where damage remains long after larvae have moved from the plant. Regular monitoring to detect the presence of galling insects early in the lifecycle is essential to apply pesticides successfully. Dissect or otherwise examine the plant where insects are known to occur.

SYSTEMIC VERSUS TRANSLAMINAR PESTICIDES

Systemic products are those that move up the plant providing protection away from the area the product was applied. When drenched they will move up and protect foliage and foliar applications can often provide great protective coverage. Translaminar products are those with very limited systemic movement. They will move from the top of the leaf to the bottom of the leaf, or vice versa, but not from one leaf to another.

For most gall species affecting nursery crop lines, it will be necessary to test the efficacy of registered products against the insects. It is recommended to apply such products using various timings (e.g. early, mid, late season or some combination). Leave some plants untreated as a comparison. Observe both treated and control plants about 2 days after application to determine if insects have been killed. It is not recommended to use products that have been shown to be ineffective. In most cases, products registered for use against gall insects are broad spectrum and will have a very high impact on predator populations. Applying products that are ineffective will therefore only reduce predator populations, but not the pest. See notes on the effect of insecticides on predator populations in Table 1 at the end of the plan.

Pesticides may also be effective against adults flying in or around the nursery and, and can significantly reduce numbers in a crop. However, do not assume that a reduction in numbers of adults will decrease damage to the crop; research overseas indicates that significant damage can still occur. Therefore, it is not recommended to apply pesticides unless shown to be effective, compared to untreated control crops.

Pesticide rotation reduces the likelihood of inducing pesticide resistance. Therefore, whenever possible, rotate between as many products from different mode of action groups as possible. For more information on this topic refer to the webinar on pests and pesticides.

INSECT GROUPS INDUCING PLANT GALLS

Each section below covers a brief description of the biology of each group and pesticide rotations that can potentially be used to assist in their management. Always refer to the general management actions, which should be used in conjunction with pesticides. Do not solely rely on pesticides to manage gall inducing pests. Larvae of some of these groups may appear very similar; i.e. cream, legless blobs. Therefore it may be necessary to rear out the gall insect or send whole plant samples to a diagnostician. Contact the diagnostician prior to sending the sample as identification often requires a specialist taxonomist. Sending photos of the insect and galls to a diagnostic laboratory may also assist.

GALL MIDGE FLIES (FAMILY CECIDOMYIIDAE)

Gall midge flies are small, delicate flies that are similar in appearance to fungus gnats. Their bodies are generally only 2–3mm long, have relatively long antennae and hairy legs (if observed under a microscope). Adults do not feed. Eggs are laid in plant tissue and the resulting larvae are tiny (<1mm). They begin feeding and immediately start to change the growth structure of the plant tissue. Larvae are often orange in colour, but may also be yellow or cream. As larvae develop they will grow to no more than about 5mm in length, depending on their age and the exact species, but are often only 2–3mm long. Like all fly larvae, maggots have a distinctive y-shaped mouthpart used to rasp food before ingestion. Their mouthparts are often black and can sometimes be seen from above, visible through the thin, soft exoskeleton at high magnification. Larvae either pupate on the plant in their gall, on the soil surface or under the soil a short distance, generally less than 5mm below the surface. Larvae of certain genera can jump 10–15cm by flicking their body when searching for a place to pupate. Adults will often emerge after 7–14 days.

Different gall midge flies will be active at different times of the year. Many species only have one or two generations per year, normally over summer. Other species will have a number of generations between spring and autumn, but may not be active over winter. Some species will remain active all year round in tropical regions or in protected cropping environments.

Galls range in appearance from relatively large ovoid growths to ornate projections or small non-descript, circular galls. Some species from this family may feed on plants but not produce galls (despite their common name); other species from the family are predators or feed on fungi.

Gall midge fly larvae are extremely difficult to manage with insecticides. In addition to being encased within plant structures, larvae are naturally resistant to most pesticides, which is a major reason why there are no pesticides specifically registered against this group. Some species have had pheromone traps developed that may be used to mass trap the pest. However, this has not been completed for most species and may not be cost effective in a nursery setting unless the crop is being grown on a very large scale. Effective long term control relies on breaking the lifecycle of pest species found in production nurseries and other strategies mentioned above. If pupation occurs in the soil then removal of infected plant material will not be sufficient. It is recommended to clean the growing area to remove pupation sites and consider discontinuing the production of susceptible lines until the infestation has been eradicated from the nursery.

The only active ingredient that is registered for use against gall midge flies that may be applied in some nursery settings is dimethoate (Table 1). Do not assume that it is effective against any or all species of gall midge flies; it is recommended to test efficacy in each case.

D. frauenfeldi flower gall midge on *Leptospermum laevigatum* – galls are brown on the right, green fruit are healthy.

Asphondylia eruciformis leaf gall midge on *Halosarcia indica* subsp. *leiostachya*. All photos by Peter Kolesik.

Dasineura banksiae leaf gall midge on *Banksia coccinea*

D. gannoni leaf gall midge on *Hakea microcarpa*

Resseliella xanthorrhoeae larvae under the leaf sheath of *Dianella*

Skusemyia allocasuarinae leaf gall on *Allocasuarina verticullata*.

GALL WASPS (VARIOUS FAMILIES, E.G. CYNIPIDAE, EURYTOMIDAE AND OTHERS)

Gall wasps are small insects generally between 2–8mm in length. They are often dark in colour with a constriction forming a 'waist' in the abdomen. The abdomen beyond the constriction is typically bulbous in shape, but some species may be very difficult to distinguish from parasitic wasps. There are perhaps thousands of species of gall wasps known worldwide. Each wasp tends to be specific to a small number of plant species or closely related genera.

Gall wasp species may lay eggs into leaves, stems or flowers and may reduce seedling height, stem diameter, cause premature leaf drop and reduce overall growth of the plant. Like other galling insects, the shape and colour of the gall produced is characteristic of the species and may assist in accurate identification. Larvae living within the galls are maggot-like, often cream in colour, legless and with chewing mouthparts.

Gall wasps are attacked by a range of parasitic wasps that lay eggs on the gall wasps, ultimately killing them. Gall wasps on native plants are more likely to have parasitoids. Research on gall wasps of eucalypts indicates that resistant clones can be developed through plant breeding. The two most important practices to manage gall wasps are to conserve natural enemies and to use resistant species or varieties. General management practices discussed above should also be put in place.

The citrus gall wasp, *Bruchophagus fellis* is probably the most widespread and important species affecting horticulture generally and production nurseries. However, there are many common native native plants may be affected by gall wasps, e.g. *Eucalyptus* spp., *Banksia* spp., *Acacia* spp., etc. Citrus gall wasps lay their eggs in plant stems, larvae develop and cause the stems to enlarge. Severe infestations can cause plants to have greatly reduced foliage, fruit load and significant plant dieback. While all citrus can act as a host, some species are more susceptible than others (grapefruit, oranges and lemons are more susceptible).

There are very limited insecticides registered for use against gall wasps. Dimethoate has a general gall insect registration and methidathion can be used against citrus gall wasp only (both the same mode of action group and methidation is a contact product – see Table 1). Citrus seedlings should not be supplied infested with gall wasps. If necessary, pesticides should be applied after gall wasp eggs have hatched, but before woody tissue has started to form around the larvae, which is generally between the last week of November and the first week of December, but may differ in some years. It is likely that this same concept will be important in the management of other gall wasp species.

Galls on *Eucalyptus marginata* induced by a gall wasp

Mossyrose gall wasp (*Diplolepis rosae*) on rose; this species is not known to be present in Australia. Photo by Haruta Ovidiu, University of Oradea, bugwood.org

THRIPS (VARIOUS FAMILIES IN ORDER THYSANOPTERA)

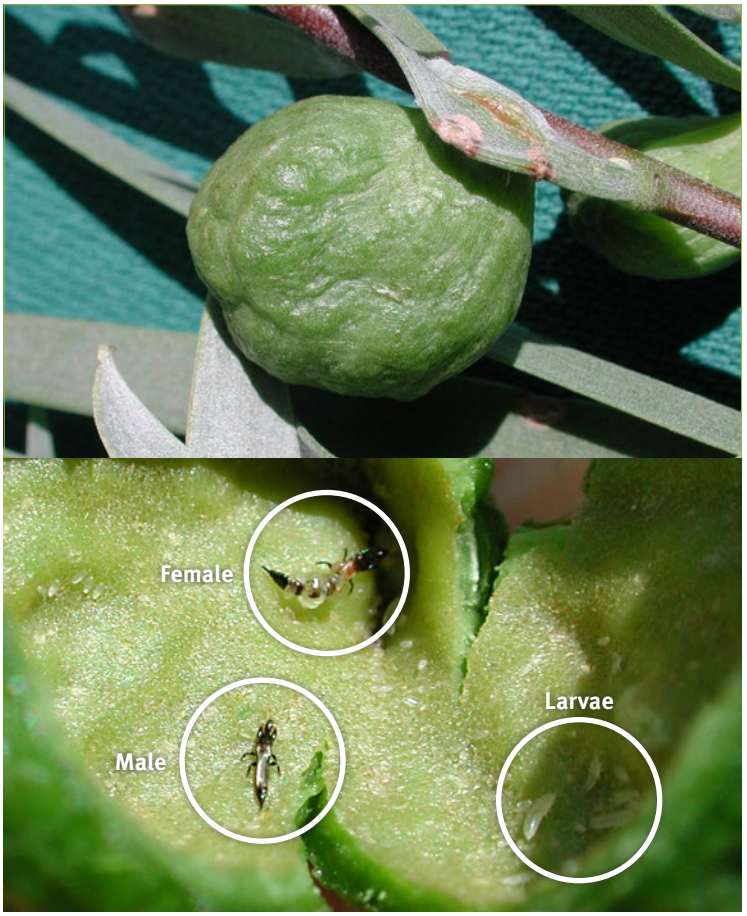
Thrips are relatively small, sausage-shaped insects that are generally 0.5–3mm in length, but sometimes up to 14mm. Details on their biology and management can be found in the thrips pest management plan, therefore the following information is in relation to their gall forming habit. World-wide there are about 300 thrips species that form galls. Most thrips that form galls cause leaves to become curled, crinkled or rolled. However, some thrips may cause horn-like projections, bubble-like growths, bladder-like projections or tumour-like galls more typical of gall wasps. Some may induce a woody gall in branchlets (e.g. on *Casuarina*).

Similar to other gall forming insects, thrips that form galls have a specific relationship with their host plants; only a small number of plant species are attractive to each thrips species. There is considerable variation in the behaviour and ecology of thrips living in galls including kelptoparasitic species that 'steal' the galls produced by gall-forming thrips. Some species of gall forming thrips may exhibit social behaviour. Some gall forming thrips also may produce variable shaped galls, depending on the size of the population and specific traits of that population; in general large populations within the gall are more likely to produce a larger, more complex gall. When dealing with variable shaped galls on a single plant species it is recommend to dissect the galls and be sure that the same pest is present before taking management actions; i.e. become familiar with the pest/s producing each gall type.

Many plant species can be affected by gall forming thrips including *Acacia*, *Myoporum*, *Ficus*, *Dianella*, *Schefflera*, *Casuarina*, *Pittosporum*, *Olearia* and others. The thrips pest management plan lists all pesticides for use against thrips in nurseries. However, only those products with a systemic or translaminar mode of action are listed in Table 1. Similar to citrus gall wasp discussed above, the timing of pesticide applications has been shown to influence efficacy in certain systems.

There are a number of products available for use against thrips. If pesticides must be used to manage the problem it is recommended to use the following rotation:

- Group 23 product (this is the only product that is relatively soft on predator species)
- Group 4A product
- Group 28 product (which also includes 4A)
- Group 1B product.



Galls caused by *Kladothrips rugosus* on *Acacia pendula*. Photo above with the intact gall, below dissected to show thrips within. Photos by Laurence Mound, ANIC, CSIRO.

Leaf curl galls caused by thrips. *Pittosporum undulatum* galls induced by *Teuchothrips ater* (above) and *Myoporum insular* galls induced by *Klambothrips adelaideae* (below). Photos by Laurence Mound, ANIC, CSIRO.

APHIDS (FAMILY APHIDAE)

Similar to thrips, most gall forming aphids cause leaf curl and distortion. Most often they feed on the new growth externally, altering the leaf growth habit as it expands and living within the folds of leaves. A relatively small number of aphids produce galls similar to that made by gall midge flies and thrips; enlarged areas of various shapes within which the aphids feed and reproduce. The biology of aphids is complex and described in detail in a separate factsheet devoted to this group. Systemic and translaminar pesticides are listed in Table 1, with the following rotations recommended.

Where natural enemies are to be preserved rotate between:

- Group 1A product (Pirimicarb is aphid specific product)
- Group 9B
- Group 12A product
- Group 23 product.

Where predators and parasitoids are not to be preserved the rotation can also include:

- 1B product
- 4A product.

Elm balloon-gall aphid (*Eriosoma lanuginosum*) Photo by György Csóka, Hungary Forest Research Institute, Bugwood.org

Gall induced by *Trioza* psyllid on *Beyeria leschenaultii*. Photo by Gary Taylor, University of Adelaide

Galls induced by grape phylloxera (*Daktulosphaira vitifolae*) on grape. The latter species is a notifiable pest in most states. Photo by Whitney Cranshaw, Colorado State University, Bugwood.org

Galls on *Eucalyptus obliqua* induced by the psyllid *Schedotrioza multitudinea* (top left), with a nymph exposed in the dissected gall (top right). Galls on *E. socialis* induced by the psyllid *S. cornuta* (bottom left), with a nymph exposed in the dissected gall (bottom right). All photos by Gary Taylor, University of Adelaide.

PSYLLIDS (FAMILY PSYLLIDAE)

Psyllids, including lerps, are small sap sucking insects, many of which produce galls. Adults resemble leafhoppers that are generally only a few millimetres (2–5mm) in length. Adults may be green, yellow, red or a pattern of brown, grey or black. Psyllids hold their wings tent-like over their abdomen similar to leafhoppers. Psyllid wings are often transparent. The head and thorax of psyllids are also relatively soft and bulbous compared to leafhoppers, which are relatively smooth and sclerotised.

Eggs are generally laid in growing tips and are typically orange or yellow in colour (often bright orange). Newly hatched nymphs are less than a millimetre in length and are often a similar colour to the eggs. Relatively small nymphs are often very flat, relatively wide, and orange to yellow in colour. Larger nymphs may be less flattened and may have body shape and colouration more similar to adults.

All nymphs produce honeydew. However, some psyllids produce honeydew in a characteristic hard white wax-like substance. It is this waxy substance that forms the covering of lerps, some of which may be gall inducing, and may act to protect the insect underneath. The wax may be long and curly or even appear similar to powdery mildew. Psyllids often produce pit galls, leaf rolls and raised globular sacks. Damage may be more severe at high densities of psyllids, i.e. at low density the species may only cause leaf rolling or crinkling, but at higher populations may produce globular sacs and more severe damage.

Rotate between pesticides from 1B and 4A mode of action groups. These are both broad spectrum products that will have a very negative impact on predator and parasitoid populations.

SCALE INSECTS

There are about 180 known species of scale insects in Australia that induce galls. A pest management plan specifically on scale insects covers the biology of this group in more detail. Therefore this section focusses on those few that induce galls. In general, scale galls may be in stems, leaves and flower buds. They often are enclosed swellings, or tubes with a single external opening (for excretion). However, some species may cause blisters, pits, pouches, rosettes or buds. Most scales that induce galls occur on eucalypts, however some are also known on banksias, casurinas, acacias, hoop and kauri pines and beeches. Systemic and translaminar pesticides registered for use against scale insects are listed in Table 1.

Where natural enemies are to be preserved rotate between:

- Group 7B or 7C product
- Group 16 product
- Group 23 product.

Where natural enemies are not being preserved rotate between:

- Group 1B product
- Group 4A product.

Gall of adult female of *A. strombylosa*. A woody gall, with a very small opening surrounded by wax, is typical of galls induced by *Apiomorpha*. Common on boxes and ironbarks in eastern Australia, and often attended by ants that get honeydew delivered from the insect through the pinprick-sized hole. Photo by Lyn Cook, UQ.

Image 1

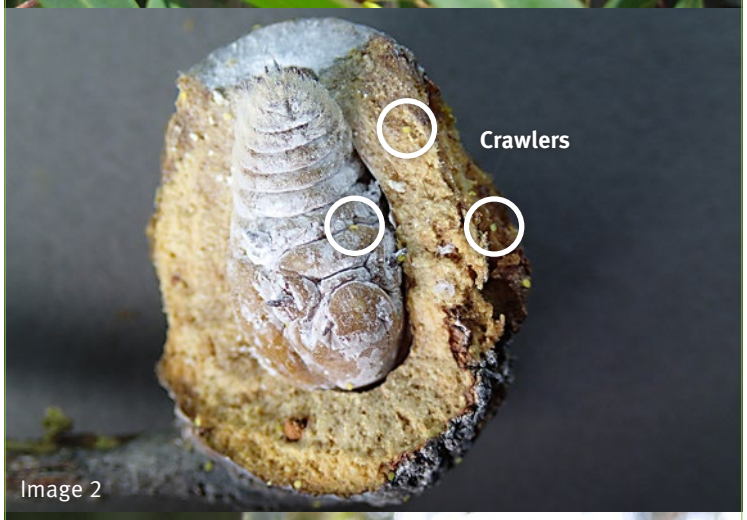


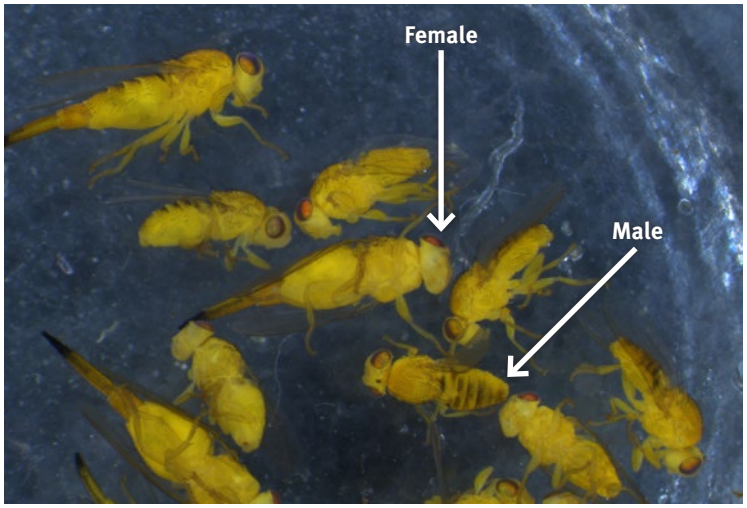
Image 2

Image 3

Image 4

Gall on stringy bark induced by the scale insect *Apiomorpha pileata* (Image 1), with the gall dissected to reveal the individual within (Image 2). Note that the yellow 'dots' around the gall are first instar nymphs (crawlers). Gall on melaleuca induced by the scale *Sphaerococcus ferrugineus* (Image 3), with the gall opened to reveal the stone-like adult female in the centre (Image 4). All photos by Lyn Cook, UQ.

Damage to gum nuts caused by flies (*Fergusonina* sp.) that often induce galls on *Eucalyptus* spp. Photo by Robbie O'Brien.



Male and female *Fergusonina* flies.

Gall induced by pine resin-gall moth, *Retinia resinella* (left) and dissected to show larva (right). This species is not known to be present in Australia. Photos by György Csóka, Hungary Forest Research Institute, Bugwood.org

OTHER GALL FORMING SPECIES

There are also a number of other groups of insects with a small number of gall inducing species. There are six known species of buprestid beetles known to cause galls, some whiteflies, a moth species and fly species from a number of families. Therefore, keep an open mind when assessing what type of insect is causing the gall.

There are a surprising number of insects that produce galls that are native to Australia and have not yet been described, i.e. they have not been given a species name. This can readily occur when native plants are initially only first cultivated in a production nursery environment. It can also occur on native plants that have been cultivated for a long time, but for which the pest has not been identified. Alternatively, it may only be an occasional pest, but if there is a very good season for the pest it may become a larger problem locally. If infested plants are then sent to regions in which it was not previously present (and are climatically suitable), the problem can then become more widespread. Sometimes specialist taxonomists are aware that there is an undescribed species on a plant because of the unique gall formed. If sufficient numbers of individuals are unable to be collected, formal description may not be possible.

BIOSECURITY

There are also a number of very serious exotic pests that form galls on introduced plants, e.g. citrus psyllids. In fact, the observation of any psyllids on citrus should be reported immediately; currently psyllids are not known to occur on citrus in Australia and are all very serious pests.

If you see anything that you believe is an exotic pest call the Exotic Plant Pest Hotline on 1800 084 881.

This document was prepared by Andrew Manners (Agri-science Queensland, Department of Agriculture and Fisheries (DAF), Ecosciences Precinct, GPO Box 267, Brisbane QLD 4001) as part of NY15002 Building the resilience and on-farm biosecurity capacity of the Australian production nursery industry in 2017. Thanks go to John Duff and Lindy Coates for helpful comments on previous version of this plan. Also thanks to the many photo contributions made by Australian taxonomists as indicated on each photo.

Table 1

Active ingredients registered against gall inducing insects relevant to Australian production nurseries.

Action C = Contact, S = Systemic and T = Translaminar. Toxicity to beneficials (insect and mite predators and parasitoids) is just a guide based on current information and some products may differ in their impact to some beneficial species.

MODE OF ACTION	ACTIVE INGREDIENT	EXAMPLE PRODUCT NAME	GALL INSECT GROUPS	REGISTRATION INFORMATION	ACTION	TOXICITY TO BENEFICIALS
1A	Pirimicarb	Pirimor, Aphidex	Aphids only	Many fruit, vegetable and ornamental crops.	T	L, some species susceptible with M–H toxicity; < 1 week.
1B[2]	Dimethoate	Dimethoate	All gall insects; all aphids, thrips, psyllids, scale insects	Registered on ornamentals, shrubs and forest trees. Labels vary. Some labels are a general ornamentals, excluding Chrysanthemums, begonias, liquidambar or gloxinias).	S	H – 4+ weeks residual
1B[2]	Methidathion	Suprathion	Citrus gall wasp only; Aphids, thrips and 'Plant Bugs'[1]	Only registered in citrus for early application – refer to notes in text; thrips and plant bugs on ornamentals trees, shrubs in nurseries, flower and vegetable seedlings.	C	H – 2-4 weeks residual
1B[2]	Omethoate	Sentinel	All thrips and aphids	Registered on carnations, chrysanthemums, pelargoniums, roses, callistemons, Eucalyptus spp., Grevillea spp., paperbarks and wattles only.	S	Probably H – 4+ weeks residual
4A	Acetamiprid	Maxguard	Aphids, scale insects, lilly pilly psyllid only	Indoor and outdoor ornamental plants and trees.	S	Probably M–H – 2-3 weeks residual
4A	Imidacloprid	Confidor	All aphids and psyllids	Ornamentals only; labels vary; PER81707 non-bearing nursery stock.	S	H – 2-3 weeks
4A	Thiamethoxam	Resolva	All thrips and Aphids	Registered on ornamentals and tomatoes as foliar application; containerised annuals, ornamentals, shrubs and ornamental trees as granular application.	S	M–H – probably moderate to long residual activity
4A + 3A	Imidacloprid + Beta-cyfluthrin	Temprid	All thrips, aphids, psyllids	Ornamental plants.	S	H – 2-3 weeks, perhaps longer
7B	Fenoxycarb	Insegar	Scale insects	PER81707 non-bearing nursery stock.	T	L–H – 1-3 weeks
7C	Pyriproxyfen	Pyxal	Scale insects	Nursery stock and ornamentals.	T	Probably L–M – 1-2 weeks residual
9B	Pymetrozine	Chess	Aphids only	PER81707 non-bearing nursery stock.	S	L – 1 week residual
12A	Diafenthiuron	Pegasus	Aphids only	PER81707 non-bearing nursery stock.	S	Unknown, probably L–M, with 1–3 week residual
16	Buprofezin	Applaud	Scale insects	PER81707 non-bearing nursery stock.	T	L–M – 0–3 weeks residual
23	Spirotetramat	Movento	All thrips, aphids and scale insects	PER81707 non-bearing nursery stock.	S	L – 0–1 week residual
28 + 4A	Chlorantraniliprole + thiamethoxam	Durivo	All thrips	PER81707 non-bearing nursery stock.	S	M–H – probably moderate to long residual activity

[1] Plant bugs is sufficiently general to refer to any plant feeding insect in the order Hemiptera including, aphids, psyllids, scale insects (including mealybugs), whiteflies, stink bugs, leaf hoppers, plant hoppers, tree hoppers, lerps, mirids, etc.

[2] Group 1B products are organophosphates. This group is currently being reviewed by the APVMA, which may result in changes to labels or products being taken off the market.