

Avocado information kit

Reprint – information current in 2001



REPRINT INFORMATION – PLEASE READ!

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

This publication has been reprinted as a digital book without any changes to the content published in 2001. We advise readers to take particular note of the areas most likely to be out-of-date and so requiring further research:

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- Financial information—costs and returns listed in this publication are out of date.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

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

This publication was last revised in 2001. The information is not current and the accuracy of the information cannot be guaranteed by the State of Queensland.

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

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



Problem SOLVER

Every crop will have a problem or two. The key to dealing with problems is prompt identification and, where appropriate, prompt treatment. This section helps you with these decisions. The common problems are shown in a series of pictures grouped according to the main symptom. From the contents, find the symptom that best fits your problem. There you will find photos of the causes and the solutions, if there is one.

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Spots or marks on leaves

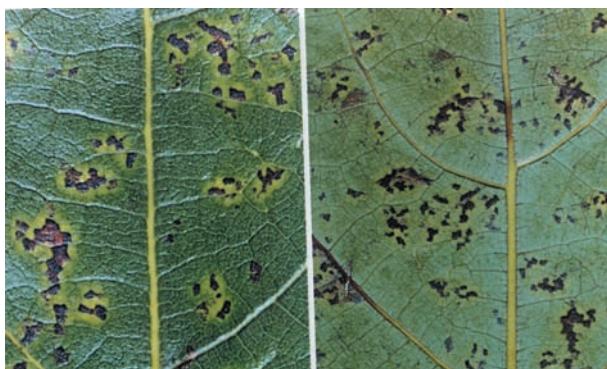


Anthracnose disease

Cause: The fungus *Colletotrichum gloeosporioides*.

Identification: Spots are large and tan-coloured with dark brown margins. Pinkish spore masses may form on the spots under humid conditions. Leaf spots are extremely rare and generally form only after prolonged wet or humid weather. More commonly affects fruit, where it is a major problem (see pages 20, 36 and 38).

Treatment/prevention: The leaf spot symptom is generally not serious enough to warrant treatment or preventative measures. However, prevention against the fruit rot symptom requires regular spraying and orchard hygiene (see page 20).



Cercospora leaf spot disease

Cause: The fungus *Pseudocercospora purpurea*.

Identification: Spots are small, angular, light brown and frequently surrounded by a yellow halo. Greyish fruiting bodies of the fungus are clearly visible on the undersides of the spots (right). Occurs in North Queensland only. Also affects fruit (see page 20).

Treatment/prevention: Generally well controlled by the fungicide spray program applied for anthracnose, provided good spray coverage is maintained.



Algal leaf spot

Cause: Unidentified algae species.

Identification: Spots are whitish to pale yellow and are most common on the upper leaf surfaces. Favoured by prolonged moist conditions. Under these conditions, the alga may cover the whole leaf.

Treatment/prevention: Generally well controlled by the fungicide spray program applied for anthracnose, provided good spray coverage is maintained.



Latania scale

Cause: The scale insect *Hemiberlesia lataniae*.

Identification: Scales are small (1 to 1.3 mm across) and creamy-brown. They are most common along the veins on the undersides of leaves. Also infests twigs and fruit (see pages 17 and 23).

Treatment/prevention: First check that the infestation is serious enough to warrant treatment. Scales need to be obvious and numerous on leaves and twigs to justify treatment. Where required, spray with an appropriate oil spray from the *Problem Solver Handy Guide*. Avoid spraying during hot weather. Avoid continuous use of insecticide sprays that are disruptive to beneficial insects. Regularly monitor the orchard so that action can be taken before scales build up to the point of infesting fruit.

Spots or marks on leaves



Avocado leafroller egg masses

Cause: The insect *Homona spargotis*.

Identification: The egg masses are pale yellow, elongated and felty. Eggs are laid in an overlapping pattern like fish scales on the upper surface of mature leaves. Occurs in North Queensland only. The caterpillars may damage leaves and fruit (see pages 14 and 26).

Treatment/prevention: The presence of egg masses alone does not require treatment. However, they indicate a possible emerging problem if and when the eggs hatch. Regularly monitor the orchard for early signs of leaf and fruit damage and spray as required. Use an appropriate chemical from the *Problem Solver Handy Guide*.



Swarming leaf beetle (*Rhyparida*) damage

Cause: The insects *Rhyparida* spp.

Identification: Feeding damage consists of brown, lace-like areas on the leaves. When severe, affected leaves appear scorched. Adult beetles are shown in the photo (actual size about 5 mm long). Mainly a problem in wetter areas of North Queensland.

Treatment/prevention: Where leaf damage is significant, spray with an appropriate chemical from the *Problem Solver Handy Guide*. Regularly monitor the orchard, particularly in spring, so that treatments can be applied before major damage occurs.



Spray damage

Cause: Either a foliar spray of phosphonate fungicide applied too soon after a spray of dimethoate; mixing of phosphonate fungicide with copper, particularly copper hydroxide; or oil sprays applied in very hot weather (temperatures above 28°C).

Identification: There is a range of leaf symptoms but the most common is small yellow spots (left), with some spots falling out to produce a shot-hole effect (see page 15).

Treatment/prevention: Do not apply phosphonate fungicide sprays within 10 days of a dimethoate spray. Do not mix phosphonate fungicide with copper, particularly copper hydroxide. Do not apply oil sprays during periods of hot weather.

Potassium deficiency

Cause: Insufficient potassium available to the tree. Generally caused by an imbalance of potassium, calcium and magnesium in the soil.

Identification: Yellowing begins at the margin of the leaf and spreads towards the veins. Brown spots develop within affected areas. Also see symptom on page 10.

Treatment/prevention: Get a leaf analysis done to confirm the diagnosis. Adjust the fertiliser program according to the leaf analysis results. In future, do regular leaf and soil analyses to monitor nutrient levels. Apply appropriate amounts of potassium fertiliser throughout the growing season.



Spots or marks on leaves



Manganese toxicity

Cause: High uptake of manganese from the soil. Occurs in soils with high manganese levels of 40 ppm and above when pH falls below 6.5 (1:5 water test). The problem is exacerbated by waterlogging and over-use of ammonium-type fertilisers.

Identification: Affected leaves show an uneven yellowing between the veins with many small dark spots. Some tip burn may also be evident. Most common on summer leaf growth.

Treatment/prevention: Get a soil analysis done to confirm the diagnosis. Apply lime or dolomite to raise soil pH to 6.5 (1:5 water test). Where possible, improve soil drainage. In future, do regular leaf and soil analyses to monitor nutrient levels.



Boron toxicity

Cause: High uptake of boron from the soil. Can be caused by uneven application of boron to the soil or excessive rates, particularly in light sandy soils.

Identification: Affected leaves have a burnt margin with a clearly defined edge. Inside the burnt area, pale yellow areas develop in which a myriad of tiny dark spots form. In severe cases, affected leaves may fall.

Treatment/prevention: Calculate boron rates carefully, using either the AVOMAN software or advice from a qualified agronomist. Apply boron evenly, particularly on sandy soils. This is best achieved by spraying it on the ground or applying it by fertigation. Do regular leaf and soil analyses to monitor nutrient levels and determine appropriate rates of application.

Yellow leaves



Phytophthora root rot disease

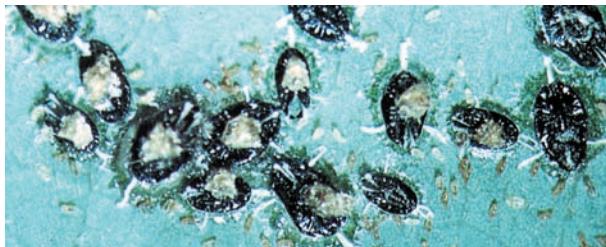
Cause: The fungus *Phytophthora cinnamomi*.

Identification: Upper: overall view of affected trees. Lower: close-up of an affected tree showing the pale yellow leaves. There is nothing highly distinctive about the yellowing caused by this disease, but it is generally associated with some leaf wilting and leaf fall. In more severe cases, shoots die back from the tips. See other symptoms on pages 16, 17, 19, 41, 43 and 44.

Treatment/prevention: Use an integrated disease management program of both chemical and cultural measures. Inject or spray affected trees with a registered phosphonate product from the *Problem Solver Handy Guide*. Use the spray option only on healthy or mildly affected trees. Follow label directions and the instructions in *Growing the Crop*. Maintain a deep layer of mulch or compost under the trees. Manage irrigation carefully to keep soil moist, but not over-wet. Regularly check drains to ensure there is no ponding of water within the orchard. Maintain soil pH at about 5.0 to 5.5 (1:5 water test) and use regular leaf and soil analyses to ensure nutrient levels are adequate at all times. In future plantings, ensure there is adequate drainage, use disease-tolerant rootstocks and buy trees from accredited nurseries.

Note: Symptoms similar to Phytophthora root rot can also be caused by wood rot fungus (see *Managing root rot* in Key

Yellow leaves



Sunblotch viroid disease

Cause: Avocado sunblotch viroid.

Identification: Affected leaves have a marked white or yellow mottle or variegation. Upper: typical field symptom. Lower: close-up of a range of affected leaves. Also affects branches and fruit (see pages 18, 21, 31 and 43).

Treatment/prevention: There is no treatment for affected trees. They must be destroyed to avoid transmission to healthy trees. Select budwood and rootstock seed only from viroid-tested trees. Plant trees propagated from viroid-tested material at least 15 m from untested trees to avoid transmission from natural root grafting. Reserve a special set of pruning, injecting and harvesting implements for these viroid-free trees to avoid transmission through sap. Alternatively, disinfect cutting tools thoroughly with a solution of 1.5% sodium hypochlorite before using on viroid-free trees.

Whitefly damage

Cause: A whitefly from the family Aleyrodidae.

Identification: Affected leaves show patchy interveinal yellowing corresponding to whitefly feeding activity on the undersides of the leaves. Affected leaves may also be distorted. Upper: typical symptoms—underside of leaf at left showing the small whiteflies. Lower: close-up of the pupal stage of whiteflies (actual size about 2 to 3 mm long).

Treatment/prevention: Usually not serious enough to warrant treatment. Generally well controlled by beneficial insects. Avoid continuous use of insecticide sprays that are disruptive to beneficial insects.

Magnesium deficiency

Cause: Insufficient magnesium available to the tree. Generally associated with an imbalance of calcium, magnesium and potassium in the soil.

Identification: Yellowing progresses inwards from the leaf margins and tips towards the main veins, leaving a band of dark green along the main veins. Always appears on older leaves. Most common in acid sandy soils.

Treatment/prevention: Get a leaf and soil analysis done to check soil pH and magnesium levels. Apply dolomite or magnesium oxide (choice depends on pH level). In future, do regular leaf and soil analyses to monitor soil pH and nutrient levels.

Yellow leaves



Nitrogen deficiency

Cause: Insufficient nitrogen available to the tree.

Identification: The older leaves are generally affected, becoming small narrow and pale green, and often rolled slightly inwards.

Treatment/prevention: Get a leaf analysis done to confirm the diagnosis. Adjust the fertiliser program according to the leaf analysis results. In future, do regular leaf and soil analyses to monitor nutrient levels and apply appropriate amounts of nitrogen fertiliser throughout the growing season.



Zinc deficiency

Cause: Insufficient zinc available to the tree. Generally exacerbated by high soil pH or high levels of soil phosphorus.

Identification: Affected leaves show uneven blotchy yellowing between the veins. With a very mild deficiency, leaf size is only marginally reduced and leaf distortion is minimal (upper photo). A more severe deficiency produces significant leaf distortion and reduction in size, accompanied by the yellowing (lower photo). With a very severe deficiency, the youngest leaves at the end of shoots become yellow, very small and distorted (see symptom on page 13). Also affects fruit (see page 31).

Treatment/prevention: Get a leaf analysis done to confirm the diagnosis. Apply zinc to the ground under the tree in a band around the dripline. In future, do regular leaf and soil analyses to monitor nutrient levels.



Manganese deficiency

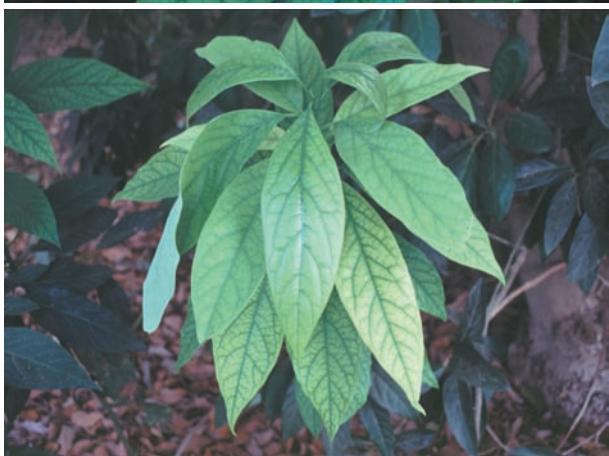
Cause: Insufficient manganese available to the tree. Generally only a problem in coarse sandy soils or where too much liming material has been applied.

Identification: Affected leaves are slightly pale green with most of the colour loss between the veins.

Treatment/prevention: Get a leaf analysis done to confirm the diagnosis. Except for sandy soils, treatment is generally not necessary as affected leaves normally grow out of the problem. Where necessary, apply manganese sulphate to the soil. In future, do regular leaf and soil analyses to monitor nutrient levels. Calculate liming rates carefully to avoid over-liming.



Yellow leaves



Iron deficiency

Cause: Insufficient iron available to the tree. Generally only a problem in highly alkaline soils ($\text{pH} > 7.5$), in the presence of high soil manganese levels, or where excessive amounts of liming materials and/or phosphorus fertiliser have been applied.

Identification: Upper: affected leaves are an overall yellow or white colour with the veins remaining green. Lower: generally occurs on the young leaves of the summer flush while the leaves of the spring flush remain green.

Treatment/prevention: Apply a collar drench of iron chelate. In future, do regular soil analysis to monitor nutrient levels. If soil manganese levels are high and pH is low, adjust pH to a level of 6.5 to 7.0 (1:5 water test). To avoid over-liming, calculate lime or dolomite rates carefully in accordance with soil analysis results. Do not apply more than 2 t/ha in any one application.



Boron deficiency

Cause: Insufficient boron available to the tree.

Identification: Affected trees are yellow and stunted—compare affected tree in the foreground with the healthy trees in the background. Yellowing is generally associated with leaf distortion and holes in leaves (see symptoms on pages 13 and 15). Also affects the trunk, branches, flowers and fruit (see pages 19, 20, 30 and 40).

Treatment/prevention: Get leaf and soil analyses done to confirm the diagnosis. Apply borax or Solubor to the ground under the trees at rates determined by either the AVOMAN software or a qualified agronomist. Apply evenly to avoid toxicity. The best method is to mix the required amount in water and spray it on the ground. In future, do regular leaf and soil analyses to monitor nutrient levels.

Manganese toxicity

Cause: High uptake of manganese from the soil. Occurs in soils with high manganese levels of 40 ppm or higher when pH falls below 6.5 (1:5 water test). Exacerbated by waterlogging and over-use of ammonium-type fertilisers.

Identification: Affected leaves show an uneven yellowing between the veins with many small dark spots. Some tip burn may also be evident. Most common on summer leaf growth.

Treatment/prevention: Get a soil analysis done to confirm the diagnosis. Apply lime or dolomite to raise soil pH to 6.5 (1:5 water test). Where possible, improve soil drainage. In future, do regular leaf and soil analyses to monitor nutrient levels.

Yellow leaves



Herbicide damage

Cause: Root uptake of soil-applied persistent herbicides such as diuron.

Identification: Leaves show irregular yellow blotches. The distribution of yellow leaves on the tree is also uneven.

Treatment/prevention: Mild symptoms will often disappear in time. In future, do not plant avocados in sites recently exposed to persistent herbicides. Avoid using persistent pre-emergent herbicides in and around trees.



Phosphonate damage

Cause: Injection of excessively high doses of phosphonate fungicide or failure of the chemical to disperse properly through the tree (generally a result of injecting during cool weather).

Identification: Causes yellowing between the veins similar to zinc deficiency. Phosphonate damage is generally isolated to some trees only or some parts of the tree, compared to the more general distribution of zinc deficiency. May also cause bronzing of leaves similar to herbicide damage on page 11.

Treatment/prevention: Mild symptoms disappear in time. In future, ensure dosages are correctly calculated. To ensure even dispersion throughout the tree, inject only when temperatures are above 23°C. Use of phosphonate products buffered to pH 7.2 will reduce the incidence of damage.



Spray damage

Cause: Either a foliar spray of phosphonate fungicide applied too soon after a spray of dimethoate; mixing of phosphonate fungicide with copper, particularly copper hydroxide; or oil sprays applied in very hot weather (temperatures above 28°C).

Identification: There is a range of leaf symptoms but the most common is small yellow spots (left), with some spots falling out to produce a shot-hole effect.

Treatment/prevention: Do not apply phosphonate fungicide sprays within 10 days of a dimethoate spray. Do not mix phosphonate fungicide with copper, particularly copper hydroxide. Do not apply oil sprays during periods of hot weather.

Dead leaves



Verticillium wilt disease

Cause: The fungus *Verticillium dahliae*.

Identification: On older trees, generally only one part of the tree is affected. Dead leaves remain attached to the tree. Right: brown discolouration of water-conducting tissues in a branch.

Treatment/prevention: No immediate treatment is required as older trees generally recover. Remove dead branches once the dieback has ceased. Avoid planting avocados in land that has previously grown *Verticillium*-susceptible crops such as tomatoes for long periods. Avoid using mulch from *Verticillium*-susceptible crops, for example peanut husks.

Dead leaves



Severe Monolepta beetle damage

Cause: The insect *Monolepta australis*.

Identification: The beetles feed on the surface layers of the leaves, giving them a scorched appearance. Inset: adult beetles (actual size about 4 mm long). Also affects fruit (see page 21).

Treatment/prevention: Where insect activity is significant, spray with an appropriate chemical from the *Problem Solver Handy Guide*. Regularly monitor the orchard, particularly after rain in spring, so that treatments can be applied before major damage occurs.

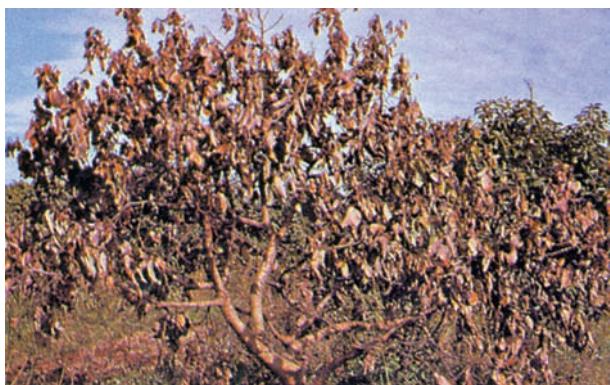


Severe avocado leafroller damage

Cause: The insect *Homona spargotis*.

Identification: Feeding of the caterpillars webs leaves together and causes them to turn brown. Heavy infestation may defoliate trees. Occurs in North Queensland only. May also damage fruit (see symptoms on page 26). Severe looper caterpillar damage may produce similar symptoms (see page 14 for details).

Treatment/prevention: Spray with an appropriate chemical from the *Problem Solver Handy Guide*. Follow label directions. Regularly monitor the orchard for early signs of leaf and fruit damage and spray as required.



Waterlogging

Cause: Heavy rain generally in association with root damage from the fungus *Phytophthora cinnamomi*.

Identification: All or most of the leaves on the tree turn brown rapidly and remain attached to the tree.

Treatment/prevention: There is no treatment for affected trees, which generally die. In future, plant avocados in soils that drain freely after heavy rain, and mound rows. Maintain the integrated program against root rot disease as recommended on page 4.



Frost damage

Cause: Temperatures below about -5°C.

Identification: Typical leaf damage. Not all of the leaf is always affected. Also see symptom on page 42.

Treatment/prevention: Avoid planting avocados in sites subject to extreme cold temperatures.

Leaves with brown margins or tips



Salt damage

Cause: Irrigation with salty water or over-use of fertilisers containing high levels of chloride, particularly chicken manure and muriate of potash. The problem is exacerbated where trees are severely affected by root rot as the affected roots cannot control salt uptake.

Identification: The marginal burn is generally fairly even and extends in towards the veins.

Treatment/prevention: Do not apply fertiliser until the problem has been investigated. Get analyses done on soil, leaf tissue and irrigation water. Check the rates of fertiliser being applied. Switch to fertilisers containing lower levels of chloride. Water heavily to leach the salt out of the root zone. If water analysis confirms salty water, use another water source. Get a water analysis done before each season. Control root rot disease.



Monolepta beetle damage

Cause: The insect *Monolepta australis*.

Identification: The beetles feed on the surface layers of the leaves, giving them a scorched appearance. Inset: adult beetles (actual size about 4 mm long). Also affects fruit (see page 21).

Treatment/prevention: Where insect activity is significant, spray with an appropriate chemical from the *Problem Solver Handy Guide*. Regularly monitor the orchard, particularly after rain in spring, so that treatments can be applied before major damage occurs.



Boron toxicity

Cause: High uptake of boron from the soil. Can be caused by uneven application of boron to the soil or excessive rates, particularly in light sandy soils.

Identification: Affected leaves have a burnt margin with a clearly defined edge. Inside the burnt area, pale yellow areas develop in which a myriad of tiny dark spots form.

Treatment/prevention: Calculate boron rates carefully using either the AVOMAN software or advice from a qualified agronomist. Apply boron evenly, particularly on sandy soils. This is best achieved by spraying it on the ground or applying it by fertigation. Do regular leaf and soil analyses to monitor nutrient levels.



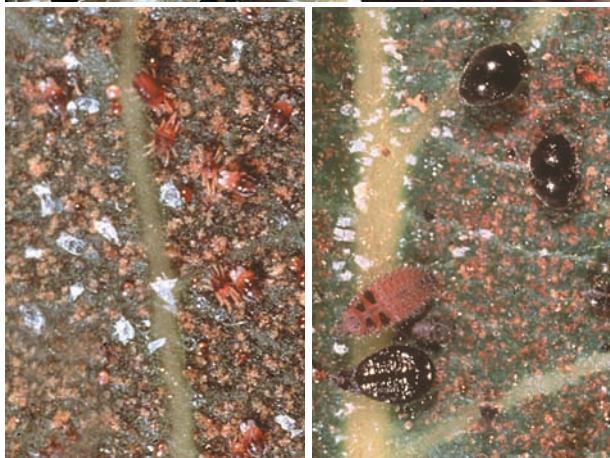
Severe potassium deficiency

Cause: Insufficient potassium available to the tree. Generally caused by an imbalance of potassium, calcium and magnesium in the soil.

Identification: The marginal burn is associated with some interveinal yellowing on the rest of the leaf. This contrasts with salt damage, where there is generally little or no yellowing associated with the marginal burn. Also see symptom on page 3.

Treatment/prevention: Get a leaf analysis done to confirm the diagnosis. Adjust the fertiliser program according to the leaf analysis results. Do regular leaf and soil analyses to monitor nutrient levels.

Bronze leaves



Tea red spider mite or thrips damage

Cause: Tea red spider mite (*Oligonychus coffeae*), redbanded thrips (*Selenothrips rubrocinctus*) or greenhouse thrips (*Heliothrips haemorrhoidalis*).

Identification: Upper: typical bronzing from tea red spider mite. The main damage is on the upper leaf surfaces of the older leaves. Wurtz is the variety most severely affected. Thrips produce visibly similar damage and close-up examination is required to distinguish between the two. Centre left: close-up of tea red spider mite damage showing the small red mites (actual size about 0.5 mm long). Centre right: adult beetles of the Stethorus ladybird (actual size about 1.5 mm long), a major natural predator of the mite. Lower: close-up of redbanded thrips showing a black adult and several cream nymphs (actual size about 1 mm long). The small dark spherical objects are thrips excreta.

Greenhouse thrips are similar in size and appearance to redbanded thrips, but nymphs are green. Greenhouse thrips are mainly a problem in Western Australia on the Hass variety. Thrips also affect fruit (see page 22).

Treatment/prevention: For tea red spider mite, first check that the infestation is serious enough to warrant treatment. At least 20% of leaves need to be affected, without the presence of substantial numbers of predators, to justify treatment. Where necessary, spray with an appropriate chemical from the *Problem Solver Handy Guide*. Regularly monitor the orchard so that action can be taken before the damage gets out of hand. In controlling other pests, avoid continuous use of insecticides that are disruptive to beneficial insects.

Thrips damage is generally not serious enough to warrant special treatment as thrips are generally well controlled by beneficial insects and, where applicable, the spray program for fruitspotting bug. Avoid continuous use of insecticide sprays that are disruptive to beneficial insects. In Western Australia, monitor the orchard from November to February so that action can be taken if necessary before damage is significant.



Herbicide damage

Cause: Uptake of glyphosate herbicide. Injection of excessively high doses of phosphonate fungicide, or the failure of the chemical to disperse properly throughout the tree, may produce a similar symptom.

Identification: Causes dark brown bronzing between the veins. Herbicide damage is almost always confined to only parts of the tree. May also cause twisting and distortion of leaves (see page 12).

Treatment/prevention: Mild symptoms will often disappear in time. Apply herbicides carefully, avoiding contact with the leaves. Prune tree skirts to remove low-hanging branches. Also use shielded, low-pressure fan or flood nozzles when applying herbicides. See page 8 for information on phosphonate damage.

Twisted, distorted leaves



Herbicide damage

Cause: Uptake of glyphosate or 2,4-D herbicides.

Identification: Upper: damage from glyphosate herbicide. Lower: damage from 2,4-D herbicide. Damage is generally confined to parts of the tree. Glyphosate may also cause bronzing of leaves (see page 11).

Treatment/prevention: Mild symptoms will often disappear in time. Apply herbicides carefully, avoiding contact with the leaves. Prune tree skirts to remove low-hanging branches. Also use shielded, low-pressure fan or flood nozzles when applying herbicides.



Sunblotch viroid disease

Cause: Avocado sunblotch viroid.

Identification: Affected leaves have a marked white or yellow mottle or variegation. See page 5 for another leaf symptom of the disease. Also affects branches and fruit (see pages 18, 21, 31 and 43).

Treatment/prevention: There is no treatment for affected trees. They must be destroyed to avoid transmission to healthy trees. Select budwood and rootstock seed only from viroid-tested trees. Plant trees propagated from viroid-tested material at least 15 m from untested trees to avoid transmission from natural root grafting. Reserve a special set of pruning, injecting and harvesting implements for these viroid-free trees to avoid transmission through sap. Alternatively, disinfect cutting tools thoroughly with a 1.5% solution of sodium hypochlorite before using on viroid-free trees.



Effect from triazole treatment

Note: This is not a problem, but a side effect from a planned application of triazole to improve fruit set and fruit size.

Cause: Use of triazole growth retardant chemicals.

Identification: Two examples of tree effects are shown.

Treatment/prevention: Not applicable.

Twisted, distorted leaves

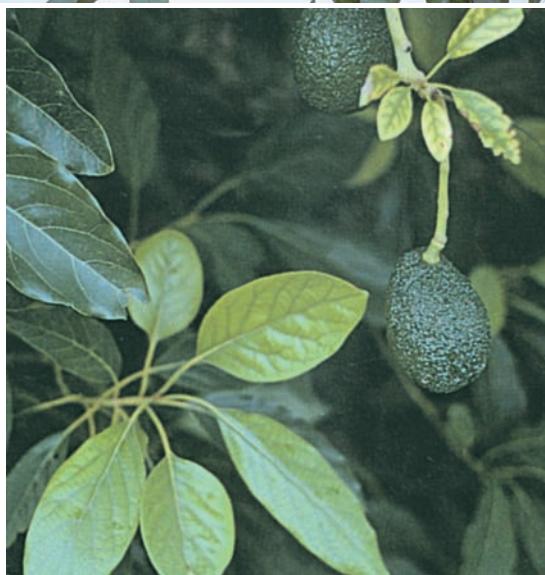


Boron deficiency

Cause: Insufficient boron available to the tree.

Identification: Upper: overall view. Lower: close-up of affected leaves. Leaf distortion is generally associated with yellowing and holes in leaves (see symptoms on pages 7 and 15). The holey leaf symptom is generally more prevalent in the spring leaf flush. Also affects the trunk, branches, flowers and fruit (see pages 19, 20, 30, 40 and 44).

Treatment/prevention: Get leaf and soil analyses done to confirm the diagnosis. Apply borax or Solubor to the ground under the trees at rates determined by either the AVOMAN software or a qualified agronomist. Apply evenly to avoid toxicity. This is best achieved by mixing it in water and spraying it on the ground or applying it by fertigation. Do regular leaf and soil analyses to monitor nutrient levels.



Zinc deficiency

Cause: Insufficient zinc available to the tree. Generally exacerbated by high soil pH or high levels of soil phosphorus.

Identification: Affected leaves show uneven blotchy yellowing between the veins. With a mild deficiency, leaf size is only marginally reduced, but the distance between the leaves on the shoot is shortened, producing a 'feather duster' appearance (upper). A more severe deficiency causes significant leaf distortion and reduction in size, with the youngest leaves at the end of shoots becoming yellow, small and distorted (lower). See other leaf symptoms on page 6. Also affects fruit (see page 31).

Treatment/prevention: Get a leaf analysis done to confirm the diagnosis. Apply zinc to the ground under the tree in a band around the dripline. In future, do regular leaf and soil analyses to monitor nutrient levels.

Chewed or holey leaves



Monolepta beetle damage

Cause: The insect *Monolepta australis*.

Identification: The beetles feed on the surface layers of the leaves, giving them a scorched appearance. Inset: adult beetles (actual size about 4 mm long). Also affects fruit (see page 21).

Treatment/prevention: Where insect activity is significant, spray with an appropriate chemical from the *Problem Solver Handy Guide*. Regularly monitor the orchard, particularly after rain in spring, so that treatments can be applied before major damage occurs.



Looper caterpillar damage

Cause: The insects *Cleora inflexaria* (grey looper), *Lophodes sinistraria* (brown looper) and *Ectropis sabulosa* (ectropis looper).

Identification: Damage and larvae of grey looper (upper) and brown looper (lower) (larvae are about 35 to 40 mm long). When disturbed, the larvae stretch out and stiffen to look like a twig. Fruit may also be damaged (see page 27).

Treatment/prevention: Treatment is generally only necessary where leaf damage is severe and fruit are being damaged. Where required, spray with an appropriate chemical from the *Problem Solver Handy Guide*. Regularly monitor the orchard so that action can be taken before damage gets too severe. Avoid continuous use of insecticides that are disruptive to beneficial insects.



Leafroller damage

Cause: The insects *Homona spargotis* (avocado leafroller) and *Cryptoptila immersana* (ivy leafroller).

Identification: Upper: typical damage from avocado leafroller. Occurs in North Queensland only. Lower left: webbed leaf that has been opened up to reveal a larva of ivy leafroller. Note the holes that have been chewed in the leaf. Occurs in south Queensland and northern NSW only. Lower right: a larva of the predatory fly (*Melanostoma agrolas*) at right feeding on an ivy leafroller caterpillar at left. Fruit may also be damaged (see page 26).



Treatment/prevention: Spray with an appropriate chemical from the *Problem Solver Handy Guide*. In future, regularly monitor the orchard for early signs of leaf and fruit damage and spray before the problem gets too severe. Avoid continuous use of insecticides that are disruptive to beneficial insects.

Chewed or holey leaves



Garden weevil damage

Cause: The insect *Phlyctinus callosus*.

Identification: Upper: typical leaf damage. Lower: an adult weevil (actual size about 7 mm long). Also affects fruit and fruit stalks (see page 22). Occurs in Western Australia only.

Treatment/prevention: Unless leaf damage is particularly severe, it is best to wait for some early indication of fruit damage before spraying. This minimises any disruption to beneficial insects from the prolonged use of the broad-spectrum insecticides necessary to control the weevil. Where necessary, spray with an appropriate chemical from the *Problem Solver Handy Guide*. Regularly monitor the orchard during spring and summer for signs of damage.



Boron deficiency

Cause: Insufficient boron available to the tree.

Identification: Affected leaves have a shot-hole effect. Note the pale yellow halos around the holes. Boron deficiency may also cause leaf distortion and yellowing (see symptoms on page 13). Also affects the trunk, branches, flowers and fruit (see pages 19, 20, 30, 40 and 44).

Treatment/prevention: Get leaf and soil analyses done to confirm the diagnosis. Apply borax or Solubor to the ground under the trees at rates determined by either the AVOMAN software or a qualified agronomist. Apply evenly to avoid toxicity. This is best achieved by mixing it in water and spraying it on the ground or applying it by fertigation. Do regular leaf and soil analyses to monitor nutrient levels.



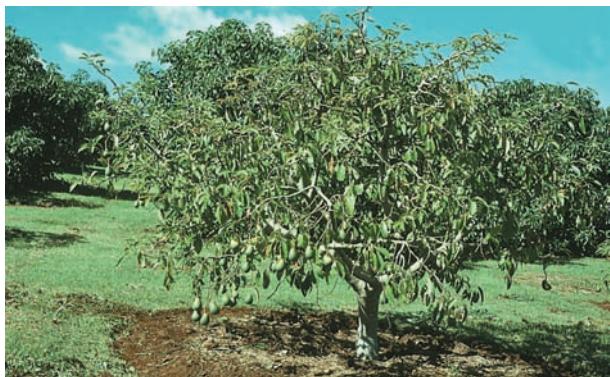
Spray burn

Cause: Either a foliar spray of phosphonate fungicide applied too soon after a spray of dimethoate; mixing of phosphonate fungicide with copper, particularly copper hydroxide; or oil sprays applied in very hot weather (temperatures above 28°C).

Identification: There is a range of leaf symptoms but damage generally first shows as small yellow spots (right). Some spots may fall out to produce a shot-hole effect (upper left).

Treatment/prevention: Do not apply phosphonate fungicide sprays within 10 days of a dimethoate spray. Do not mix phosphonate fungicide with copper, particularly copper hydroxide. Do not apply oil sprays during periods of hot weather.

Wilted leaves



Root rot disease

Cause: The fungus *Phytophthora cinnamomi*.

Identification: Upper: overall view of affected tree. Lower: close-up of wilted leaves. Wilting from root rot disease is generally always associated with some leaf yellowing and leaf fall. In more severe cases, shoots die back from the tips. See other symptoms below on this page and on pages 4, 17, 19, 41, 43 and 44. Do not confuse with Verticillium wilt where leaves die suddenly and remain on the tree (see page 8).

Treatment/prevention: Use an integrated disease management program of both chemical and cultural measures. Inject or spray affected trees with a registered phosphonate product from the *Problem Solver Handy Guide*. Use the spray option only on healthy or mildly affected trees. Follow label directions and the instructions in *Growing the Crop*. Maintain a deep layer of mulch or compost under the trees. Manage irrigation carefully to keep soil moist, but not over-wet. Ensure there is no ponding of water within the orchard by regularly checking drains. Maintain soil pH at about 5.0 to 5.5 (1:5 water test) and use regular leaf and soil analyses to ensure nutrient levels are adequate at all times. In future plantings, ensure there is adequate drainage, use disease-tolerant rootstocks and buy trees from accredited nurseries.

Note: Leaf wilting can also be caused by wood rot fungus (see *Managing root rot* in *Key Issues*) and severe water stress.

Excessive leaf fall



Root rot disease

Cause: The fungus *Phytophthora cinnamomi*.

Identification: Upper: overall view of affected tree showing the typical extent of leaf loss. Lower: leaf fall is often severe at flowering when significant demands are made on the depleted root system. This photo shows an affected branch at flowering. Leaf fall from root rot disease is generally always associated with some leaf yellowing and wilting. In more severe cases, shoots die back from the tips. See other symptoms above on this page and on pages 4, 17, 19, 41, 43 and 44.

Treatment/prevention: Use an integrated disease management program of both chemical and cultural measures. Inject or spray affected trees with a registered phosphonate product from the *Problem Solver Handy Guide*. Use the spray option only on healthy or mildly affected trees. Follow label directions and the instructions in *Growing the Crop*. Maintain a deep layer of mulch or compost under the trees. Manage irrigation carefully to keep soil moist, but not over-wet. Ensure there is no ponding of water within the orchard by regularly checking drains. Maintain soil pH at about 5.0 to 5.5 (1:5 water test) and use regular leaf and soil analyses to ensure nutrient levels are adequate at all times. In future plantings, ensure there is adequate drainage, use disease-tolerant rootstocks and buy trees from accredited nurseries.

Note: Excessive leaf fall can also be caused by severe boron toxicity (see page 4) and wood rot fungus (see *Managing root rot* in *Key Issues*).