SFHA Subtropical Forest Health Alliance

Forest&Wood Products Australia

Healthy hardwoods

A field guide to pests, diseases and nutritional disorders in subtropical hardwoods

A field guide to pests, diseases and nutritional disorders in subtropical hardwoods. This field guide will assist identification of common damaging insects, fungi and nutritional disorders in young eucalypt plantations in subtropical eastern Australia.

The guide was compiled by Angus Carnegie, Christine Stone (NSW Department of Primary Industries), Simon Lawson, Tim Smith, Geoff Pegg and Janet McDonald (Department of Primary Industries and Fisheries, Queensland).

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Angus Carnegie, Simon Lawson, Tim Smith, Geoff Pegg, Christine Stone and Janet McDonald.

Contents

Fungi

Healthy hardwoods: a field guide to pests, diseases and nutritional disorders in subtropical hardwoods can assist identification of common damaging insects, fungi and nutritional disorders in young eucalypt (*Eucalyptus* and *Corymbia* species) plantations in subtropical eastern Australia.

This guide includes photographs of each insect, fungus and nutritional disorder and the damage they cause, along with a brief description to aid identification. A brief host list for insects and fungi, including susceptibility and occurrence, is also provided. We recommend using a hand lens to identify fungi. Although it is possible to identify insects and fungi from these photographs, laboratory examination is sometimes necessary—for example, microscopes and culturing media might be used to identify fungi.

Information about four exotic pests and diseases is also included in the *Biosecurity threats* chapter. Potentially, these would have a severe impact on plantation and natural forests if introduced into Australia. To prevent establishment of these pests, early detection and identification is crucial. **If an exotic insect or disease is suspected, then an immediate response is required.** Usually, the first response is to seek advice from the nearest Australian Quarantine and Inspection Service office or forestry agency.

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Anoplognathus boisduvali
Anoplognathus chloropyrus
Anoplognathus porosus
Anoplognathus spp.

Identification

A. chloropyrus

- These beetles are large (15–30 mm), shiny and red-brown with an iridescent green posterior protruding behind the wing covers, and faint black lines running down the wing covers.

A. porosus and *A. boisduvali*

- These beetles are large (15–30 mm), shiny and red-brown to yellow brown, with black spots (*A. porosus*) or lines (*A. boisduvali*) running down the wing covers; with no obvious green posterior. *A. boisduvali* has a red-brown posterior.
- Often several species are observed in plantations at the same time.

Damage

- The larvae feed on grass roots; adults emerge from the soil—often following rainfall—to feed on eucalypt leaves.
- Beetles feed in swarms, so can cause extensive damage to young plantations, particularly those surrounded by pasture.
- Beetles mainly feed on mature leaves, with a jagged ripped pattern to feeding; but they do also feed on immature leaves.

Hosts	Susceptibility	Occurrence
Corymbia citriodora subsp. *variegata*	High	Common
C. maculata	High	Common
Eucalyptus argophloia	Low	Uncommon
E. cloeziana	Low	Uncommon
E. dunnii	Very high	Very common
E. grandis	Very high	Very common
E. grandis hybrids	Very high	Very common

Damage to mature *C. maculata* leaves by Christmas beetles (note the jagged feeding pattern)

A. chloropyrus

A. porosus

A. boisduvali

Automolus spp.
Liparetrus spp.

Identification

Automolus spp.

- Beetles of these species are small (4–5 mm long) and mainly brown to dark brown. The elytra (wing covers) cover most of the abdomen and they have short body hairs.
- These beetles are active in plantations during daylight hours.

Liparetrus spp.

- Beetles are larger than *Automolus* (5–7 mm long) and mainly brown to light brown. The elytra are short and often lighter in colour than the rest of the body, covering only about two-thirds of the abdomen. Long body hairs are present on the end of the abdomen.
- Beetles of these species are mostly active at night, but some are active during the day.
- Often several species are observed in plantations together.

Damage

- Larvae feed on grass roots and soil organic matter. Adults emerge from the soil to feed on leaves and shoots, usually following rainfall in spring and early summer.
- Beetles feed in swarms, so can cause extensive damage to young plantations, particularly those surrounded by pasture.
- Beetles mainly feed on young and expanding eucalypt leaves, with a characteristic jagged ripped pattern that can cause distortion and dieback of young shoots in addition to defoliation. This may limit early season growth and establishment of apical dominance.

Hosts	Susceptibility	Occurrence
Corymbia citriodora subsp. *variegata*	Very high	Very common
Eucalyptus argophloia	Low	Uncommon
E. cloeziana	High	Common
E. dunnii	Very high	Very common
E. grandis	Very high	Very common
E. grandis hybrids	Very high	Very common

Early season shoot damage caused by swarming scarab feeding

Aggregation of *Automolus* sp. beetles feeding on young seedling

Eucalyptus tortoise beetle

Paropsis atomaria

Identification

- Adults are 10 mm long, orange with yellow specks.
- Larvae are 2–5 mm long and yellow-green. Mature larvae have thick black medial and lateral stripes on the abdomen.
- Eggs are orange to pink, in rings on twigs, petioles and occasionally leaf tips.
- Often observed with other chrysomelid beetles.

Adult *P. atomaria*

Damage

- Larvae feed on immature leaves, mostly consuming the whole leaf and defoliating the upper crown which results in typical 'broom topping'.
- Adults feed on mature leaves, scalloping the edges.

P. atomaria eggs

Host	Susceptibility	Occurrence
Corymbia citriodora subsp. *variegata*	High	Uncommon
C. maculata	High	Uncommon
Eucalyptus cloeziana	High	Common
E. dunnii	High	Common
E. grandis	High	Common
E. pilularis	High	Uncommon

P. atomaria larval group, including early and late-stages

Northern eucalyptus leaf beetle

Paropsisterna cloelia
(=*Chrysophtharta cloelia*)

Identification

- Adults are <10 mm long. They are mostly orange but can be black with an orange edge and head.
- Larvae are 2–5 mm long, yellow-green to olive-green with a black head. Mature larvae have thin black medial and lateral stripes on the abdomen.
- Eggs are yellow to cream, in long clusters or rows on immature leaves.
- Often observed with other chrysomelid beetles.

Damage

- Larvae feed gregariously on immature leaves, mostly consuming the whole leaf and defoliating the upper crown; this causes typical 'broom topping'.
- Adults feed on mature leaves, scalloping the edges.

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P. cloelia adults, common (R) and dark (L) form

Host	Susceptibility	Occurrence
Eucalyptus dunnii	High	Common
E. grandis	High	Common
E. grandis hybrids	High	Common

P. cloelia eggs on underside of expanding leaf

P. cloelia mature larvae

Damage to immature leaves by chrysomelid larvae (note top of tree defoliated)

Damage to mature leaves by chrysomelid adults (note scalloped edges)

Doratifera casta
Doratifera vulnerans
Doratifera quadriguttata

Identification

D. casta (black slug cup moth)

- Mature larvae (caterpillars) are 20–35 mm long; black with a yellow-white 'skirt' and white, raised dots on their back; and have four clusters of stinging spines at the front of the body. Young caterpillars cluster together; older larvae feed singly or in small groups.

D. vulnerans (mottled cup moth)

- Mature larvae (caterpillars) are 20–35 mm long, saddle-shaped with a yellowish 'skirt', and four bunches of spines at each end, which are raised when the insect is disturbed (contact with spines causes a painful sharp sting). Colour varies from light green to pink with yellowish markings when young to green, grey, red and brown with yellow markings when older. The larvae tend to feed alone.

D. quadriguttata
(four spotted cup moth)

- Similar to *D. vulnerans*. Green and red caterpillars with four pairs of black spots at each end of the body.

Damage

- Young caterpillars skeletonise leaves; older larvae of these moths feed alone or in groups of less than 5 per leaf, and consume the whole leaf. They can cause extensive defoliation, but this is usually restricted to a few trees in a plantation.

Host	Susceptibility	Occurrence
Corymbia citriodora ssp. *variegata*	Moderate	Uncommon
C. maculata	Moderate	Uncommon
Eucalyptus cloeziana	Moderate	Uncommon
E. grandis	Moderate	Uncommon
E. pilularis	Moderate	Uncommon
E. saligna	Moderate	Uncommon

Typical cup-shaped cocoon

D. casta larvae

D. vulnerans larva

D. quadriguttata larva

Gum leaf skeletoniser

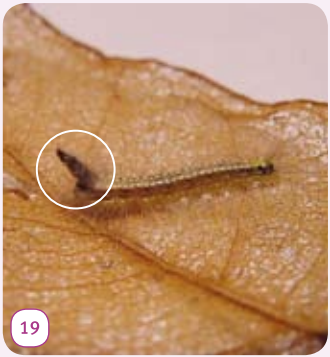
Uraba lugens

Identification

- Larvae are small (5–20 mm), hairy and yellow with brown markings and a 'head dress' made up of a chain of black head capsules (added to after each moult).
- Young larvae are usually found clustered in a hairy mass on the leaf surface. Mature larvae disperse.

Damage

- Larvae graze both surfaces of leaves, leaving just a leaf skeleton.
- Damage from this moth is usually restricted to several leaves on a few branches per tree and not widespread in a plantation.



U. lugens larvae (note head capsules, circled)

U. lugens larvae feeding (note grazing and skeletonising of leaves)

Host	Susceptibility	Occurrence
Eucalyptus argophloia	Moderate	Uncommon
E. dunnii	Low	Uncommon

Leaf damage caused by larval feeding

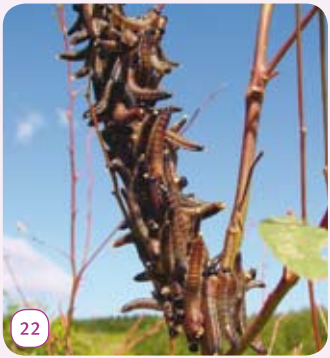
Perga spp.
Pergagrapta spp.

Identification

- Sawfly larvae are similar to caterpillars with three pairs of legs, covered in short bristles, tan to dark brown or black, with a yellow to orange clasper at the tip of the tail and a black head; adults can be up to 60 mm long. Other species can be light green in colour with an orange clasper and black head.
- Observed in clumps of >10 on stems during the day; they disperse and feed at night.
- When disturbed they raise their tails and regurgitate a yellowish fluid as a defensive mechanism.

Damage

- Sawflies are voracious leaf eaters. They are mostly restricted to a few trees in a plantation, but will often defoliate the whole tree. They rarely cause widespread defoliation.



Clump of eucalypt sawfly larvae on branch of *E. grandis* (note feeding damage to tree)

Hosts	Susceptibility	Occurrence
Corymbia citriodora subsp. *variegata*	High	Uncommon
C. maculata	High	Uncommon
Eucalyptus cloeziana	High	Uncommon
E. dunnii	High	Uncommon
E. grandis	High	Uncommon
E. grandis hybrids	High	Uncommon
E. pilularis	High	Uncommon

Young eucalypt sawfly larvae (note raised tail)

Phylacteophaga spp.

Identification

- Leafblister sawfly larvae feed beneath the upper surface of leaves, mining out a section and creating a distinctive blister. Blisters are initially small and enlarge as the larvae grow.
- Larvae are often seen beneath blisters, with more than one larva occurring on a single leaf, causing many blisters on the leaf.
- Mostly occur on older, lower leaves, especially in larger trees.

Damage

- Young mature leaves are preferred, but not exclusively. Severe damage can result in premature leaf fall. Can cause severe defoliation in plantations.

Leafblister sawfly larval damage on mature leaf (note the larvae visible under blisters)

Host	Susceptibility	Occurrence
Corymbia citriodora subsp. *variegata*	High	Common
Corymbia hybrid	Recent record—status unknown	Uncommon
C. maculata	High	Uncommon
Eucalyptus camaldulensis	Moderate	Uncommon
E. dunnii	High	Common
E. grandis	High	Common
E. grandis hybrids	High	Common

Severe leafblister damage to mature foliage

Damage symptoms on young tree (note damage and leaf loss on lower canopy)

Monolepta australis

Identification

- Adult beetles are up to 5 mm long, orange with a red band on the front edge of the wing covers.
- Often feed in swarms.

Damage

- Graze both sides of leaves. Graze stems when in high numbers. Can severely damage young trees and kill seedlings.
- Often observed on hilltops, and adjacent orchards (pest of avocado, mango and other orchard trees).
- Insect numbers can quickly build up then disperse—leaving the damaged trees as the only means of identification.

M. australis grazing on *E. pilularis*

Host	Susceptibility	Occurrence
Corymbia hybrid	Variation between hybrids	Isolated
Eucalyptus grandis	High	Isolated
E. grandis hybrids	High	Isolated
E. pilularis	High	Isolated

Leaf damage by *M. australis*

M. australis severe damage on a small tree

Gonipterus spp.
Oxyops spp.

Identification

- Adults are <10 mm long, brown to dark red-brown. Adult *Oxyops* spp. have a rough dorsal surface but *Gonipterus* spp. are smooth. They are often observed clinging tightly to branchlets.
- Larvae resemble slugs: <10 mm long, yellow to orange, with small black spots on their back and black stripes on their sides; older larvae are often slimy. When feeding, larvae produce a thin thread of excrement, which coils up behind them.

Damage

- Larvae feed on the surface of leaves, leaving characteristic tracks where the upper surface of the leaf tissue has been removed. The epidermis is left, resembling a long, thin window or hole. The hole enlarges as the leaf grows.
- Adults mainly feed on the edges of leaves, leaving ragged or scalloped edges.

Adult *Oxyops* sp.

Eucalyptus weevil larvae feeding

Host	Susceptibility	Occurrence
Corymbia citriodora subsp. *variegata*	Low	Rare
Eucalyptus dunnii	Moderate	Common

Eucalyptus weevil larval damage to *E. dunnii*

Chaetocnema spp.

Identification

- These tiny black beetles are 2–3 mm long and difficult to find on the foliage; however the damage they cause is easily identified.
- Beetles have enlarged hind legs that enable them to jump, hence the common name.

Damage

- Upper surface of the leaf is etched by feeding beetles, causing necrotic patches to form.
- Damage is usually restricted to the lower third of the canopy; loss of growth due to these beetles is considered insignificant.
- Damage is most evident in winter.

Flea beetle damage to upper surface of *E. dunnii* leaf

Host	Susceptibility	Occurrence
Corymbia citriodora subsp. *variegata*	Low	Common
C. maculata	Low	Uncommon
Eucalyptus argophloia	Moderate	Common
E. dunnii	High	Common
E. grandis	Low	Uncommon
E. pilularis	Low	Uncommon

Flea beetle damage to upper surface of *E. argophloia* leaf (note leaf etching and necrotic patches)

Strepsicrates spp. and other tortricid larvae

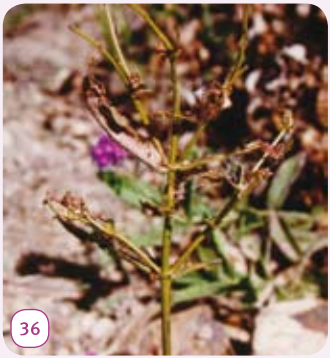
Identification

- Caterpillars range from 10–20 mm long, and are generally <3 mm wide. They can range in colour from grey-green to light green to pinky-red, and occasionally light brown. The head is shiny, and often differs in colour to the body (black to light green or light brown).

Damage

- Caterpillars prefer to feed on young leaves, commonly in growing shoots. Some web leaves together as a shelter, while others roll a leaf over and use silk to hold it in place.
- Young caterpillars tend to scour the leaf surface; mature caterpillars either skeletonise or feed on the edges of leaves.
- Rarely cause significant damage. Can affect form of newly planted trees.

Leaf rolling of young *E. dunnii*



Defoliation of young *E. dunnii* caused by leaf rollers

Host	Susceptibility	Occurrence
Corymbia citriodora subsp. *variegata*	Moderate	Uncommon
Eucalyptus cloeziana	Moderate	Uncommon
E. dunnii	Moderate	Common
E. pilularis	High	Uncommon

Leafroller caterpillar (note silk webbing and feeding damage)

Rhombacus spp.
Acalox spp.

Identification

- A microscope is needed to see individual mites, so field identification is based on the symptoms they cause.
- Thousands of mites aggregate and cause yellow to red raised blisters on the leaf surface—in severe cases blisters cover the entire leaf surface.

Damage

- Blisters reduce photosynthetic efficiency and the retention of infested leaves over a long period affects tree growth. Severe defoliation also results when leaf blisters become necrotic and heavily infested leaves are shed prematurely.
- Mites may also cause distortion of shoots, resulting in loss of apical dominance.
- Damage is most prevalent in plantations that are two to three years old.
- There is variation between provenances of *Corymbia* spp. in tolerance to the mite. Woondum provenance is one of the most susceptible; northern New South Wales provenances appear to be less susceptible.

Blistering, chlorosis and distortion of spotted gum leaves caused by erinose mites

Host	Susceptibility	Occurrence
Corymbia citriodora subsp. *citriodora*	High	Common
C. citriodora subsp. *variegata*	High (provenances vary)	Common
C. henryi	Low	Uncommon
Corymbia hybrids	Low	Uncommon
C. maculata	Low	Common

Chlorotic symptoms on upper leaf surface of spotted gum

Wingless grasshopper

Phaulacridium vittatum

Identification

- Grasshoppers are up to 20 mm in length and brown to grey in colour.
- Large hind (hopping) legs usually reddish in colour.
- Adults do not develop fully functional wings and cannot fly. Wing buds are present in adults but do not cover the abdomen as in other grasshopper and locust species.

Damage

- Large numbers of adults and nymphs build up in pasture and on broadleaved weeds. Risk of damage is higher for plantations established on ex-pasture sites and where grasses and weeds are present between rows.
- Newly planted stock can be totally defoliated. Chewed leaves have jagged appearance, with midribs often left intact.
- Grasshoppers may also feed on stems and can cause twig and branch dieback and breakage on saplings.
- Damage is more prevalent during drought where trees provide alternative source of moist foliage/bark for grasshopper feeding.

Host	Susceptibility	Occurrence
Corymbia citriodora subsp. *variegata*	High	Uncommon
Corymbia hybrids	High	Uncommon
Eucalyptus argophloia	High	Uncommon
E. longirostrata	High	Uncommon

Grasshopper feeding on young *E. argophloia* stem

Grasshopper damage on *Corymbia* hybrid

Cardiaspina fiscella
Cardiaspina maniformis

Identification

C. fiscella

- Lerps 1–4 mm, yellow-brown, lacy or basket-like, mainly on lower leaf surface, mostly on mature foliage, several to large numbers per leaf.
- Psyllid nymphs (if present) are seen under lerps.

C. maniformis

- Lerps 1–4 mm, ribbed, light yellow, scallop-like mainly on upper side of leaves, mostly on mature foliage, several to large numbers per leaf.

Damage

- Cause leaf chlorosis (yellowing) and reddening leading to necrosis (death) and leaf fall. Foliage on heavily affected trees can appear purple to brown.
- Common cause of damage and defoliation in young and mature *E. grandis*.
- Both species often observed together.

Host	Susceptibility	Occurrence
Eucalyptus grandis	High	Common (young and mature trees)
E. grandis hybrids	Moderate	Common (young and mature trees)

Leaf symptoms of *C. maniformis* damage

C. maniformis lerps

Leaf symptoms of *C. fiscella* damage

C. fiscella lerps

Creiis lituratus

Identification

- Lerps of varying sizes (1–5 mm), smooth, opaque and shell-like, on both sides of leaves, but predominantly on the underside; more common and larger on older leaves, smaller on immature leaves.
- Psyllid nymphs (if present) are seen under lerps, and nymphal stages and adults sometimes observed on leaves.

Damage

- Causes chlorosis (yellowing) and reddening/purpling leading to death and leaf fall. Isolated red-purple patches when only a few lerps per leaf; however, commonly many lerps per leaf when leaves turn dark purple and eventually die, giving the tree a purple to brown appearance. Insects can build to large numbers quickly (within one month).

C. lituratus lerps and psyllids on *E. dunnii*

Upper leaf surface symptoms (note purple blotches)

Host	Susceptibility	Occurrence
Eucalyptus dunnii	Very high	Very common

Creiis psyllid damage to *E. dunnii* plantation

Glycaspis spp.

Identification

- Lerps vary in shape from squarish to conical, are up to 5 mm in diameter, usually glistening white but can be yellow, and occasionally have numerous fine white filaments on the outer surface.
- Often found on the upper surface of leaves. Occasionally in large numbers per leaf. Often along midrib of leaf.
- Often produce honeydew (sticky), thereby supporting growth of sooty mould on leaves and stems.

Damage

- Rarely cause discolouration of leaf surface; however, do cause defoliation when present in large numbers.

Host	Susceptibility	Occurrence
Eucalyptus cloeziana	Low	Uncommon
E. grandis	Low	Uncommon
E. pilularis	Low	Uncommon

Glycaspis sp. lerps

Glycaspis sp. lerps

Eucalyptolyma maideni

Identification

- Lerps are white, flat, and in the shape of a small fern leaf (or skeleton of a flat-head fish). These psyllids are unusually mobile and often seen outside the lerp.
- Often many individuals per leaf.
- Mainly restricted to spotted and lemon-scented gums (*Corymbia citriodora* subsp. *citriodora*, *C. maculata* and *C. citriodora* subsp. *variegata*).

Damage

- Very common on spotted gum foliage but does not cause discolouration or damage to leaves and does not lead to defoliation.
- Very high densities can be associated with sooty mould due to secretion of copious amounts of honeydew.

Host	Susceptibility	Occurrence
Corymbia citriodora subsp. *citriodora*	Low	Common
C. citriodora subsp. *variegata*	Low	Common
C. maculata	Low	Common

Lerps of *E. maideni* on *C. citriodora* subsp. *variegata*

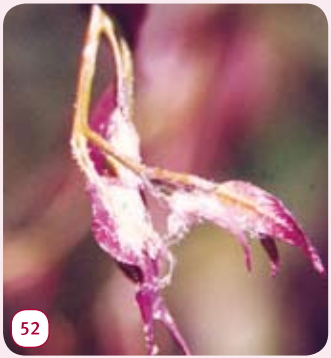
Identification

- Young nymphs are small (1–2 mm), pale yellow. Adults are yellow and winged.
- Psyllids produce white woolly filaments and masses of powdery material on leaves; often resembles cotton wool. Psyllids observed within and around woolly filaments.
- Mainly restricted to growing shoots.

Damage

- Do not appear to have a serious effect on trees, although may cause shoot distortion when present in high numbers.

Host	Susceptibility	Occurrence
Eucalyptus grandis	Low	Common
E. pilularis	Low	Common



Free-living psyllids produce white woolly filaments around growing tip

Eurymela spp.
Eurymeloides spp.

Identification

- Adult treehoppers are small (<10 mm), winged and triangular resembling small cicadas. They are black with white markings on the wings and red and metallic blue underneath. Nymphs are smaller, wingless, orange and black with red markings and often a striped abdomen.
- Adults and nymphs occur in colonies at the juncture of small branches and twigs. When disturbed they either fly or hop away (adults) or move to the other side of the twig.

Damage

- Damage to tree is not obvious. Honeydew and sooty mould are associated with large infestations.

Treehoppers on twigs of *E. grandis* hybrid

Host	Susceptibility	Occurrence
Corymbia citriodora subsp. *variegata*	Low	Uncommon
Eucalyptus grandis	Low	Common
E. grandis hybrids	Low	Common
E. longirostrata	Low	Uncommon
E. pilularis	Low	Common

Large aggregation of treehopper nymphs and adults on stem of *E. grandis* hybrid (note copious honeydew and ants in attendance)

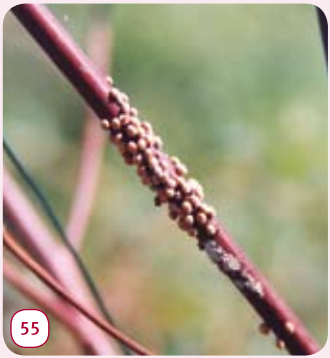
Eriococcus spp.

Identification

- Gumtree scale forms large colonies of small (2–4 mm diameter) reddish to white globules, which are often clustered, on stems, branches and leaves. The insects feed under these globules.
- The insects secrete a white cottony substance that covers the globules.
- When squashed, gumtree scales contain a reddish-brown fluid.
- Leaves are often sticky from honeydew excreted by the insect, and sooty mould is often associated with gumtree scale, turning leaves and branches black. Ants are also commonly associated with gumtree scale (feeding on the honeydew).

Damage

- Cause defoliation, especially the lower and inner canopy of young trees.
- Sooty mould may affect photosynthesis by covering leaves.
- Small or stressed trees are usually the most affected.



Gumtree scale on branch of *E. grandis*

Host	Susceptibility	Occurrence
Corymbia citriodora subsp. *variegata*	Moderate	Common
Eucalyptus cloeziana	Low	Uncommon
E. grandis	High	Common
E. pilularis	Low	Common

Gumtree scale and associated sooty mould on branches and leaves of *C. citriodora* subsp. *variegata*

Amorbus spp.

Identification

- Adults are brown and shaped like a shield with ridged shoulders. They are 15–22 mm long, and winged.
- Nymphs vary in colour from yellow to orange and light-green, with grey markings, and are wingless.
- Adults and nymphs have long antennae and long legs.
- Often found feeding on new shoots.
- When handled, bugs give off a pungent odour.
- Not to be confused with predatory bugs (see p. 76).

Damage

- Both adults and nymphs are tip-feeders, sucking sap from new shoots, causing tips to wilt and die. Only causes significant damage to trees if the bugs are in high numbers.

Host	Susceptibility	Occurrence
Corymbia citriodora subsp. *variegata*	Low	Uncommon
Eucalyptus cloeziana	Low	Uncommon
E. dunnii	High	Common
E. longirostrata	High	Common

Adult *Amorbus* sp.

Nymph of *Amorbus* sp.

Thaumastocoris sp.

Identification

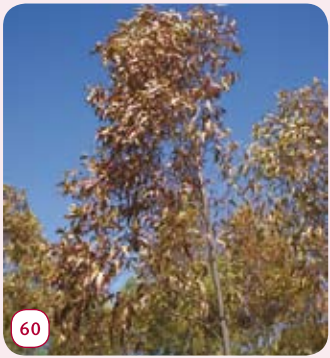
- Adults bugs are small (2–3 mm long) and brown to orange-brown; adults have a long and flat shape.
- Most often found on mature foliage of spotted gums.
- Seen under a hand lens, eyes on broad 'stalks' are characteristic of the adults.

Damage

- Both adults and nymphs are sap-suckers, extracting nutrition from leaves.
- These bugs inject enzymes into the leaf while feeding to assist in digestion of leaf cells and their contents, causing red-brown 'bronzing' of leaves. The north to north-eastern side of the canopy is usually first affected with symptoms appearing from May to August and September.
- Severely affected leaves have reduced photosynthetic capacity and are shed prematurely.

Adult *Thaumastocoris* (bar represents 1 mm)

Host	Susceptibility	Occurrence
Corymbia citriodora subsp. *variegata*	High	Uncommon



Extensive 'bronzing' of foliage of young spotted gum

Leaf symptoms (note red-brown discolouration and black faeces on leaf surface)

Rayieria sp.

Identification

- Thin, medium-sized bugs 8–10 mm in length, with an orange to red thorax and black and white abdomen and wing covers. Black antennae are as long or longer than the body.

Damage

- Both adults and nymphs are sap suckers, extracting nutrition from leaves. Adults are swift and active flyers and are mostly present in the lower third of canopy.
- Bugs inject enzymes into the leaf while feeding to assist in digestion of leaf cells and their contents, causing dead patches to form on the upper leaf surface. Dead patches are generally square to rectangular in shape.
- Severely affected leaves have reduced photosynthetic capacity and may shed prematurely.

Rayieria sp. adult on *E. dunnii* leaf

Host	Susceptibility	Occurrence
Eucalyptus argophloia	Low	Uncommon
E. dunnii	High	Common

Rayieria sp. symptoms on *E. dunnii*

Ophelimus sp.

Identification

- These galls form on leaves; they are large (up to 20 mm diameter), mainly round soft and fleshy, and red to green or occasionally yellow.
- Tiny wasps lay eggs in the leaves, which cause these galls to develop. If broken open small maggot-like larvae are seen inside the gall.

Damage

- Unless the galls are in very high numbers there is generally no significant damage to trees.

Severe leaf galling symptoms on *E. dunnii*

Host	Susceptibility	Occurrence
Eucalyptus dunnii	Moderate	Common

Typical wasp galls on leaves of *E. dunnii*

Blair's gall midge

Eucalyptodiplosis mcintyrei

Identification

- Adults are very small, slender flies.
- Larvae are small and orange in colour and found between the distorted leaflets.

Damage

- Gall midges induce galls in new shoots. The gall is a thickened and shortened leaflet on terminal, lateral and branch buds. Infested buds do not develop further and eventually turn brown, dry out and die.
- Trees observed to grow through the damage.

Host	Susceptibility	Occurrence
Eucalyptus grandis	Low	Rare

Blair's gall midge damage on *E. grandis*

Ophelimus sp.

Identification

- Raised, brown plate-like galls form on the upper surface of leaves of the western white gum (*Eucalyptus argophloia*).
- Galls often form masses which can completely cover the leaf surface.
- Galls are caused by the feeding of the larvae of tiny wasps. Exit holes of adult wasps are sometimes seen on the surface of the gall.

Damage

- Severe infestations can affect 100 per cent of leaves, with associated defoliation.

Severe plate galler damage on young *E. argophloia* (note brown appearance of foliage)

Host	Susceptibility	Occurrence
Eucalyptus argophloia	High	Common

Raised, hard plate galls on *E. argophloia* leaf (note small round wasp emergence holes on galls)

Phoracantha spp.

Identification and damage

- Adult beetles have long (30–45 mm) narrow bodies. The antennae are as long or longer than the body. They are rarely observed. Larvae are large (20–40 mm long) and cream, with a small reddish-brown head with chewing mouthparts.
- A fine frass (similar to sawdust) caught in the bark or at the base of the tree and kino bleeding are early signs of longicorn activity in trees. The characteristics of external tree damage (see below) can assist identification of the species involved.
- Wood quality can be severely affected by staining and physical damage associated with larval feeding.

Two-hole borer (*P. solida*)

- One or two larvae of this borer feed in the cambium over a radius of 100–150 mm. In the early stages there are associated kino bleeds and larvae may construct small 'air holes' through the bark. When larvae complete development they bore into the heartwood to pupate, at which stage the external bark falls away from the feeding site leaving exposed sapwood and one or two frass-packed oval-shaped holes (7–10 mm in length) into the heartwood. The wound later seals over as the tree grows.

Host	Susceptibility	Occurrence
Corymbia spp.	Moderate	Common
Eucalyptus dunnii	High	Common
E. grandis	Very high	Common
E. grandis hybrids	High	Common
E. pilularis	High	Common
E. saligna	Very high	Common

Ringbarking longicorn (*P. mastersi*)

- Damage signs are large wounds or 'blazes' caused by larval feeding under the bark, and are more often observed in *Corymbia* spp. In contrast to *P. solida* and *P. acanthocera*, larvae feed gregariously and over a much wider area of bark. Saplings and small trees can sometimes be killed by girdling. Copious kino bleeding is associated with these wounds, with the affected area turning grey-black.

Bulls-eye borer (*P. acanthocera*)

- This borer leaves a characteristic 'bulls-eye'—an oval shaped groove in the tree, with a hole in the centre. However, this is often hidden under bark, and all that is visible are splits in the bark. The bulls-eye becomes more visible once the beetle emerges and the bark falls off. The actual area damaged under the bark is greater than that indicated by the bulls-eye. The wound later seals over as the tree grows.

Typical longicorn larva (note creamy white colour)

Two-hole borer damage (note two oval-shaped larval tunnels into heartwood, circled)

Bulls-eye on *E. grandis* (note oval-shaped groove above central tunnel)

Ringbarking longicorn wounds on mature spotted gum

Endoxyla cinereus

Identification

- Adult wood moths are large, with a wingspan of about 250 mm and weighing up to 30 g. Adults are rarely seen. Larvae are large, up to 150 mm long, creamy white with pink to purple bands and a red-brown head.
- Often the first sign of giant wood moth activity in a tree is a pile of coarse frass (like sawdust) at the base of the tree. A cap-like cover of frass is often seen on the trunk (up to 3 m high) during spring to summer covering the entrance hole of the young larva. As the larva grows the trunk of the tree swells due to feeding activity inside.
- Just prior to emergence the larva makes a larger exit hole above the original, plugged entry hole. These holes, as well as trunk swelling, are characteristic signs of activity.

Damage

- On smaller trees, larval tunnelling weakens stems, which can then snap in strong winds.
- Yellow-tailed black-cockatoos rip into the trunk to feed on larvae—this may cause further damage to the tree and contribute to stem breakage.

Tent-like cap over entrance hole

Host	Susceptibility	Occurrence
Eucalyptus argophloia	Low	Uncommon
E. cloeziana	Low	Uncommon
E. dunnii	High	Common
E. grandis	Very high	Common
E. grandis hybrids	High	Common
E. pilularis	Low	Common
E. saligna	Very high	Common

Exit hole and characteristic swelling

Cossid moth larva inside tunnel of split stem

Culama spp.

Identification

- Adults are medium-sized moths (30–50 mm wingspan), motley brown-grey in appearance and are rarely seen.
- Larvae are pink to red, up to 40 mm long and feed gregariously under the bark, which eventually falls away from the site of infestation exposing the sapwood to fungal staining and rot. Webbing and frass pellets are associated with this feeding.

Damage

- Damage is usually associated with primary attack by longicorn beetles or giant wood moth, or with bark splitting as a result of severe drought. Sites of attack are often reinfested, with a range of larval stages present.
- Severe attack can girdle young trees.

Culama larva

Host	Susceptibility	Occurrence
Corymbia citriodora subsp. *variegata*	Moderate	Uncommon
C. maculata	Moderate	Common
Eucalyptus argophloia	Low	Uncommon
E. cloeziana	Low	Uncommon
E. dunnii	High	Common
E. grandis	Very high	Common
E. grandis hybrids	High	Common

Sapwood exposed due to extensive feeding on cambium by *Culama* larvae (note copious associated kino and fungal staining)

Uzucha humeralis
Maroga spp.
Cryptophasa spp.

Identification

- The larvae of xyloractine wood moths are rarely seen; they feed externally on the bark, forming a gallery around the stem or branch covered by conspicuous webbing composed of frass (sawdust) and silk. Removal of the webbed frass reveals the gallery and often a small tunnel into the tree, where the larva pupates.

Damage

- Larvae cause damage to the stem and branches of young—usually smooth-barked—eucalypts.
- The damage can ringbark small trees or branches, or cause structural damage and breakage. However, often the damage seals over with subsequent tree growth.

Host	Susceptibility	Occurrence
Corymbia citriodora subsp. *variegata*	High	Common
Corymbia hybrids	High	Common
C. maculata	High	Common
Eucalyptus grandis	High	Common
E. grandis hybrids	High	Common
E. pilularis	High	Common

Typical *U. humeralis* webbing symptoms on *Corymbia* sp.

Horizontal scarring and damage by a xyloryctine wood moth

Reduviidae

Assassin bugs (reduviids) are common and important predators of other insects.

Identification

- Adults are up to 20 mm long and shaped like a shield. They are orange to black in colour, with long legs and a long, curved beak. These bugs are usually solitary and are often seen near shoot tips.
- One of the most common species in plantations is *Pristhesancus plagipennis*—adults are up to 20 mm in length and brown-grey in colour. This species has pronounced 'flanges' on the sides of the abdomen extending laterally beyond the wings.
- Assassin bugs are often only observed when prey is in high numbers, and are occasionally seen feeding with chrysomelid leaf beetle larvae impaled on their beaks.

Insect prey

- Assassin bugs prefer soft-bodied insects such as caterpillars and leaf beetle larvae, but will feed on other stages also, including leaf beetle adults.

Adult *P. plagipennis*

Spined predatory shield bug

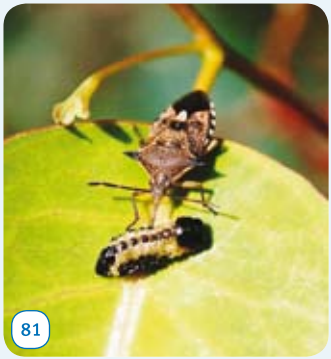
Oechalia schellenbergii

Identification

- The shield bug feeds on other insects by sucking their body fluids.
- Adult bugs are <10 mm long, brown and shaped like a shield with pronounced lateral spines on the thorax. Nymphs are smaller, with black and red markings but no wings.
- Shield bugs are one of the most common insect predators seen in plantations—especially when prey, such as chrysomelid leaf beetles, are in high numbers. They are sometimes seen feeding on larvae impaled on their proboscis.

Insect prey

- Shield bugs are generalist predators and feed on leaf beetle eggs, larvae (most common prey), and adults, as well as caterpillars, eucalypt sawfly larvae, treehoppers, scale insects and aphids.



Adult spined predatory shield bug feeding on *Paropsis atomaria* larva

Neopolycystus sp.

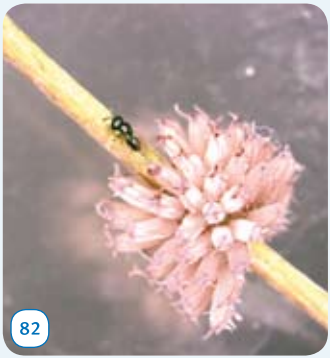
The leaf beetle egg parasitoid is the most significant insect natural enemy of *Paropsis atomaria* in the subtropics.

Identification

- Tiny black wasps that crawl over *P. atomaria* egg batches in plantations.
- On average this wasp parasitises almost one-third of all *P. atomaria* egg batches in plantations, and can parasitise up to 100 per cent of eggs within individual batches.

Insect hosts

- Female wasps lay single eggs into individual *P. atomaria* eggs.
- *Neopolycystus* sp. has been recorded parasitising other chrysomelid leaf beetle species.



Neopolycystus sp. wasp on egg batch of *P. atomaria*

Giant wood moth parasitoid

Virgulibracon endoxylaphagus

Identification

- Large black, white and pink wasp, body length up to 15 mm, with prominent long (up to 50 mm) ovipositor (egg laying tube).
- Most common giant wood moth (*Endoxyla cinereus*) parasitoid in the subtropics.
- Often observed on tree trunks after wood moth larvae have constructed exit holes (late-spring to early summer). Wasps rapidly touch the tree trunk with the tips of their antennae in order to locate the position of the host larva, and several wasps may compete aggressively for a single host (up to eight have been observed).
- The long ovipositor is used to drill through the bark and wood and lay eggs into a host's late-stage larvae or prepupae. This process takes around 20 minutes to complete.

Insect hosts

- Specific to *Endoxyla* spp. wood moths.
- Female wasps lay many eggs into a single giant wood moth larva. More than 100 wasps have been recorded emerging from a single wood moth host.
- Parasitism rates of between 10 per cent and 20 per cent have been observed.

Virgulibracon wasp on bark surface preparing to drill and lay eggs in host

Aulographina eucalypti

Identification

- Leaf spots 2–10 mm, mostly single, yellow-brown to dark-brown, often raised and corky, on upper and lower leaf surface but rarely penetrating through to the opposite side of the leaf; often occur along the midrib and will coalesce when there are many.
- Distinctive black fruiting bodies often observed within leaf spots.

Damage

- Damage occurs mostly on older, lower foliage and can cause defoliation, mainly of lower crown.

Host	Susceptibility	Occurrence
Eucalyptus cloeziana	Low	Common
E. dunnii	Low	Uncommon
E. grandis	Low	Uncommon
E. grandis hybrids	Low	Uncommon
E. nitens	Moderate	Common
E. pilularis	Moderate	Common
E. saligna	Moderate	Common

Target spot on *E. pilularis*

Target spot showing typical fruiting bodies

Pilidiella eucalyptorum
(=*Coniella fragariae*)

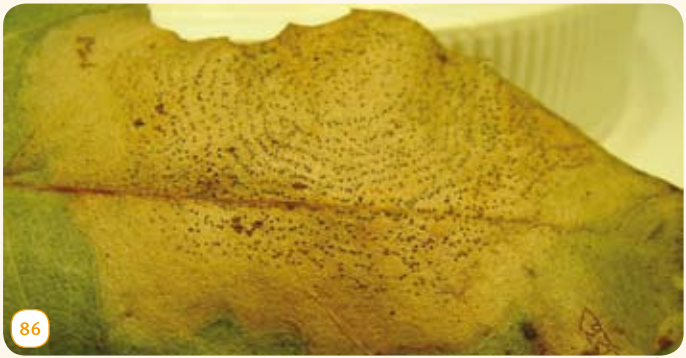
Identification

- Coniella causes large circular yellow-brown spots that begin on leaf margins and spread to form large blights, with many per leaf and often covering most or the entire leaf.
- Small black fruiting bodies are seen in concentric rings within spots and blights mostly on the upper leaf surface.

Damage

- Heavily infected leaves are prematurely shed.
- Coniella is more often observed on older, lower foliage.

Host	Susceptibility	Occurrence
Eucalyptus dunnii	High	Common
E. grandis	Low	Uncommon



Coniella leaf blight on *E. dunnii* (note concentric rings of fruiting bodies)

Microsphaeropsis sp.

Identification

- *Microsphaereopsis* causes small (<2 mm), corky-like, yellow-brown leaf spots, mainly on the lower surface of leaves (but also found on upper surface) scattered across the whole leaf. Leaf spots often coalesce to form larger spots, more commonly on leaf margins.

Damage

- Heavily infected leaves often turn purple on the upper surface.
- Mature leaves are more susceptible, often leading to premature leaf fall of the lower, inner canopy.

Host	Susceptibility	Occurrence
Eucalyptus grandis	High	Common
E. saligna	High	Common

Microsphaeropsis on *E. grandis*

Mycosphaerella cryptica

Identification

- Leaf spots can be single or coalesce when many; often causing leaves to crinkle.
- Small black fruiting bodies are often seen within leaf spots, aggregating on leaf veins, and often prominent on the underside of leaves.

Damage

- Mycosphaerella causes defoliation, mostly in the lower crown.
- On older leaves it is often observed with other leaf spot fungi (e.g. target spot).
- Symptoms vary on different hosts:
  - On *Eucalyptus nitens*: light to dark brown spots (10 mm diameter), mainly on lower, inner foliage
  - On *E. pilularis*: red-brown to dark brown irregular spots (10 mm diameter) on older leaves, and chlorotic (yellow) specks (<5 mm diameter) to red-brown irregular spots (10 mm diameter) on younger leaves
  - On *E. grandis*, *E. dunnii* and *E. saligna*: yellow-brown spots or blights.

Host	Susceptibility	Occurrence
Eucalyptus camaldulensis	High	Common
E. dunnii	Low	Common
E. grandis	Low	Uncommon
E. nitens	High	Common
E. pilularis	Moderate	Common
E. saligna	Moderate	Uncommon

Leaf spot of *M. cryptica* (note fruiting bodies on lower leaf surface)

M. cryptica on *E. pilularis*

M. cryptica on *E. saligna*

Defoliation of *E. globulus* in NSW caused by Mycosphaerella leaf disease

Mycosphaerella marksii

Identification

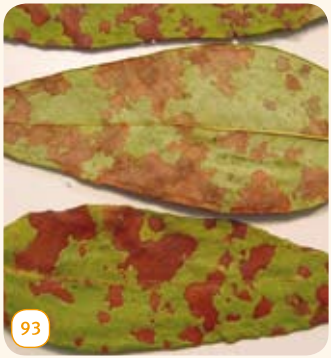
- Fruiting bodies are seen mainly on the upper leaf surface.

Damage

- Leaf spots affect mainly the older lower foliage, causing defoliation of the lower canopy.
- Symptoms vary on different hosts:
  - On *Eucalyptus pilularis*: leaf spots are red-brown, circular to irregular (12 mm diameter), often with an irregular, raised margin, and often coalescing.
  - On *E. grandis* & *E. dunnii*: leaf spots yellow-brown with raised red-brown border, mostly circular (12 mm diameter), and coalesce when many.

Host	Susceptibility	Occurrence
Eucalyptus dunnii	Low	Rare
E. grandis	Low	Rare
E. pilularis	Moderate	Common

M. marksii lesion on *E. pilularis*



M. marksii damage on *E. pilularis*

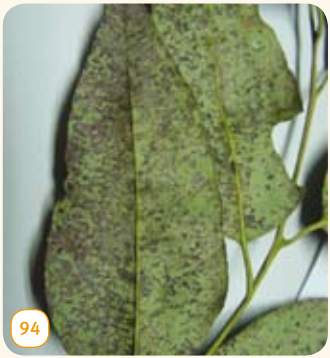
Kirramyces epicoccoides (=*Phaeophleospora epicoccoides*)

Identification

- Initially leaf spots appear as small (1 mm) angular purple spots, most obvious on the upper leaf surface, and can eventually cover much of the upper leaf. These can turn yellowish to yellowish brown on the lower surface, soon joining together into irregular, angular blotches delimited by leaf veins and gradually covering much of the leaf.
- Brown to black spores are often observed covering the lower surface of leaves (resembling charcoal). The purple discolouration and presence of black spores is often observed even when yellow-brown leaf spots are not obvious.

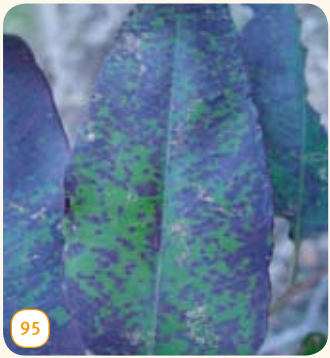
Damage

- Charcoal leaf disease is common on the lower and older leaves, but can occur throughout the tree crown in severe cases. Severe infection leads to defoliation.
- Defoliation of the lower crown is common, and can extend over much of the crown in severe cases, appearing to spread from the bottom-up. Such severe damage is often seen across the whole plantation, and damage can recur annually.
- Severe charcoal leaf disease occurs mainly (but not exclusively) in trees growing in low-lying areas and flats within the plantation.



K. epicoccoides on *E. grandis* (note masses of black spores on underside of leaf)

Host	Susceptibility	Occurrence
Eucalyptus grandis	Very high	Common
E. grandis hybrids	Very high	Common



Purpling on upper surface of *E. grandis* associated with *K. epicoccoides*

Lower crown defoliation of young tree

Kirramyces eucalypti
(=*Phaeophleospora eucalypti*)

Identification

- Leaf spots are circular to irregular, often <12 mm diameter, first signs are pale patches (often translucent) on young leaves which turn pale yellow, then carmine-red with a yellow halo, then eventually become necrotic (grey-brown on *E. nitens* and yellow-brown on *E. grandis* hybrids) often with carmine-red margins.
- Leaf spots can be single, often delimited by large veins, but may coalesce to cover the leaf.
- Black spore masses are often seen exuding onto the lower surface of young (yellow to purple) leaf spots. Small black fruiting bodies are often seen once leaf spots turn necrotic.
- Common in New South Wales.

Damage

- Severe infection, with much of the leaf surface infected, can result in premature leaf fall.

Host	Susceptibility	Occurrence
Eucalyptus grandis × *E. camaldulensis*	High	Common
E. nitens	High	Common
E. tereticornis	High	Common

K. eucalypti on *E. nitens* showing carmine-red spots with yellow halo

K. eucalypti on *E. grandis* hybrid showing yellow-brown spots

Severe damage and defoliation by *K. eucalypti* to *E. nitens*

Phaeothyriolum microthyrioides

Identification

- Leaf spots are circular, commonly 5–15 mm diameter, but can be larger, beginning as a chlorotic (yellow) spot before becoming purple. Leaf spot eventually turns brown then grey with age.
- Leaf spots occur on both surfaces of the leaf but rarely extend through to the opposite side of leaves.
- Black fruiting bodies form within leaf spots. Often these are seen before the spot turns purple.
- Common on *Corymbia* spp.; rare on *Eucalyptus* spp.

Damage

- Affects mature and old leaves but rarely causes defoliation.

Host	Susceptibility	Occurrence
Corymbia citriodora subsp. *variegata*	Low	Common
C. henryi	Low	Common
C. maculata	Low	Common

Purple leaf spot on *C. citriodora* subsp. *variegata*

Quambalaria pitereka
(=*Ramularia pitereka*)

Identification

- Quambalaria shoot blight is recognisable by the white powder-like fungal fruiting structures observed on the growing shoots and spotted on expanding leaves (like white paint).

Damage

- Quambalaria shoot blight infects the young growing shoots and tips of *Corymbia* species, causing spotting, necrosis and distortion of young expanding leaves and shoots, leading to shoot dieback.
- Heavily infected and damaged trees are often stunted and multi-branched. Trees can grow through the damage, but some may remain suppressed.

Host	Susceptibility	Occurrence
Corymbia citriodora subsp. *variegata*	High	Very common
C. henryi	High	Very common
Corymbia hybrids	Low	Uncommon
C. maculata	High	Very common
C. torelliana	Low	Uncommon

Q. pitereka on shoot of *C. citriodora* subsp. *variegata*
(note white fruiting structures)

Q. pitereka on leaf of *C. citriodora* subsp. *variegata*
(note white fruiting structures)

Shoot blight caused by *Q. pitereka*

Spotted gum leaf spot

Kirramyces corymbiae

Identification

- Leaf spots are yellow-brown to tan in colour, circular to irregular in shape, commonly 10 mm diameter, usually several to many spots per leaf.
- Can be on a few or many trees per plantation.

Damage

- Most common on fully expanded leaves and more common on trees greater than two years old.
- Rarely severe enough to cause defoliation.

Host	Susceptibility	Occurrence
Corymbia spp.	Low	Common (rarely damaging)

Leaf spot symptoms of *K. corymbiae* on spotted gum

Kirramyces viscidus
Kirramyces spp.

Identification

- Leaf spots initially pale-green turning yellow and almost translucent when held up to the light, becoming purple then necrotic. Necrosis often occurs before any appreciable purpling.
- Leaf spots can be small (<5 mm) to large blights and commonly cover much of the leaf.
- Black spore masses are visible on both surfaces of pale-green to yellow spots and necrotic blights; initially a small number of spore masses are observed, but these spread to cover much of the leaf spot or blight.
- Common in Queensland.

Damage

- Leaf necrosis causes leaves to distort and buckle, often severely.
- Infection often begins on immature leaves, and is observed over much of the tree crown.
- Results in severe defoliation.

Host	Susceptibility	Occurrence
Eucalyptus grandis × *E. camaldulensis*	Very high	Very common
E. grandis hybrids	Very high	Very common

Yellow leaf spots of *Kirramyces* leaf blight on *E. grandis* hybrid

Typical yellow leaf spots becoming purple then necrotic, showing leaf distortion, on *E. grandis* hybrid

Severe necrosis and buckling of *E. grandis* hybrid leaf, showing black spore masses

Quambalaria eucalypti
(=*Ramularia eucalypti*)

Identification and damage

- Quambalaria leaf spot is associated with small (<5 mm) circular to irregular spots on leaves of several *Eucalyptus* species, and can infect wounds caused by insect feeding e.g. chewing from eucalyptus weevils (see page 27) and flea beetles (see page 29).
- White fruiting structures are often observed, commonly on the lower surface of leaf spots or associated with the feeding damage of insects.
- Quambalaria leaf spot (on *Eucalyptus*) can be confused with *Q. pitereka* (on *Corymbia*); however, their hosts distinguish them, and *Q. eucalypti* is not associated with shoot blight.

Damage

- Often only a few leaves per tree affected.
- Rarely seen on green stems.

Q. eucalypti infecting insect damage on *E. dunnii*

Host	Susceptibility	Occurrence
Eucalyptus dunnii	Low	Uncommon
E. grandis	Low	Uncommon
E. longirostrata	Low	Uncommon

Small leaf spots caused by *Q. eucalypti* on *E. dunnii*, showing white conidiophores

Cytospora canker

Cytospora eucalypticola

Identification

- Cytospora canker is observed as dead and dying patches, often on stems of trees, but also on branches. These often appear as small (less than 50 mm diameter), red-brown patches, but can become larger.
- Small fruiting structures are often observed within the canker. These develop just beneath the surface, and break through, splitting the bark surface. These fruiting structures appear as black to grey and sometimes white dots.

Damage

- The bark at the canker site eventually cracks and splits, but the damage is often superficial, only affecting the outer bark. Often one tree can have multiple cankers.
- Cankers caused by *Cytospora eucalypti* are often associated with stressed trees. It is more common on older trees, and rarely causes significant damage to the tree.

Host	Susceptibility	Occurrence
Corymbia spp.	Low (stressed trees)	Uncommon
Eucalyptus spp.	Low (stressed trees)	Uncommon

Cankers (circled) on stem of mature *E. saligna*

Fruiting bodies of *Cytospora* erupting through bark within canker

Caliciopsis pleomorpha

Identification

- Small (‹50 mm diameter) localised cankers on branches or small stems; can be confused as hail damage; small cankers often occlude over.
- Commonly seen in trees under stress, such as that from defoliating insects and fungi.
- Severe cankers resulting in tree death have only been seen in *Eucalyptus nitens* on the Dorrigo Plateau.

Damage

- In severe cases larger cankers develop (100–200+ mm long) on branches and stems and can kill the branch; multiple severe cankers can result in tree mortality.

Small canker on branch of *E. grandis* (note occlusion)

Host	Susceptibility	Occurrence
Corymbia citriodora subsp. *variegata*	Low	Common
C. maculata	Low	Common
Eucalyptus dunnii	Low	Common
E. grandis	Low	Common
E. grandis × *E. camaldulensis*	Low	Common
E. nitens	Very high	Rare

Large canker on branch of *E. nitens*

Fruiting bodies (under magnification)

Holocryphia eucalypti
(=*Endothia gyrosa*)

Identification

- Symptoms of *Endothia* canker are dead and dying patches on stems or branches. These can be small (<1 m) to large (>4 m). The bark at the canker site is commonly, but not always, cracked and split, with some kino exudation.
- Small orange and black fruiting structures are often seen within cankers and on bark associated with cankers.
- Cankers caused by *H. eucalypti* are often associated with tree stress, such as that caused by defoliating insects or fungi or damaged by wind storms.

Damage

- The cambium and sapwood under the canker eventually die. This can lead to death of the branch above the canker or of the whole tree or branch. However, often trees recover, with the canker sealing over with subsequent tree growth.

Large *Endothia* canker on *E. dunnii*, associated with wind damage (note dead inner cambium and occlusion)

Host	Susceptibility	Occurrence
Eucalyptus dunnii	Low (stressed trees)	Uncommon
E. nitens	Low (stressed trees)	Uncommon
E. pilularis	Low (stressed trees)	Rare

Orange fruiting structures on bark within canker

Botryopshaeria spp.
(=*Neofusicoccum* spp.;
Fusicocum spp.)

Identification

- *Botryosphaeria* is a stress-related pathogen. Common stress factors include drought, severe defoliation by insects or fungi and physical damage to the tree (e.g. from cattle).
- Infection by *Botryosphaeria* can occur in twigs, branches, or anywhere along the tree bole including the root bole. As drought is a common stress factor, affected trees tend to be on ridge tops or on poorer sites.
- Cambial staining is evident under the bark if the affected area is cut by a knife.
- Small black fruiting bodies are also seen on the affected (dead) part of the tree.

Damage

- Infection commonly results in death of the particular part of the tree affected, resulting in twig or branch death, top death or tree mortality.

Cracking and cambial staining at base of *E. dunnii* following drought stress

Host	Susceptibility	Occurrence
Corymbia spp.	Moderate	Uncommon
Eucalyptus cloeziana	Moderate	Uncommon
E. dunnii	Moderate	Uncommon
E. pilularis	Moderate	Uncommon

Canker on twig caused by *Botryosphaeria* sp.

Twig dieback caused by *Botryosphaeria* cankers on *E. pilularis* on hill-top

Armillaria luteobubalina

Identification

- *Armillaria* invades trees via roots and girdles the tree.
- White 'sheets' of fungal mycelium grow under the bark at the base of trees and in roots.
- *Armillaria* infects via root-to-root contact and requires a woody food base (e.g. old stumps) from which to spread. The fungus does not spread far from the initial source.
- Dense clusters of yellow-brown mushrooms (fruiting bodies of *Armillaria*) may grow at the base of diseased trees during autumn-winter.

Damage

- Death occurs very suddenly; the leaves wilt then turn brown but stay on the tree. Often cracks in the bark are observed at the base of dead trees.

E. nitens killed by *Armillaria* sp.

Host	Susceptibility	Occurrence
Eucalyptus cloeziana	High	Isolated
E. nitens	High	Isolated

Bark cracking at base associated with *Armillaria* infection

White mycelium at base of infected tree

Phytophthora root rot

Phytophthora cinnamomi

Identification

- Phytophthora root rot is a soil-borne pathogen that attacks the root system. Spores travel through wet soil, infecting rootlets.
- A characteristic staining of the cambium is often seen if the base of affected trees are dissected with a knife (however, *Phytophthora* is not the exclusive cause of this symptom).
- The fungus needs wet soil to travel and infect, hence, the problem is often more common in gullies and low-lying areas. Warm summer rains are ideal conditions for *Phytophthora* infection and spread.
- Identification needs to be confirmed in the laboratory.

Damage

- This fungus causes root death and leads to tree mortality. Often death is sudden; the leaves wilt then turn brown but stay on the tree.

Staining of cambium of infected stem

Host	Susceptibility	Occurrence
Eucalyptus cloeziana	High	Isolated
E. pilularis	High	Isolated

Young *E. pilularis* killed by *Phytophthora*

Affected area	Symptoms	Deficiency
Symptoms appear first or are more prevalent on mature leaves	Even leaf discoloration	Nitrogen (N)
		Phosphorus (P)
	Patterns of leaf discolouration	Magnesium (Mg)
		Potassium (K)
Symptoms appear first or more prevalent on expanding leaves	Reduced growth or dieback of the shoot apex	Boron (B)
		Calcium (Ca)
	No dieback of the shoot apex	
		Copper (Cu)
		Sulphur (S)
		Iron (Fe)
		Manganese (Mn)
		Zinc (Zn)

Symptoms	Image number(s)
Leaves pale green to yellow	125
Leaves green with reddish blotches or uniformly purple to red	126–127
Distinct interveinal chlorosis often bright yellow in appearance	128
Leaves with marginal burns or necrosis and often extending into interveinal regions as symptoms develop	125, 129–131
Enlarged nodal regions; slowing growth and often death of the apical shoot; proliferation and often death of lateral shoots; interveinal crinkling of younger leaves (often starting with the third youngest leaf); leaves with corky abaxial veins or malformed with incomplete margins	132–135
Nodes normal, death of the apical shoot, leaves buckled due to impaired marginal growth, leaf expansion often stunted	136
Leaves normal size	
‘S’ shaped stem growth, leaves with irregular or undulate margins, some interveinal chlorosis	137
Leaves pale green to yellow	138
Interveinal chlorosis with sharp borders to green veins	139
Leaves with marginal or mottled chlorosis, small necrotic bleached or brown spots may appear	140
Leaves small and crowded, developing an interveinal chlorosis with hazy borders to green veins	141

Macronutrient deficiency in *Eucalyptus grandis*, left to right—healthy, K deficiency, N deficiency (note with N deficiency, general light green colour of younger and mature leaves; old leaves are chlorotic and abscised)

P deficient *E. nitens* (note anthocyanin development—purpling—of leaves and necrotic blotches)

P deficient *E. pellita* (note anthocyanin development—purpling—of leaves and necrotic blotches)

Mg deficiency in *E. grandis* × *E. urophylla* foliage (note bright yellow interveinal chlorosis of mature leaves, younger leaves green)

K deficiency in *Corymbia citriodora* subsp. *variegata* (note symptoms of marginal necrosis initially on the mature leaves)

K deficiency in *C. citriodora* subsp. *variegata* (note mild symptoms of marginal necrosis initially on the mature leaves)

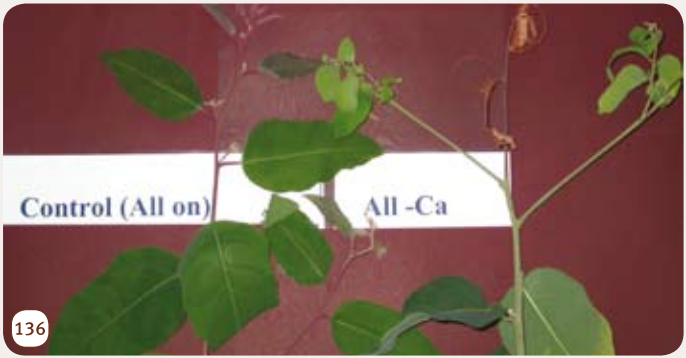
K deficiency in *C. citriodora* subsp. *variegata* (note symptoms of marginal purpling which develop into necrosis initially on the older leaves)

B deficiency of *C. citriodora* subsp. *variegata* (note loss of apical dominance leading to ramicorn formation)

B deficiency of *E. cloeziana* (note loss of apical dominance)

B deficiency of *E. nitens* (note loss of apical dominance)

B deficient *C. citriodora* subsp. *variegata* (note loss of apical dominance leading to poor form and interveinal crinkling of younger leaves)



Ca deficient *C. torelliana* × *C. citriodora* subsp. *variegata* hybrid (note reduced expansion of younger leaves, death of shoot apex and subsequent death of apical bud of auxiliary shoots)

Cu deficient *E. globulus* (note twisting of leaves)

S deficient *E. globulus* (note general chlorosis of younger leaves)

Fe deficient *E. cloeziana* (note interveinal chlorosis of younger leaves with sharp margins between veinal and interveinal regions)

Mn deficiency in *E. globulus* (note chlorosis starting from the margins and extending in towards the midvein in the interveinal regions of expanding and younger leaves)

Zn deficiency *E. cloeziana* (note hazy margins between green veinal regions and interveinal regions on younger leaves)

Eucalypt rust

Puccinia psidii

Identification

- Attacks foliage, inflorescences and succulent twigs of young *Eucalyptus*.
- First symptoms appear as small chlorotic spots which, after a few days, change to small raised pustules producing masses of yellow spores.
- Infected areas are initially circular spots but coalesce as severity increases.

Damage

- Infected leaves and shoots become deformed and eventually shrivel.

Host	Susceptibility
Corymbia citriodora subsp. *variegata*	Low–moderate
C. maculata	Unknown
Eucalyptus grandis × *E. camaldulensis*	Unknown
E. cloeziana	High
E. dunnii	Moderate
E. grandis	High
E. pilularis	Low–moderate

Early symptoms on a eucalypt leaf infected with *P. psidii*

Shoot wilting and malformation on a eucalypt from repeated infection by *P. psidii*

Gypsy moth

Lymantria dispar dispar

Identification

- There are two biotypes of the gypsy moth: the Asian gypsy moth and the European gypsy moth. Both are similar in appearance, however, the female European gypsy moth cannot fly.
- Egg masses contain between 100 and 1000 eggs and are covered with duff or yellowish coloured scales from the female moth.
- Larvae grow up to 70 mm in length, are dark, hairy and have a double row of dots along the back, five pairs of blue and six pairs of red.
- Female moths are large and distinctive, with wavy dark-coloured bands across the forewings while males are brown with dark brown patterns on their wings.

Damage

- Damage from early instar larvae appears as small holes in the leaf. As the larvae grow the holes become larger and feeding will occur along the leaf margin. In the final instar stage the larvae will consume the entire leaf.

Host range

- Gypsy moth is known to complete development on more than 650 species of plants, including many forest, orchard and ornamental trees such as species of *Eucalyptus* and *Pinus*.

Gypsy moth egg masses on tree trunk

Late stage gypsy moth larva

Female (left) and male (right) gypsy moth adults

Coniothyrium canker

Kirramyces zuluensis

Identification and damage

- This canker is a serious stem pathogen of *Eucalyptus* and currently is not known to be present in Australia.
- Early symptoms of infestation are small discrete, black or dark brown lesions ('measle spots') on young green bark, usually at the tops of trees.
- On susceptible trees, these lesions coalesce to form large necrotic cankers along the stems from which copious amounts of red kino exude.
- Cankers penetrate into the sapwood, with kino pockets evident if the bark is peeled back.
- Epicormic shoots are commonly produced in the cankered areas, indicative of partial girdling of the stems. The tops of severely affected trees tend to die.

Host range

- The pathogen has been isolated on various *Eucalyptus* species, clones and hybrids in Asia (Thailand, Vietnam); Africa (Ethiopia, South Africa, Uganda); North America (Mexico, USA and Hawaii) and South America (Argentina).

Coniothyrium canker lesions on the stem of a young eucalypt

Coniothyrium canker lesions on a eucalypt stem

Kino pocket under bark

South American carpenter worm (*Chilecomadia valdiviana*)
South African cossid goat moth (*Coryphodema tristis*)

Identification and damage

- These two species have recently expanded their host ranges to include *Eucalyptus* spp. Larvae of both species bore large galleries into the heartwood of tree trunks.

C. valdiviana

- Larvae are large stout grubs with a dark head and pale creamy coloured body.
- Larvae form multiple galleries which can cause stem breakage in strong winds and introduce fungal rot and staining.

C. tristis

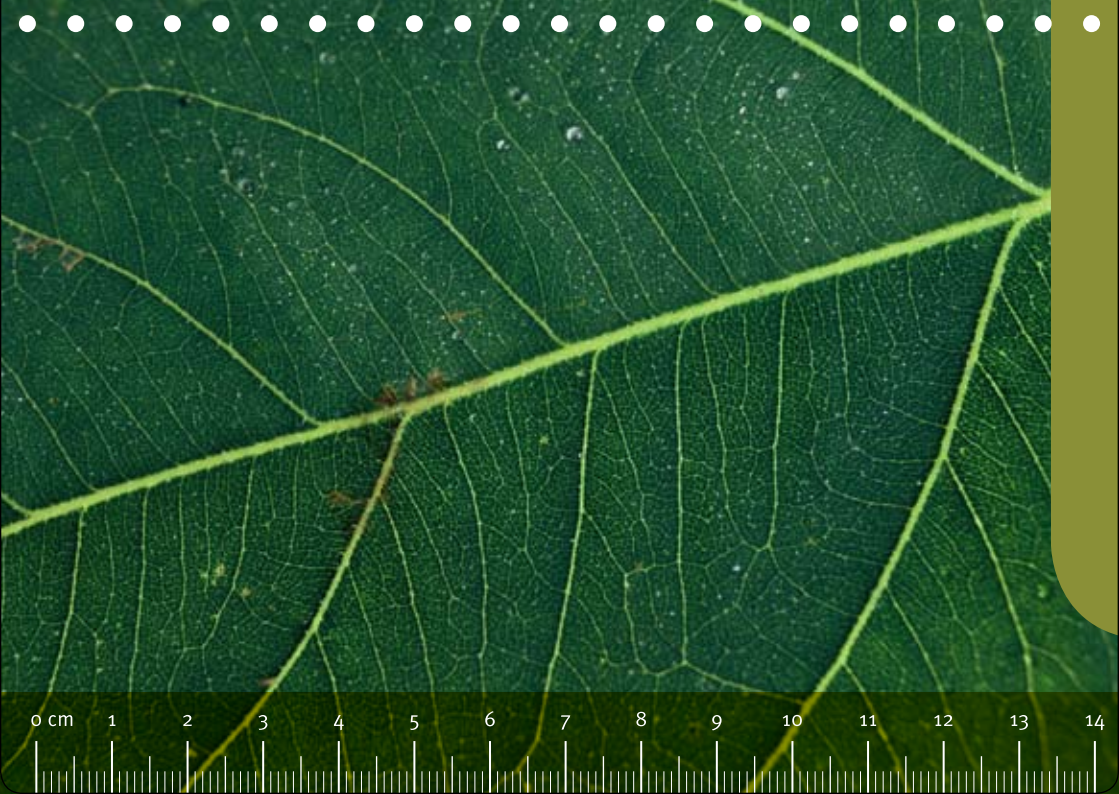
- Larvae are large, stout and up to 60 mm in length, are light yellow in colour with reddish blotches and a dark brown head.
- Larvae feed gregariously and form numerous galleries in infested stems.

Host range

- *C. valdiviana* has been recorded on *E. nitens* and occasionally on *E. gunnii*, *E. camaldulensis* and *E. delegatensis* in Chile.
- *C. tristis* has so far only been recorded on *E. nitens* in South Africa.

C. tristis external symptoms of attack on *E. nitens*
(note coarse white frass and resin dribbles on the bark)

Gregarious larval feeding of *C. tristis* in the heartwood of *E. nitens*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